Information and Communication Technology for Development (ICT4D)

Richard Heeks



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Information and Communication Technology for Development (ICT4D)

Mobile phones are close to ubiquitous in developing countries; Internet and broadband access are becoming commonplace. Information and communication technologies (ICTs) thus represent the fastest, broadest and deepest technical change experienced in international development. They now affect every development sector – supporting the work of hundreds of millions of farmers and micro-entrepreneurs; creating millions of ICT-based jobs; assisting healthcare workers and teachers; facilitating political change; impacting climate change; but also linked with digital inequalities and harms – with the pace of change continuously accelerating.

Information and Communication Technology for Development (ICT4D) provides the first dedicated textbook to examine and explain these emerging phenomena. It will help students, practitioners, researchers and other readers understand the place of ICTs within development; the ICT-enabled changes already underway; and the key issues and interventions that engage ICT4D practice and strategy.

The book has a three-part structure. The first three chapters set out the foundations of ICT4D: the core relation between ICTs and development; the underlying components needed for ICT4D to work; and best practice in implementing ICT4D. Five chapters then analyse key development goals: economic growth, poverty eradication, social development, good governance and environmental sustainability. Each chapter assesses the goal-related impact associated with ICTs and key lessons from real-world cases. The final chapter looks ahead to emerging technologies and emerging models of ICT-enabled development.

The book uses extensive in-text diagrams, tables and boxed examples with chapter-end discussion and assignment questions and further reading. Supported by online activities, video links, session outlines and slides, this textbook provides the basis for undergraduate, postgraduate and online learning modules on ICT4D.

Richard Heeks is Chair in Development Informatics at the University of Manchester, UK. He has researched, taught and practised ICTs and international development for more than 30 years.

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Abbreviations

3G, 4G, 5G	Generations of mobile telecommunications standards
ATM	Automated teller machine
CC	Creative Commons
CGNet	Central Gondwana network
CIPSODAR	Capture, Input, Process, Store, Output, Decision, Action, Result
CO_2	Carbon dioxide
CRT	Cathode-ray tube
DANIDA	Danish Development Cooperation (was Danish International Development Agency)
DFID	Department for International Development
DHIS2	District Health Information Software v.2
DIRT	Digitisation – improvement – redesign – transformation
DOTForce	Digital Opportunities Taskforce
DRC	Democratic Republic of Congo
DRR	Disaster risk reduction
DVD	Digital versatile/video disk
EEE	Electrical and electronic equipment
e-ID	Electronic identity
EMIS	Education management information system
FabLab	Fabrication Laboratory
FAO	Food and Agriculture Organization
FEWS NET	Famine Early Warning Systems Network
FOSS	Free and open source software

GDP	Gross domestic product
GEM	Gender evaluation methodology

GIS	Geographic information system
GKP	Global Knowledge Partnership
GPS	Global positioning system
GSM	Global System for Mobile Communications
GSMA	Groupe Speciale Mobile Association (the global mobile operators association)
HCI4D	Human-computer interaction for development
HISP	Health Information Systems Programme
HMIS	Health management information system
HTML	Hypertext markup language
HTTP	Hypertext transmission protocol
ICANN	Internet Corporation for Assigned Names and Numbers
ICT	Information and communication technology
ICT4CCA	Information and communication technology for climate change adaptation
ICT4D	Information and communication technology for development
ICT4E	Information and communication technology for education
IDRC	International Development Research Centre
IETF	Internet Engineering Task Force
IFIP	International Federation for Information Processing
IGF	Internet Governance Forum
IICD	International Institute for Communication and Development
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IPID	International Network for Postgraduate Students in the Area of ICT4D
IPR	Intellectual property rights

IPv6	Internet Protocol Version 6
IS	Information system
ISAD	Information Society and Development conference
ISP	Internet service provider
ITPOSMO	Information, Technology, Processes, Objectives and values, Skills and knowledge, Management systems and structures, Other resources
ITU	International Telecommunication Union
KISS	Keep it simple, stupid
Mbps	Million bits per second
MDGs	Millennium Development Goals
MIS	Management information system
MOOC	Massive open online course

NGO	Non-governmental organisation
NORAD	Norwegian Agency for Development Cooperation
OCARA	Openness, completeness, accuracy, relevance, appropriateness of presentation
OECD	Organisation for Economic Co-operation and Development
OER	Open educational resources
OLPC	One Laptop per Child
OSS	Open source software
PC	Personal computer
PPGIS	Public-participation geographic information system
RABIT	Resilience Assessment Benchmarking and Impact Toolkit
REDD	Reducing Emissions from Deforestation and forest Degradation
SDC	Swiss Agency for Development Cooperation
SDGs	Sustainable Development Goals
SIDA	Swedish International Development Cooperation Agency
SIM	Subscriber identity module

SLF	Sustainable Livelihoods Framework
SMS	Short message service
SPIDER	Swedish Program for ICT in Developing Regions
TAM	Technology Acceptance Model
TCP/IP	Transmission control protocol/Internet protocol
UAV	Unmanned aerial vehicle
UNCSTD	United Nations Commission on Science and Technology for Development
UNCTAD	United Nations Conference on Trade and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-GAID	United Nations Global Alliance for ICT and Development
UNGIS	United Nations Group on the Information Society
UNI	Union Network International
UNICEF	United Nations International Children's Emergency Fund
UNWCED	United Nations World Commission on Environment and Development
USAID	United States Agency for International Development
USF	Universal service fund
VPO	Village phone operator

W3C	World Wide Web Consortium
WB	World Bank
WHO	World Health Organization
WiFi	Wireless fidelity
WiMAX/LTE	Worldwide Interoperability for Microwave Access/Long-Term Evolution
WIPO	World Intellectual Property Organization
WSIS	World Summit on the Information Society

XML	eXtensible markup language

Introduction

Information and communication technology for development (ICT4D)

Take a step back and think about our world. What might you list as some of its biggest challenges? Perhaps poverty, inequality, hunger, ignorance, tyranny, climate change and more. There are many tools we use to try to address these challenges. One tool of increasing importance is information and communication technology: ICT. The aim of this book is to help you understand how and to what extent, ICTs can help fix some of these problems.

ICTs' potential to do this has expanded rapidly during the initial years of the twenty-first century. Internet connectivity is now widespread in developing countries, and mobile telephony close to ubiquitous: far more people now have access to a mobile than have access to sewerage, piped water or electricity (Mitullah et al. 2016).

This connection between ICTs and the goals of international development goes by many names, but the one chosen here is "information and communication technology for development" or "ICT4D" for short. The term has been in circulation since at least 1996 when the UN's Commission on Science and Technology for Development set up a working group under that name (UNCSTD 1997). In 2000, the term became associated with a planned Programme Area of work within Canada's International Development Research Centre, which began in January 2001. Incoming

Programme Area Director Rich Fuchs claims development of the "ICT4D" abbreviation, leading to its first externally published use (Gomez et al. 2001). Though slowly at first, it was from 2001 that both term and abbreviation started to take off. In 2016, for example – based on Google Scholar data – nearly 1,000 academic papers were published that made use of the term.

An abbreviation can seem trivial at one level, but the existence of ICT4D has been quite powerful in terms of individual and collective identities (people will state "I work in ICT4D"), and as a centripetal force drawing people and knowledge together, and assisting aggregation. As a search term, as a hashtag, as a label for groups and workspaces and conferences, ICT4D has been of great benefit to those involved in this domain.

Of course, the real potential benefit of ICT4D is noted above: its contribution to international development, and it is this – rather than terminology – that forms the focus for this book. The book is divided into three parts:

- Three foundational chapters come at the start. Chapter 1 explains what ICT4D is by breaking it down into its constituent parts and discussing and explaining each one; then showing how this determines the relation between ICTs and development. Chapter 2 explores the underlying layers and components that need to be put in place for ICT4D to work: technology, people, institutions and money. Chapter 3 reviews how best to implement ICT4D from strategy through design and roll-out and adoption and use to monitoring and evaluation.

- Then five chapters analyse the role ICTs play in the delivery of specific international development goals. Chapter 4 discusses economic growth at micro, meso and macro levels. Chapter 5 looks at poverty eradication and the livelihoods of those on the lowest incomes. Chapter 6 considers social development; specifically health and education including a discussion of capabilities development. Chapter 7 deals with good

governance; in particular better public services, improved accountability of the state, and increased democracy. And Chapter 8 analyses ICTs and environmental sustainability including resilience-building.

- Finally, Chapter 9 looks ahead to future directions in ICT4D: not just emerging technologies but emerging models of development like "Development 2.0", data-intensive development, and open development.

This content helps explain why it is important to study – and practise – ICT4D. ICT plays an increasingly significant role in international development. Those interested in development need to understand that role. Those interested in ICTs will find a particular value in ICT4D:

> Before proceeding, though, we should ask "why ICT4D"? Why should we give any priority to ICT application for the poor in developing countries? There is a moral argument. Most informatics professionals spend their lives serving the needs of the world's wealthier corporations and individuals – to borrow bank robber Willie Sutton's phrase – "because that's where the money is". Yet seeking to squeeze a few extra ounces of productivity from firms that already perform relatively well, or save a few minutes in the life of a busy citizen pales in ethical importance compared to applying new technology to the mega-problems of the planet.
>
> p.3
>
> It is the poor of the world who are on the front-line of those problems. From climate change to conflict and terror; from disease to resource depletion – it is the poor in developing countries who suffer most. And, of course, they suffer from that other blot on the world's conscience – poverty – with more than half the global population living on less than two US dollars per day.
>
> There is enlightened self-interest. In a globalised world, the problems of the poor today can – through migration, terrorism, disease epidemics – become the problems of those at the top of the pyramid tomorrow. Conversely, as the poor get richer, they buy more of the goods and services that industrialised countries produce, ensuring a benefit to all from poverty reduction.
>
> And there is personal self-interest. Compare designing a system for an African or Asian community to doing the same for a company in the global North. The former is quite simply

more interesting – a richer, more satisfying, more colourful experience.

(Heeks 2008d:26)

Of course this generally assumes that ICTs *can* address the major problems of our planet. Another reason to study ICT4D is to find out whether this is true, and this book will help assess that.

As well as reflecting on why one should study ICT4D, we can also reflect on how and what to study. Drawing from my experience of teaching ICT4D at the University of Manchester, I would argue that ICT4D champions need to be two types of "hybrid". First, they need to be a development–informatics hybrid. They need to understand informatics: the role of information, the capabilities of technology, the nature of information systems. And they need to understand development. This book will therefore draw on informatics and development models throughout and, of course, look particularly at their intersection.

Second, ICT4D champions need to be a theory–practice hybrid. They need to understand theory. When I first mention theory, my students shrink back in fear like vampires from sunlight. But discussion with our graduates shows theory to have been their most useful learning; as they put it, spectacles for viewing their ICT4D work in new ways. ICT4D study must also involve practice. This book can't provide direct field experience – something ICT4D courses should try to include if at all possible – but it will draw from practice through cases and lessons, and will show how practice can be better-illuminated through theory. Overall, in studying ICT4D through this book you will learn to:

- analyse the generic contribution of ICTs to international development;
- analyse the role of policy, strategy and operational interventions in promoting effective developmental use of ICTs;

- identify key roles, challenges and questions in the application of ICTs to specific development goals; and
- apply critical conceptual frameworks to analyse ICT4D evidence and practice.

1 Understanding ICT4D

In reading this chapter, you will learn to:

- define the whole and parts of ICT4D;
- outline specific features of ICTs and developing countries;
- explain the connection between ICTs and development;
- contrast different development paradigms;
- categorise key theories and concepts of relevance to ICT4D.

This chapter provides an understanding of what ICT4D means, breaking it down into its constituent parts and discussing and explaining each one. As well as defining ICT4D, this will help understand what makes ICT4D different, and how it determines the relation between ICTs and development in both practical and theoretical terms.

1.1. What do we mean by "ICT4D"?

What is ICT4D:

- A Kenyan farmer uses a mobile phone to find the best price for her crops. Is that ICT4D?
- A doctor in India records the details of his patients on a database. Is that ICT4D?

- A multinational company in Argentina installs improved point-of-sale terminals in its supermarkets. Is that ICT4D?
- An African-American teenager from a low-income family uses Twitter to organise a protest against alleged police harassment. Is that ICT4D?

To understand, we have to go back to first principles, and the meaning of ICT4D.

At one level, what we mean by ICT4D is obvious. It's an abbreviation, and it stands for "information and communication technology for development". But that raises two immediate questions: what do we mean by "information and communication technology" and what do we mean by "development"?

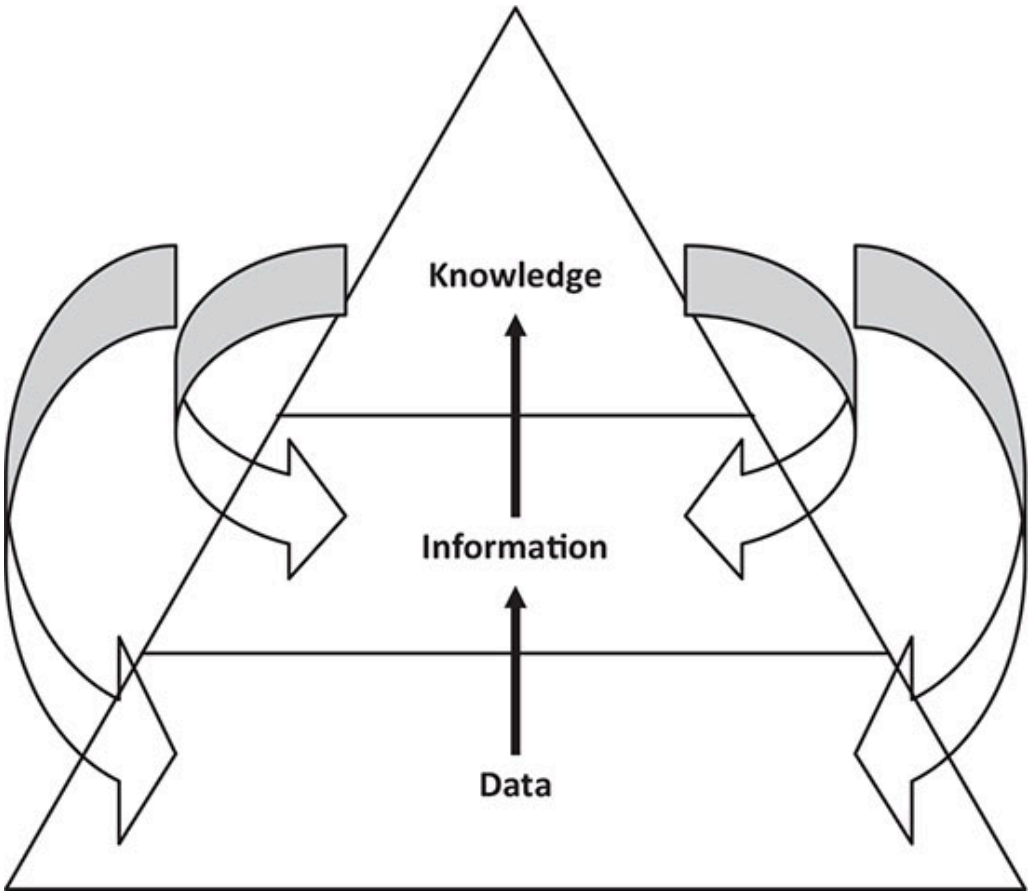
And that in turn means we have to define "information", "communication" and "technology". The only thing we can take as read in ICT4D is the word "and".

1.1.1. Defining information and communication

Probably the best way to understand information is as part of three related concepts, illustrated in Figure 1.1.

Data is raw, unprocessed information. This is what you always start with. Often, data consists of descriptions (qualitative data) or numbers (quantitative data) that have been recorded to represent some object, place, event or other phenomenon. For example, the questionnaire responses of community members about their health needs. Data is also produced as part of the routine activities of any person or organisation.

Figure 1.1 The relation between data, information and knowledge



Information is data that has been processed to make it useful to its recipient. This is what comes next. For example, a summary of the analysed responses used by the community health centre manager, laying out in a few graphs and tables the main perceived health needs. Note that amending the old saying about meat and poison, we can say that "one person's information is another person's data": for example, something like details of an individual patient's health records could be information to a doctor but just data (i.e. requiring further processing, such as adding together) to a hospital manager.

Knowledge is information that has been assimilated into a coherent framework of understanding: often within the human mind. This comes last and can involve a person receiving information, processing it themselves, understanding it and fitting it into their existing base of knowledge. To complete our health example, once the community health centre manager has read through the analysed responses, s/he will match it against previous information and ideas on provision

of health services to the community. Note that, increasingly, knowledge can be stored – even created – by ICTs.

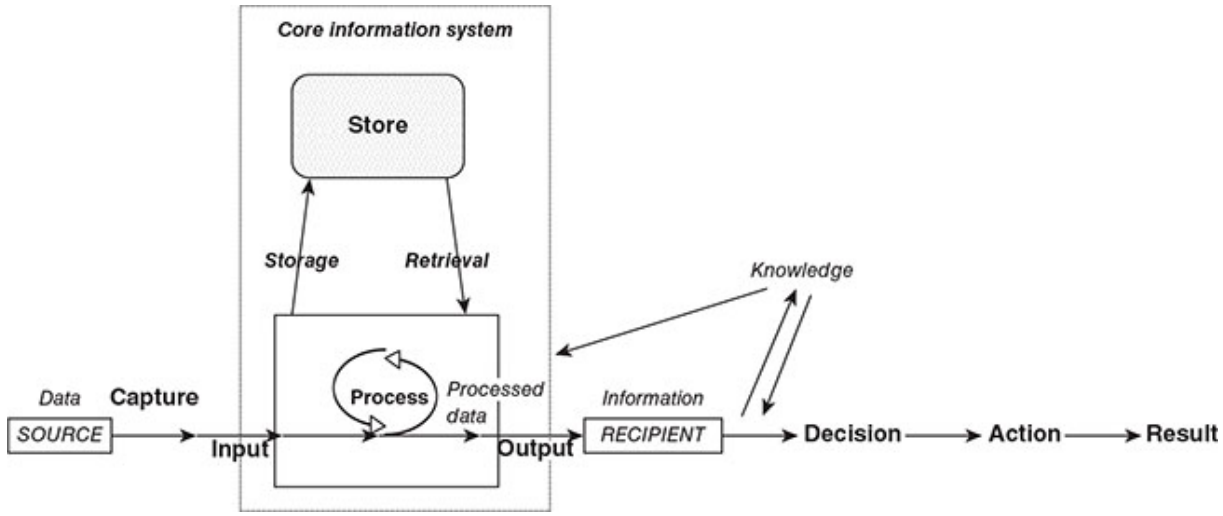
In everyday speech, the words "data" and "information" are often used interchangeably, but in formal terms we can now see that they are different. We can summarise the definitions given above as follows in terms of a forward flow: data is processed into information is assimilated into knowledge (see also Box 1.1). Though note there is also some kind of a reverse flow – see Figure 1.1 – because knowledge explains information, and knowledge filters and processes data.

We can represent the process of changing data into information, and information into knowledge in a little more detail, as shown in Figure 1.2. This is a foundational model for the book known as the "information value chain". It is summarised as consisting of the "CIPSODAR" steps, which can be divided into two parts. First are the "CIPSO" steps associated with the core activities of an information system: Capture (data is first gathered from its source), Input (data is entered into the information system), Process (data is manipulated by categorising it, or filtering it, or totalling it, or performing some other calculation on it), Store (data is held in the information system), and Output (processed data is communicated to a recipient). Then come the "DAR" steps: Decision (the recipient makes a decision on the basis of the information received), Action (some action is taken on the basis of that decision), and Result (this action has some impact on development).

It is a value chain because it shows that data only has developmental value if it becomes information, and information only has value if it is applied to decisions which lead to actions which lead to development results. (Note that sometimes this happens through conversion of information into knowledge – via learning – which is only later applied to a decision and action and result.)

From both Figures, it can be seen that communication is pervasive. Each arrow represents a movement of data: this is communication, and we can therefore define communication as the transmission of data.

Figure 1.2 The "CIPSODAR" steps of the information value chain



Source: adapted from Lucey (2005) and Laudon & Laudon (2016)

Box 1.1

Data, information, etc: a cooking analogy

When you have all your items of shopping together in a bag, they're a jumble that doesn't make much sense. Just the same is true of raw data.

To make sense of your shopping items, you need a recipe. A recipe is explicit knowledge – a framework for understanding your data. Seen in this way, some of your shopping items now become ingredients. The information systems equivalent is that data that are understood are "capta": those specific items that are relevant to the current situation (on the information value chain diagram, we would indicate those as the specific data that has been captured).

Using the recipe and an oven, pans, food mixer, etc, you then turn your ingredients into something to eat – say, a cake. The information systems equivalent is that you use a combination of knowledge and technology to turn the capta into processed data. The cake is processed data.

It becomes information – data that has been processed to make it useful to a recipient – if someone is hungry. Then they must make a decision to take

action: to eat the cake.

Finally, the cake is eaten: an action that leads to results (they are not hungry any more). Perhaps this takes place at a birthday party. Likewise, information is never consumed in a vacuum; it is always consumed in a social context that influences the way the information is perceived, and the impact of its consumption.

And the cake, once eaten, turns into energy that could build muscles; likewise the information, once consumed, turns into knowledge that builds your frameworks of knowledge.

Source: original idea from Norah Stoops

1.1.2. Defining technology and ICT

There are whole papers, books even, that discuss what is meant by technology, but I will try to keep things fairly simple by teasing out three elements:

a) Technology is a non-human entity. Your hand is not technology. We typically think of technology as a physical device but it can also be intangible: a particular technique or method.

b) Technology applies knowledge. So technology does not occur naturally: it has been created by the build-up of human knowledge; often – though not always – through the formal knowledge-creation process we call science.

c) Technology does something. It has a purpose of undertaking a task such as converting some inputs into different outputs.

Putting those elements together, we can define technology as: “devices or techniques that apply knowledge in order to complete a particular task”.

With that in mind, ICT would be defined as “devices or techniques that apply knowledge in order to process or communicate data”. There are three,

increasingly broad understandings of what that means:

- ICT Scope 1: digital ICT – any entity that processes or communicates digital data: smartphones, laptops, computer software, apps, the Internet, etc.
- ICT Scope 2: electrical ICT – any entity that processes or communicates data in electrical or electro-magnetic form: all of ICT Scope 1 plus analogue technologies like radio and TV.
- ICT Scope 3: all ICT – any entity that processes or communicates data in any form: all of ICT Scope 2 plus paper-based technologies like pens, typewriters, books, newspapers, etc.

In this book, we will use Scope 1. So we limit ourselves to digital technologies but note that the technologies of Scopes 2 and 3 are increasingly being digitised.

1.1.3. Defining development

Just as with the definition of ICT, we can identify three different breadths of understanding of development. In this case, running from broader to narrower:

- Development Scope 3: generic development – any progressive change in a society (for the moment, swerving to avoid the key issue of who and what defines a "progressive change").
- Development Scope 2: geographically specific development – any progressive change in a developing country. "Developing country" is another minefield. Some people don't like the term: the idea that countries like the US and UK are "developed" is clearly ridiculous if we equate this with them being the finished article. Hence some prefer to use terms "global South" and "global North". But "developing country" is so widely used it will be used here. We can define it as covering those nations identified by the OECD's Development Assistance Committee as low- and middle-income Official Development

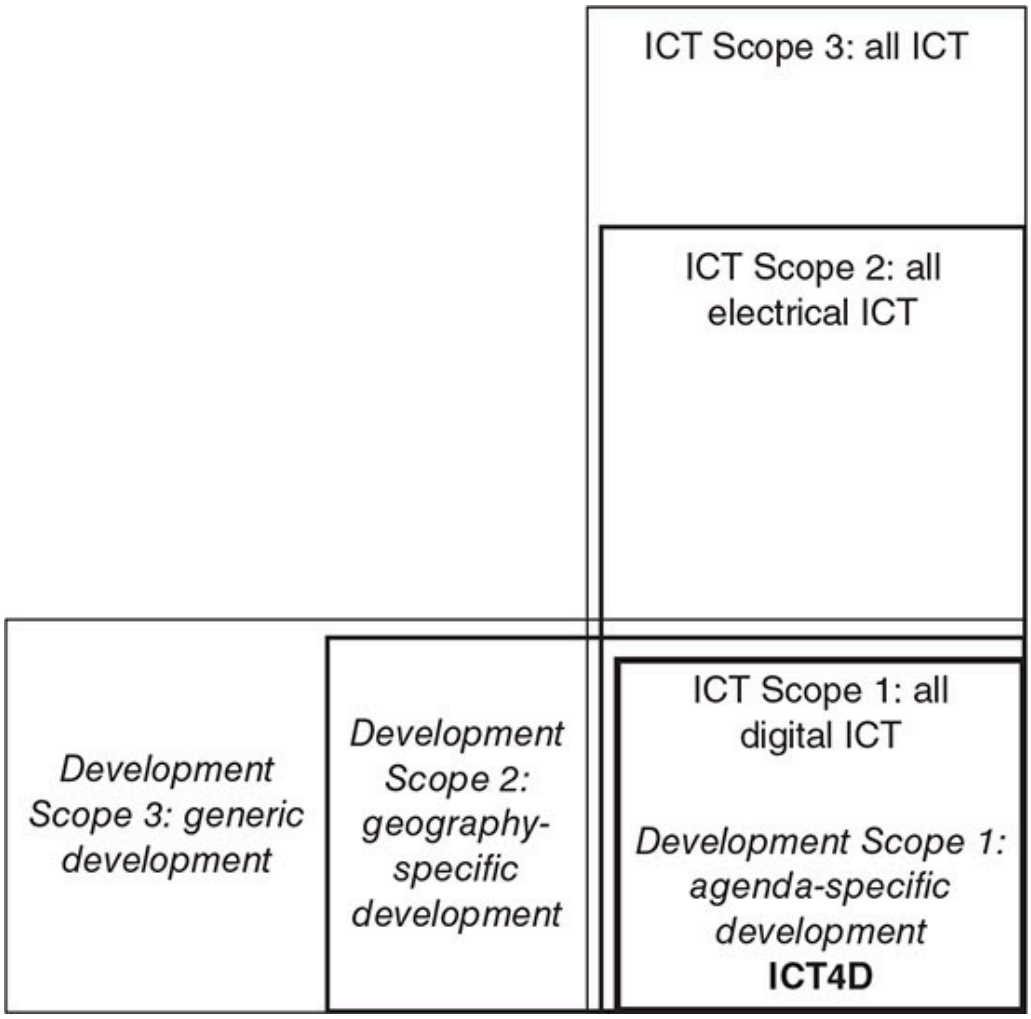
Assistance recipients. This means, for example, that use of ICTs by the poor in the global North will not be included in our understanding of ICT4D.

- Development Scope 1: geographic- and agenda-specific development – particular progressive changes in a developing country. We can divide society into its three components: government, civil society (including NGOs) and private sector. In simple terms, there seem few arguments that government, civil society, and micro- and small private sector enterprises are development-oriented. But there are question marks over larger firms: from medium-sized local firms up to very large multinationals. Those question marks arise because of differing definitions of what constitutes the international development agenda. We will discuss that in the following section but, for now, note that it may exclude some changes which certain groups might see as progressive but others would not. Specifically, this means that many uses of ICTs by larger private sector firms may not be included in our understanding of ICT4D since we will be using Scope 1 as our focus.

1.1.4. Defining ICT4D

In this book, as summarising in Figure 1.3, ICT4D will be defined as combining ICT Scope 1 and Development Scope 1: "the application of any entity that processes or communicates digital data in order to deliver some part of the international development agenda in a developing country". Some related terms are defined in Box 1.2. But this means – if we return to the starting point of the chapter – that we are therefore going to exclude the Argentina and US examples from our understanding of ICT4D. But we will include the Kenya and India examples.

Figure 1.3 The meaning of ICT4D



Box 1.2

Terms related to ICT4D

- ICTD. Grrr. Whatever the good intentions behind invention of this term as an alternative to ICT4D, it now seems to mean the same thing. It makes online searching in this field harder, fragments the evidence base, and should be killed off and sent to the big abbreviation pile in the sky.

- Development informatics. A rather unsuccessful attempt, mainly by your author, to distinguish between research and practice. It sees ICT4D as a field of practice (see earlier definition) and development informatics as the academic sub-discipline that studies this field of practice; just as

"development studies" is the academic discipline researching the practice of "international development" (see Figure 1.6).

- IS-in-DCs: information systems in developing countries (developed from Brown & Grant 2010). Also an academic sub-discipline, but studies all ICT applications in developing countries (i.e. Development Scope 2 not Development Scope 1) and does so from an information systems perspective, often focusing on the context of developing countries and its difference from the context of the global North.

- ICT4E, ICT4H, e-government: these are all terms covering application of ICTs to specific sectors or purposes – education, health, government in these cases. Where focused on developing countries, these are sub-sets of ICT4D.

- M4D, Web2forDev: technology-specific sub-sets of ICT4D e.g. focusing on mobile or Web 2.0.

1.1.5. What's different about ICT4D?

To justify this book, there must be something specific and different about ICT4D: different from other applications of technology, different from other applications of ICT, and different from other aspects of development.

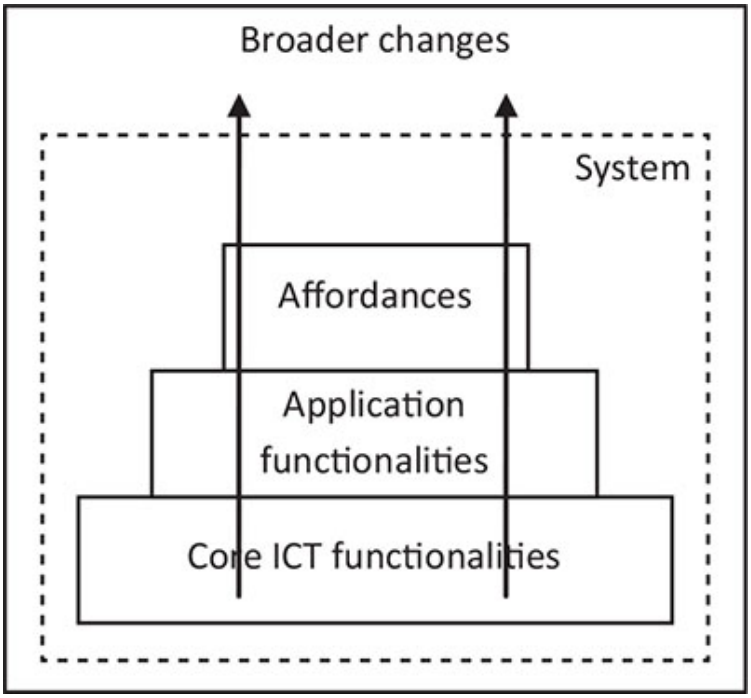
What's different about ICT?

The first thing specific and different is ICT. So what does ICT do that other technologies do not? We can understand that at four levels, as summarised in Figure 1.4:

a) *Core functionalities*: at its heart, all ICT does is handle digital data according to the CIPSO part of the information value chain model in Figure 1.2. So its core functionalities are to capture, input, process, store and output digital data (though with increasing ability to also decide and act; the D&A of the value chain: see Chapter 9). However, that gives us little clue to its value because ICTs are bundled into information systems applications.

b) *Application functionalities*: being a technology, ICTs undertake processes. The specific processes any ICT system undertakes are its application functionalities: to calculate total number of health centre patients, to store digital documents, to display geo-location data via a map, to transmit agricultural information, etc.

Figure 1.4 ICT functionalities and affordances



If those application functionalities are successfully realised, they can bring one or more of five generic process benefits:

- Cheaper: ICTs can make a process cheaper than it was before e.g. substituting a free Skype call for a costly landline call.

- More: ICTs can increase the number of process outputs e.g. processing more government licence applications than before.

- Quicker: ICTs can reduce the time required for a process e.g. delivering market price information much more quickly.

- Better: ICTs can make process outputs of higher quality e.g. gathering better information to form the basis for a better policy decision.

- New: ICTs can help create a new process or new outputs e.g. creating a new communication space for globally dispersed users.

c) *Affordances*: functionalities are inherent features of the technology. Affordances bring people into the picture. They can be defined as the potential actions an individual or organisation with a purpose can undertake with the ICT system within the context of the environment within which they function (adapted from Anderson 2011 and Majchrzak & Markus 2012). While these are potentials, what is actually realised in any situation is said to be "afforded by" the technology. (As we will note later in Chapter 6, this is very similar to Amartya Sen's notion of potential capabilities and realised functionings.)

Two affordances arise from the core functionalities of ICT:

- Information: the provision of digital information to feed a decision that leads to an action which leads to a result. This is the "DAR" component of the Figure 1.2 model. As a reminder, this is the heart of the value that ICTs bring to development: the information that ICT4D applications produce only has value if it feeds into this decision-action-result chain.

- Communication: the transmission of digital data from a source to a recipient either one-way or two-way (interaction).

A number of other affordances are widespread but will vary from application to application. Key examples include (adapted from Afuah & Tucci 2003, OUP 2012):

- Computation: application of mathematical calculations to digital data.

- Creation: the development of new digital content (a message, document, music, video, etc) which may also be extended to fabrication of non-digital content such as physical objects using digital tools like 3D printing.

- Transaction: digital exchange of some kind which could be commercial (buying and selling) or non-commercial.

- Distribution: sharing of some kind of digital content (data, goods or services) which could be commercial (via marketing, sales and supply) or non-commercial.

- Collaboration: working together with others on other affordances such as joint creation of digital content, or sharing of content in an online community.

- Coordination: digitally organising different parts of a system (such as processes or people or organisations) so that they work together.

d) *Broader changes*: the value of these affordances arises from the changes they bring about. We can understand these at the micro-level of processes in terms of the categorisation above: cheaper, more, quicker, better, new. But we could alternatively understand it in terms of higher-level changes which may or may not occur depending on the situation. Examples could include (adapted from Afuah & Tucci 2003):

- Automation: the replacement of human with digital labour, potentially bringing reduced costs and higher quality working. Related concepts include digitisation (replacement of physical or analogue content and processes with their digital equivalents) and virtualisation (the creation of a virtual digital equivalent for a real entity, for example, a virtual equivalent for an organisation). Together, these are the foundation for the digital economy: both the "pure-play" part that is wholly digital and represents a new source of wealth and livelihoods; and the hybrid "clicks-and-bricks" part that combines digital and traditional means of wealth creation.

- Connection: ICTs connect entities; which could be people or data stores or organisations, etc. We can understand value in terms of connection: those

entities obtain value as others connect with them in a network. In the first instance, this is the value of "inclusion": the benefits a new member finds in joining the network. They gain this value partly through access to resources such as information which resides on the network, but also through the collective power of the network if it can represent the sum of its collective resource. That collective value may be subject to "network effects": additional benefits that arise to members as new members join the network. Metcalfe's Law may hold for some networks. It says that the value of a network equals the square of the number of network users: in other words, the benefits of being in a network increase very greatly as more people join; and the disbenefits of being outside that network also increase. If the costs of joining remain constant then the benefit:cost ratio steadily rises as the network grows, making it ever more attractive to new users: an example of what's called "positive feedback". As a result, a few networks will grow huge and come to dominate to the virtual exclusion of competitors: think Facebook and LinkedIn. As members invest more money, time, learning, habits, relations in that network, their costs of switching to a different network rise and they become increasingly locked-in: so huge networks may stay huge. (Though it's not all good news. There can be negative network effects: things which get worse as the network gets bigger like more spam, more information overload and stress, slower network performance, slower network innovation, etc.) Network effects will also create a threshold below which full benefits of ICTs are not realised – these are estimated to be the point at which 20–25 per cent of the population is connected to the network (Pepper & Garrity 2015). Second, we can understand value in terms of disconnection: those entities obtain value by delinking with some existing connections, and relinking with others. A key concept here is "disintermediation": making a direct connection with another entity instead of via an intermediary. For example, a seller can sell direct to a customer via ICTs instead of going through a retailer or trader (see Chapters 4 and 9).

- Equalisation: particularly equalising "information asymmetries" which exist when one party in a relationship or transaction has information that others do not (see Chapter 4). If digital information is more freely available, then all parties can have equal access to it. The same is true of digital goods and services. Combined with the "cheaper" change, this means ICTs may

both level and lower the "playing field" for many human activities, making it easier for anyone to engage in business, politics, cultural activities, etc.

- Illumination: physical processes must be directly observed as and when they occur; physical records must be directly inspected. This limits their visibility to others. But digital processes and records can, in theory, be seen by anyone and ICTs therefore illuminate increasing amounts of human activity. By doing this, ICTs can enable digital surveillance (activities being observed by others) and digital control (constraints on online behaviour imposed by others) (see Chapter 7). Conversely, ICTs can enable open society models such as open innovation or open source development (see Chapter 9).

- Innovation: digital content and tools are more flexible, more reworkable, more combinable than their physical equivalents. As a result, digital systems are associated with greater levels of innovation that create further digital content, products and tools.

- Universalisation: the breaking down of barriers of time and space so that digital processes can be undertaken 24/7 and are disembedded from any particular physical location. This means joint human activities move from having to be synchronous (undertaken at the same time) and co-located (undertaken in the same place), to being asynchronous and distributed. And the breaking down of organisational and societal barriers so that ever more people, content, organisations, etc can engage in digital activity.

Putting many of these together, we can see even higher-level changes that ICTs enable. An obvious example is globalisation: "the process of international integration arising from the interchange of world views, products, ideas and other aspects of culture" (WP 2017b).

But we can also see the potential for negative outcomes, at least for some groups. A classic query for ICT4D would be the Latin question, "*Cui bono?*". In simple terms, it asks "Who benefits", but it is better understood to ask "Who wins, and who loses?" ICTs including ICT4D are often associated with inequality (WB 2016). From the discussion above we can see why. As ICT benefits increase, the gap between those who have access and those who do not will grow: this is the

"digital divide" discussed further in Chapter 2. Automation, disintermediation and other changes will remove human roles and livelihoods: those affected will lose income, jobs, etc. Finally, there is another network effect, which is adverse incorporation. This means joining a network but lacking important resources, capabilities and other sources of power compared to those who are favourably incorporated. The latter will thus benefit far more than the former; increasing inequality. Again, we will look at this further in Chapter 2.

What's different about developing countries?

The second thing specific and different is the context of developing countries in which ICTs are being applied. Here, a tricky line must be steered. On the one hand, we must not pretend that "developing countries" represent a single homogeneous block: there are great differences between and within countries. On the other, we must not deny that the global South is different from the global North. So, while always being alert to the specific context of any individual ICT4D application, we can identify some typical features of context to look out for (Garcia-Murillo 2003, 2012; Roztocki & Weistroffer 2011):

- Uncertainty: there may be greater instability and volatility in systems in developing countries. This relates to markets and supply chains: supply and demand for goods and services is less reliable. It relates to politics: regimes are less stable, existence and implementation and impact of policies are less predictable. It relates to crises: both natural and man-made. This impacts behaviour: for example, discouraging investment in new technology.

- Resource constraints: many key resources – money, skills, technology, etc – are generally in shorter supply in developing countries. So we may expect to find not only less ICT but also fewer of the complementary resources that effective ICT application requires (see Chapter 2).

- Inequality: there may be greater inequality both in the distribution of material resources but also in related factors such as power and control with, for example, more hierarchical structures within organisations and society. This

will impact, for instance, the ability of ICT4D projects to impact the lives of the poorest in society.

- Institutional differences: languages and cultural norms and values may be different. There may be a greater reliance on informal, personal processes and systems, and less prevalence of formal, impersonal processes and systems. This will affect the design and implementation of ICT-based systems (see Chapter 3).

- Localism: individuals seeking advice and enterprises seeking suppliers and customers may rely more on closer connections including face-to-face interactions (see Chapter 4). This will affect the use and value of ICTs.

The third thing specific and different is the international development agenda to which ICT4D is applied. We now turn to that in more detail.

1.2. What does "development" mean?

Our definition of ICT4D means the technology is used to help deliver on the international development agenda. But what is that agenda? To understand, it will help to know a brief history of international development; especially its dominant paradigms: overarching ideas of what development means and how it should be achieved.

Taking the long view, the idea of international development is relatively new. It began only after World War II which galvanised a process of decolonisation and created a different relationship between countries of the global North (including the former colonial powers) and the newly independent nations of the global South. From this point, there has been a fairly regular pattern, at least during the twentieth century, of a paradigm coming to prominence, shaping development thinking and action for some while, then being seen not to have delivered as much as hoped, and a new paradigm emerging, though with earlier paradigms often still surviving in some form. A short chronology follows, which adapts text from Heeks (2009a); see also Figure 1.5.

Modernisation was a philosophy of development that dominated the third quarter of the twentieth century and thus also the initial years of applying ICTs to development. It saw nations of the global North as advanced and modern; and nations of the global South as underdeveloped and backward. To make development happen, the "underdeveloped" countries must transfer technology, ideas and values from those who had already industrialised.

Not surprisingly, this turned out to be a very problematic process. Thus, leavened with a sprinkling of Marxist philosophy, a new development idea was born. This was the *dependency* paradigm, which argued development happened best when countries broke away from an exploitative world system. Hence, during the 1970s, barriers to imports were raised and the ablest developing nations sought to create their own technologies. India, for example, began designing and building minicomputers, driven partly by IBM's departure from the country in 1978.

In its turn, though, this dependency model was found to have feet of clay. For example, it was seen to disregard the needs of ordinary citizens, leading to a discourse from the 1970s about *basic needs*. Also, dependency's attempt to build local technologies that would substitute for imports was good for the technology producers. They built capabilities and profits (often with the help of generous government subsidies). But their local customers suffered with goods of high cost and low quality that were several years behind the technological frontier.

And so, a new paradigm was born: *neo-liberalism*. In many ways, this was a return to modernisation, with an emphasis on the ready transfer of technology from North to South. But this time to be achieved not through the guiding hand of government so much as by market forces. The 1980s and early 1990s therefore saw a freer flow of technology in the world, helping act as the carrier wave for the growth of market globalisation. But it also saw the erosion of some of the bases of technological capabilities that developing countries had built up during their more protected years.

Neo-liberalism was also argued to ignore the needs of the poorest (echoing the earlier basic needs discourse), who were often seen to remain excluded from markets and their benefits, or adversely incorporated into markets which acted as institutions of exploitation not liberation. Some of these concerns were given particular voice when the ideas of Amartya Sen and others gave rise to the *human*

development paradigm that placed a priority on delivering health, educational, income and related improvements to the mass of poor citizens in developing countries. Such ideas guided the Millennium Development Goals which (see Box 1.3) were important shapers of ICT4D application during the first years of the twenty-first century.

But two concerns with all previous development paradigms were bubbling up during the last years of the twentieth century, which gave rise to two alternatives. The first, *post-development*, is more of an anti-paradigm. It argues the very notion and discourse of development has been a means to entrench the interests of the global North; though it sees ICTs as holding the potential to help indigenous and alternative approaches to emerge. The second also sees a foundational problem: that development paths to date have been too resource-intensive and too unequal so that continuing with them will only create more problems in future. From this derives the *sustainable development* paradigm. It is shaped around the two core issues of environmental sustainability and social justice for those marginalised by inequality, and its much-repeated definition comes from the 1987 UN report, *Our Common Future*, also known as the Brundtland Report:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> • the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and
>
> • the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.
>
> (UNWCED 1987:41)

Figure 1.5 Chronology of development paradigms

1950s	1960s	1970s	1980s	1990s	2000s	2010s
Dominant phases of particular development paradigms						
Modernisation Growth as development Technology transfer Transfer of ideas/values						
	Dependency Core-periphery positions within world system Breaking away					
		Basic needs Focus on basic human needs High degree of state intervention (agricultural policies, credit, etc)				
			Neo-liberalism Beginning of retreat of the state Focus on markets – getting prices right			
				Human development Multi-dimensional – micro-credit, gender, education, poverty, etc Greater focus on participatory methods		
					Post-development Idea and discourse of development as problematic	

1950s	1960s	1970s	1980s	1990s	2000s	2010s
Dominant phases of particular development paradigms						
					Sustainable development Meeting current needs without compromising future needs; especially environment	
International development goals						
					Millennium Development Goals	
						Sustainable Development Goals
ICT4D phases						
ICT4D 0.0						
				ICT4D 1.0		
					ICT4D 2.0	

Adapted from: Ellis & Biggs (2001) and Heeks (2009a)

These ideas were a foundation for the Sustainable Development Goals which (see Box 1.3) were important shapers of ICT4D application from 2016 onwards.

Box 1.3

UN development goals

The "international development agenda" that ICT4D seeks to serve is a rather fuzzy notion that undoubtedly varies between different countries and different development organisations. But there have been two clear statements of agenda emerging from the UN system: the Millennium Development Goals (MDGs), which (approximately) ran from 2000 to 2015, and the Sustainable Development Goals (SDGs), which ran from 2016 onwards.

These have not been universal. They have had more influence on discussion and levels of aid than they have on policy and practice: some governments and organisations have followed them closely; the MDGs and SDGs have influenced the agenda of other governments and organisations to some degree; some governments and organisations have completely ignored them (Heeks 2014a). But they do represent the single most important statement of the development agenda and, hence, the single most important agenda shaping ICT4D.

Millennium Development Goals

Goal 1. Eradicate extreme poverty and hunger

Goal 2. Achieve universal primary education

Goal 3. Promote gender equality

Goal 4. Reduce child mortality

Goal 5. Improve maternal health

Goal 6. Combat HIV/AIDS, malaria, and other diseases

Goal 7. Ensure environmental sustainability

Goal 8. Develop a global partnership for development

Under Goal 8, there was an ICT-specific target: “In cooperation with the private sector, make available the benefits of new technologies, especially information and communications”.

Sustainable Development Goals

Goal 1. End poverty in all its forms everywhere

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 3. Ensure healthy lives and promote well-being for all at all ages

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5. Achieve gender equality and empower all women and girls

Goal 6. Ensure availability and sustainable management of water and sanitation for all

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

Goal 10. Reduce inequality within and among countries

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12. Ensure sustainable consumption and production patterns

Goal 13. Take urgent action to combat climate change and its impacts

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Goal 17. Strengthen the means of implementation and revitalise the global partnership for sustainable development

Under Goal 9, there is an ICT-specific target: “Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020”. But there are also targets that specifically identify ICTs in relation to higher education scholarships (under Goal 4), women’s empowerment (Goal 5) and innovation capacity (Goal 17).

Beyond the goals and targets, there are three principles driving the SDGs (ibid.) which is that development should be transformative, inclusive and sustainable.

1.2.1. How development paradigms shape ICT4D

Why should we be concerned about these different development paradigms? Because, as noted, the development paradigm sets the development agenda, and

the development agenda shapes why and how ICTs are used for development. Though ICT does not form an explicit part of any development paradigm, its role will differ, as Table 1.1 briefly summarises.

Table 1.1 Role of ICT under different development paradigms

Development paradigm	*ICT role*
Modernisation	ICTs transferred from global North have a central role in delivering economic growth and new cultural values
Dependency	ICTs transferred from global North could be exploitative, and greater emphasis should be on local development of ICTs which would have a central role in delivering economic growth
Neo-liberalism	ICTs have an important role in connecting enterprises and countries to local and global markets, and in increasing the efficiency of – and delivering alternatives to – the state
Human development	ICTs are not central, but locally appropriate digital applications could deliver social and other development outcomes for those on lowest incomes
Post-development	ICTs are not central, but are carriers of discourse and sites for both exclusive and alternative approaches to development
Sustainable development	ICTs are not central and can deliver either sustainable and just, or unsustainable and unjust development depending on the type of application

Source: developed from Prakash & De' (2007) and Thapa & Saebo (2014)

Not only do different paradigms imply different roles for ICT, they also imply different development outcomes. As an example, Prakash and De' (2007) analyse the Bhoomi project in India, which computerised farmers' land records. They identify Bhoomi as being implemented within a neo-liberal development paradigm. They then perform the thought experiment of implementing the same project within a human development paradigm. In the former case, larger farmers are the main beneficiaries and village-level officials are removed from the process. In the latter case, small-scale and landless farmers are the main beneficiaries and village-level officials are empowered.

As this illustrates, believing in one development paradigm can make one critical of ICT projects implemented on the basis of a different paradigm. As Box 1.4 summarises, this underpins a number of criticisms to which ICT4D has been subject.

Box 1.4

Critiques of ICT4D

Three main categories of ICT4D critique can be identified:

Technical. These accept that ICTs have a positive role to play in development but criticise the implementation process which is seen to fail too often to deliver intended benefits. Much of this critique focuses on the implementation techniques and, as discussed further in Chapter 3, seeks to improve those techniques (Heeks 2002a). The link is not often exposed between these techniques and the development paradigm within which they are being applied. However, one example is the criticism from a human development standpoint of the over-centrality of technology in some ICT4D methodologies; a fixation that can emerge from the important role technology is seen to play in the modernisation and neo-liberal paradigms (Prakash & De' 2007, Johri & Pal 2012).

Instrumental. These accept that ICTs have a positive role to play in development but identify a negative role that runs alongside. Much of this relates to the uneven distribution of ICT benefits, including discussions about the digital divide (see Chapter 2). Some of this relates to "digital harm": cybercrime, technostress and ICT-based conflict, "wilfing" and other perceived online time-wasting, environmental damage of ICTs, etc (Ndung'u & Waema 2011, Heeks 2016a). These critiques come from many angles but have been particularly derived from the human and sustainable development paradigms (Oosterlaken 2015, Souter 2015).

Structural. These do not accept that ICTs have a positive role to play in development, because of the dominant development paradigm. These typically identify ICT4D as operating within a modernisation/neo-liberal

paradigm, and argue the impacts of ICT are to serve the economic and political interests of a narrow corporate elite (Schech 2002, Pieterse 2010). A related critique is that ICT4D's impact to date has been incremental and has not (yet) transformed, but rather tends to reinforce, the structures of power and privilege in society (Avgerou 2010, Murphy & Carmody 2015).

The critiques of ICT4D come from the dependency, human, sustainable and post-development paradigms. Modernisation and neo-liberal paradigms see ICT as an important and positive development tool. The relative lack of critique and the unstoppable nature of the ICT4D bandwagon arise partly because of the strength of the latter paradigms, but also from the strength of the multi-stakeholder support for the bandwagon, which comes from development agencies, politicians, the media, thought leaders, the private sector and the "aspirational poor" in developing countries (Wade 2002, Pal 2008).

1.2.2. An ICT4D development paradigm?

While ICT may have a role to play in the development paradigms described above, it is not the central focus of those paradigms. However, there are paradigms that perceive a new world being created partly or wholly as a result of digital technologies, which could form the vision that ICT4D is seeking to realise. Three related terminologies have been most widely used:

Information society: in the early 1980s, as personal computers became more commonplace, a number of writers foresaw an ICT-based future with the following beliefs:

[t]hat the world is in a state of fundamental transition/upheaval, similar in kind and intensity to that experienced in the shift from agrarian to industrial society in the nineteenth century; that the crucial resource of the new society is knowledge/information; that the primary dynamic force in this revolution/society is technology development and diffusion; that the generation of wealth in the information economy has eclipsed that of the material/manufacturing economy; that the social transformation accompanying these technical and economic changes is essentially positive; that the information revolution – technical, economic and social – is planetary in scale; that the information revolution is not only a new phase in human *civilization* but also an evolutionary step forward for *life itself*.

(Barney 2004:9)

During the 1990s, these ideas began to have some impact among a few development organisations; most notably the World Bank (Hanna 1991, Talero & Gaudette 1996).

Knowledge society: as will be apparent from Figure 1.1 above and the related discussion, knowledge is more valuable than information. Therefore, during the 1990s, some writers reworked the ideas of the information society to focus more on the role of knowledge. Within the ICT4D field, this would be a largely overlooked quasi-synonym for "information society" except for two key publications that emerged at the end of the 1990s:

- *Knowledge Societies* (Mansell & Wehn 1996) was commissioned by the United Nations.
- *Knowledge for Development* (WB 1999) was the World Development Report (an annual flagship publication of the World Bank) for 1998/99.

Though both were largely information society-focused they, like other knowledge society publications, did put a particular emphasis on knowledge-rich areas of society such as education, learning, science, research and innovation.

Network society: the ideas of an information or knowledge society are content-focused; they look at what ICTs can handle and create. An alternative is the idea of "network society" which focuses on the social structures that ICT enables, with the network being seen as the dominant form of human organisation and relationship in the economic, political and socio-cultural spheres (Barney 2004). Particularly drawing from the work of Manuel Castells, this sees economic activity based around a global network model that is "informational" rather than industrial; human experience shaped by the universalisation of time and space with power a function of inclusion/exclusion and role within social networks; and conflict arising from the clash between "the placeless character of networks and the rootedness of human meaning" (ibid.:31). Castells has engaged with developing countries, broadly moving from a negative perception of them as excluded from the core global networks (Castells 2000) to a recognition of the potential for ICTs to help network models develop (Castells et al. 2007) to the idea that ICTs can form the basis for a new development paradigm (Castells & Himanen 2014). As with the other ideas presented here, the World Bank took a look at this some years back (Analysys 2000) but it does not seem to have been carried forward as a whole; instead fragmenting into network-based concepts like social capital or global production networks.

All three of these visions of the future had their origins in the global North with, as noted, a few attempts at extending the concept into international development. But they have not been development-specific. Four ideas have been mooted that do make a direct connection between ICTs and development:

- "Informational development" (Castells & Himanen 2014) sees international development in light of Castells' network society ideas bringing changes to economic and human development and to cultural identity. But the idea of informational development remains undeveloped in favour of an argument about "dignity as development".

- "Digital development" (Heeks 2016a) sees ICT not as one tool among many that enables particular aspects of development, but as the platform that mediates development. It seeks to identify the changing patterns this causes in the conflict between open and closed models of development. Again, the content gives little detail about emergence of a new ICT-based development paradigm.

- "Development 2.0" (Thompson 2008, Heeks 2010a) sees development processes and structures transformed through ICTs via the types of higher-level changes identified earlier (automation, connection, etc), and seeks to identify, understand and map those transformations. This will be explored further in Chapter 9.

- "Open development" (Smith et al. 2011) sees ICTs enabling much greater access, participation and collaboration in development, but the idea is challenged because of the contested nature and value of openness. This also will be explored further in Chapter 9.

In all four cases, there is no sense yet of a clear new or alternative development paradigm, though there are many hints and glimpses. One way forward might be to build on the ideas of "ICT4D 2.0", summarised in Box 1.5 (see also Figure 1.5 timeline). But any vision for a new ICT-enabled development paradigm will require a lot more depth of thought and evidence before it can emerge.

Box 1.5

ICT4D 2.0

ICT4D 2.0 is the third in a set of historical phases in the application of ICTs to development. As seen in the quote below (see Heeks 2009a for further details), each new phase does take a different view of the relation between ICTs and development, and each new phase is associated with a different development paradigm. However, ICT4D 2.0 in itself should not be seen as an ICT-based development paradigm.

"There is no sharp dividing line to let us say, 'ICT4D 1.0 stopped here; ICT4D 2.0 began here'. On the ground, there is a sense of evolution, not discontinuity. And yet . . . something messy, fuzzy but new is emerging. And it makes sense to see what happens if we give this a label and a summary, as shown in Table 1.2.

What, then, might we argue are the key differences between ICT4D 1.0 and 2.0? In answering this and summarising what was presented above, we could draw parallels with the concept of Web 2.0. For example, ICT4D 2.0 is about the world's 'long tail' – using digital technologies to draw on the capacities of the 80 per cent who hold only 20 per cent of the world's resources. Or, using Eric Schmidt's 'don't fight the Internet' characterisation, we can see ICT4D 2.0's slogan as 'don't fight the poor'. Where 1.0 imposed pre-existing designs and expected the poor to adapt to them, 2.0 designs around the specific resources, capacities and demands of the poor. Or, we can transform 'the network is the platform' to argue that while ICT4D 1.0 saw ICTs as a tool for development, the second phase sees ICTs as the platform for development.

Table 1.2 Summary of ICT4D phases

Issue / phase	*ICT4D 0.0 (1960s to mid-1990s)*	*ICT4D 1.0 (mid-1990s to mid- to late-2000s)*	*ICT4D 2.0 (mid- to la 2000s onwards)*
Iconic technology	PC database	Telecentre	Mobile phone
Key application	Data processing	Content (& interaction)	Services & productio
The poor	Who?	Consumers	Innovators & produce
Key goal	Organisational efficiency	MDGs	?Growth & developme
Key issue	Technology's potential	Readiness & availability	Uptake & impact
Key actor	Government	Donors & NGOs	All sectors
Attitude	Ignore —> Isolate	Idolise —> Integrate	Integrate —> Innovat
Innovation model	Northern	Pro-poor —> Para-poor	Para-poor —> Per-poo
Dominant discipline	Information systems	Informatics / development studies	Tribrid of CS, IS and I
Development paradigm	Modernisation	Human development	?Development 2.0?

p.29

In conclusion and above all, we can see that ICT4D 2.0 is about reframing the poor. Where ICT4D 1.0 marginalised them, allowing a supply-driven focus, ICT4D 2.0 centralises them, creating a demand-driven focus. Where ICT4D 1.0 – fortified by the 'bottom of the pyramid' concept – characterised them largely as passive consumers, ICT4D 2.0 sees the poor as active producers and active innovators."

(Heeks 2009a:28–29)

1.3. Theoretical foundations of ICT4D

Why should we be concerned about theory in such a practical field as ICT4D? Any theory has two parts.

First, it is a theory of knowledge: a framework for understanding the world. The world is far too complex for humans to comprehend. Theory provides us with a lens through which to view the world; spotlighting a few elements that we should attend to and ignoring others; simplifying the world sufficiently to help us

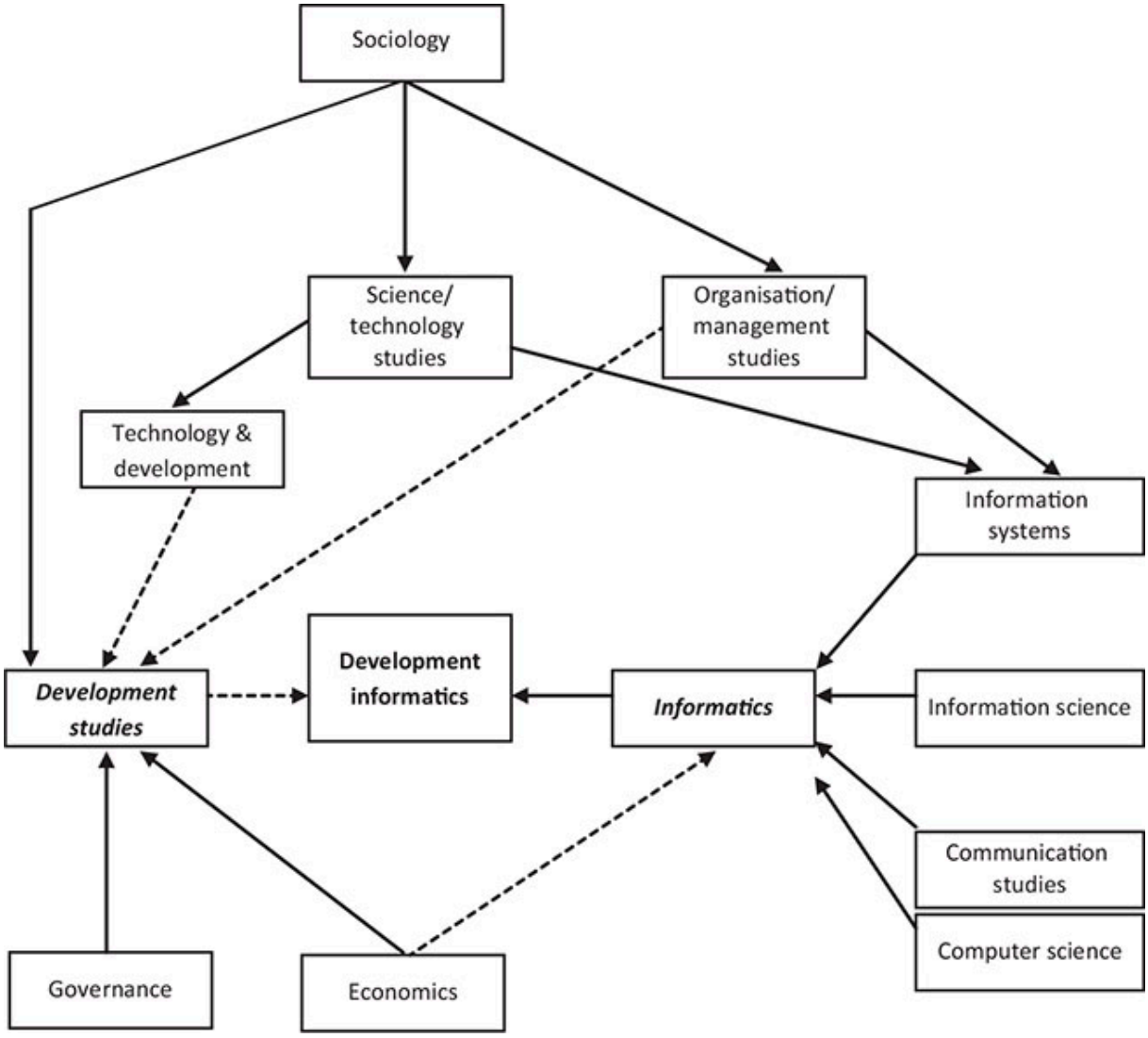
understand it. By sharing this view with other people, we can communicate with them, and collectively – rather than individually – build more knowledge.

Second, it is a theory of change: a framework for understanding how to bring about a particular change in the world, such as the achievement of a development goal. Our chosen development paradigm may set the goals for ICT4D interventions, but the theory of change identifies the mechanisms by which those goals will be achieved. Designers and project managers therefore use theory to know where to focus their attention during ICT4D implementation.

What theories can we use to understand and implement ICT4D? One starting point will be to look at the academic disciplines that contribute to the sub-discipline of development informatics which, as noted in Box 1.2, is the name of the field that researches ICT4D. These are summarised in Figure 1.6 (Heeks 2010c).

Any one of the identified disciplines could be the source of a theory relevant to ICT4D but, to keep things simple, we can associate theories with the "I", the "C", the "T" and the "D" of ICT4D (see also Box 1.6).

Figure 1.6 Disciplinary foundations for development informatics research



Box 1.6

ICT4D and other disciplines

As discussed next, this book draws particularly on ideas from the academic disciplines of information systems and development studies, reflecting patterns in the ICT4D literature. But there are other sources of ideas that could be used more by development informatics researchers.

Some sources have long-standing links with ICT4D. For example, via the field of development communication, communication studies could be seen as a foundation of ICT4D but "ICT4D literature has largely ignored

communication theory" (Heffernan et al. 2016). Yet communications studies ideas could help, for example, to explain how social media interacts with social networks in developing countries, or to explain the factors that enable and constrain ICT-enabled communications to make a difference to health-related attitudes and behaviour.

Other sources of ideas are long-standing but took time to be linked with ICT4D. For example, design science has been around since the 1950s and is the academic discipline dealing with creation of "things that serve human purposes"; typically understood to include the act of design as the core of its research methods (March & Smith 1995:253). There has been limited use to date of design science within ICT4D but it has demonstrable potential in bringing rigorous insight to the development of new ICT4D artefacts; be they data models, apps, devices, etc (Islam & Gronlund 2012).

Yet other sources of ideas are themselves fairly new. For example, development engineering is "an emerging field of research that focuses on technology interventions designed to improve human and economic development within complex, low resource settings" (McCormick & Martin 2014). While covering the whole gamut of technologies from cookstoves to bridges, an important component of development engineering will be ICT-based interventions (e.g. De Mel et al. 2016).

1.3.1. "I", "C", "T" and "D" theories and ICT4D

Given that – at root – all ICTs do is process and communicate data and information, then information- and communication-oriented theories are central to understanding ICT4D. The ideas of the information value chain and its CIPSODAR steps were introduced above and will re-appear in later chapters. These informatics discipline ideas help us understand at the most micro-level what function and impact ICTs have in development. We could also, as noted in Box 1.6, use communication theories as a basis for ICT4D.

ICTs are a form of technology, and insights into the uptake of ICTs can therefore be provided by technology-specific theories. In Chapter 3, two of these will be used that derive respectively from innovation and information systems studies:

Rogers' Diffusion of Innovation theory, and the Technology Acceptance Model. Technology-related theories can also help in understanding the extent of impact of ICTs, and Chapter 4 introduces a simple model of ever-increasing change (DIRT: digitisation – improvement – redesign – transformation) based on earlier models of ICT- and Web-enabled change.

Broader still are models drawn from the management literature. These can help understand the context within which ICTs are being introduced: for example, stakeholder analysis, as applied in Chapter 2. And they can help understand where ICTs fit into an organisation: the value and supply chain models discussed in Chapter 4 are helpful here, especially in considering the role ICTs play in enterprise.

At the broadest level, we need theories drawn from development studies to help understand what contribution ICTs are making to development. The two most widely used development models in the ICT4D field – both associated with the human development paradigm – are the Sustainable Livelihoods Framework (used in Chapter 5) and the Capabilities Approach (used in Chapter 6). There are also more specific frameworks such as the climate sustainability and resilience models used in Chapter 8, which help locate ICTs within a sustainable development paradigm.

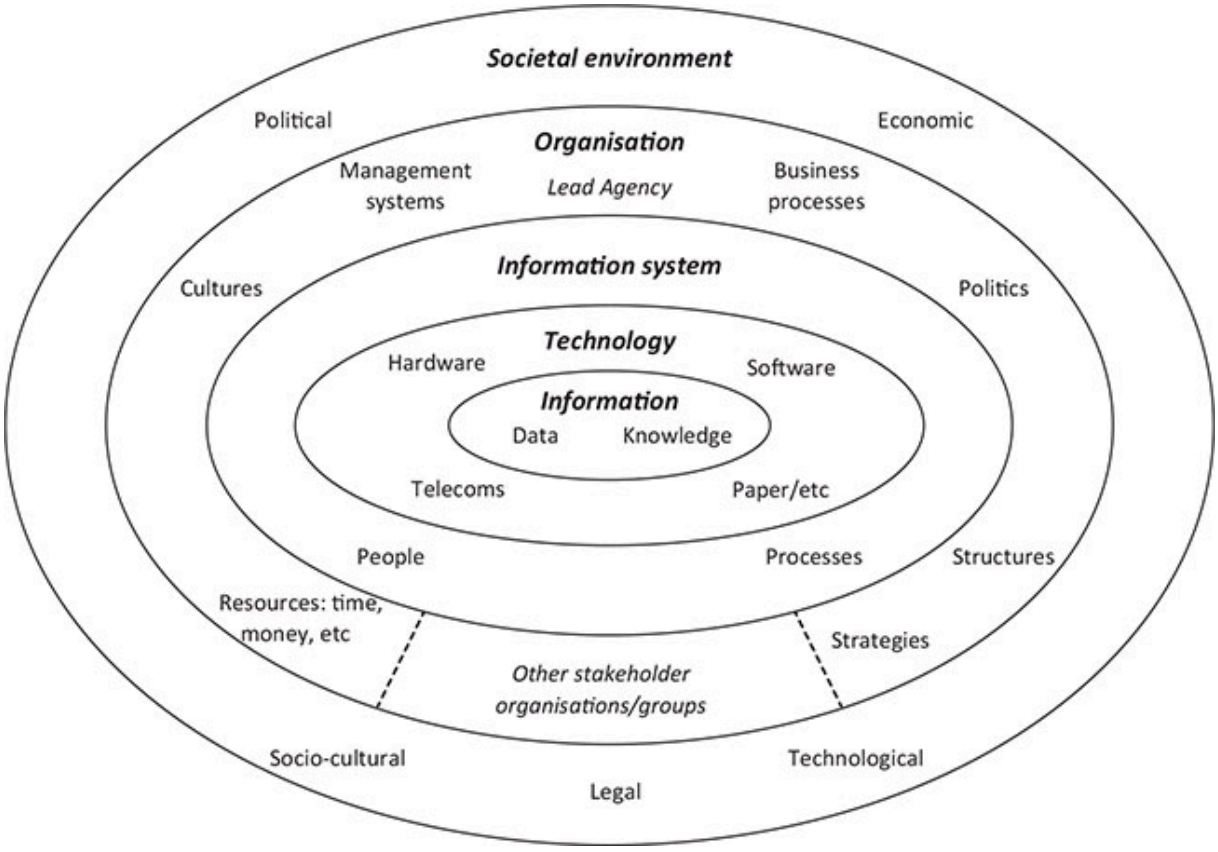
Finally – and implicit within this explanation of theories – there are multi-level models that start at the micro-level of data, technology and people; then aggregate those into digital information systems; and locate those systems within a structural context of organisations and a societal environment of various factors. Figure 1.4 above was an example, and there will be others, each of which is a simplified version of Heeks' onion-ring model (see Figure 1.7 adapted from Heeks 2006a). Where most of the models above focus on informational, technological and development processes, this model focuses on structure.

1.3.2. Are there any ICT4D theories?

The preceding section can make development informatics seem like a beggar, always borrowing someone else's theories, and never coming up with any of its own. But this isn't the whole picture because there have been adaptations and

combinations of other theories to produce frameworks from within the development informatics field (Andersson & Hatakka 2013). For example, both Sein and Harindranath (2004) and Kleine (2013) merge ideas from the fields of informatics and development studies – specifically the Capabilities Approach – to develop new frameworks specifically for understanding the role of ICTs in development.

Figure 1.7 Structural "onion-ring" model of information systems



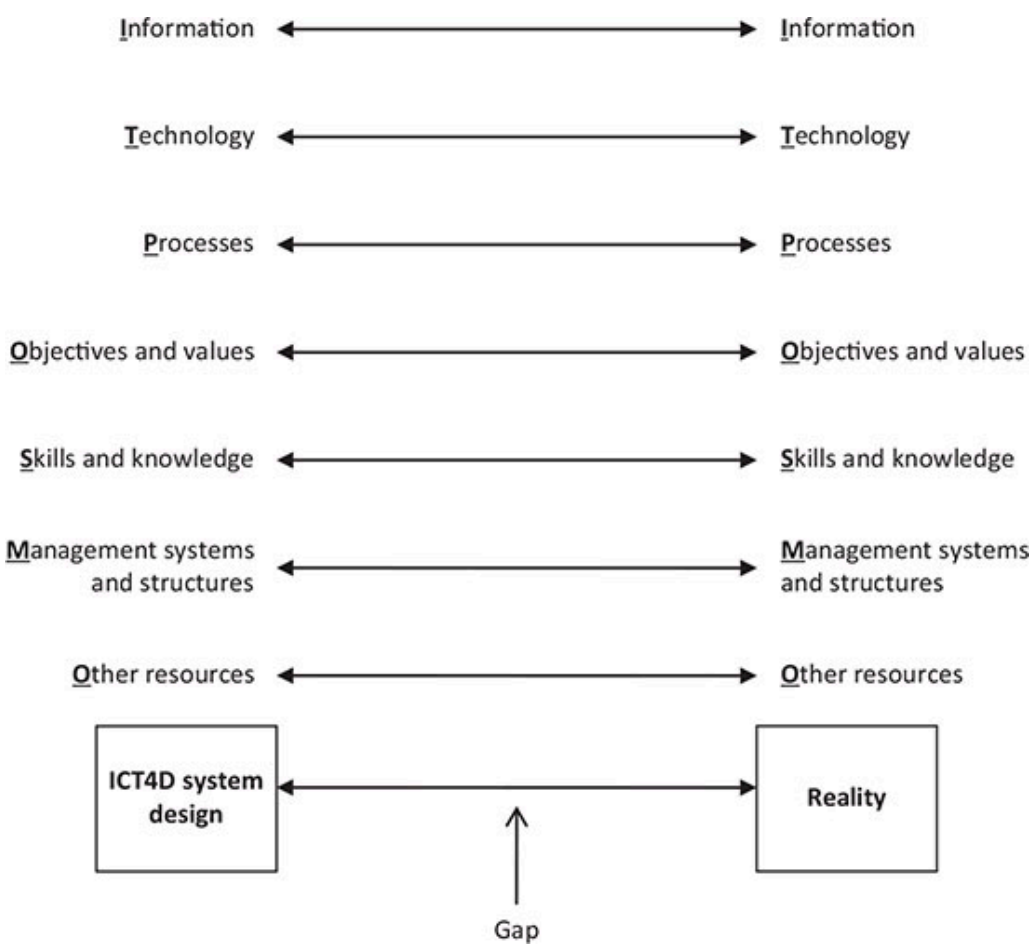
Two other ICT4D-specific models will recur more frequently in the book. First, the "design–reality gap" framework.

Around the turn of the century, I developed this framework (Heeks 2002b). It was a mongrel: borrowing from science and technology studies (especially Akrich 1992), a book on ICTs and development (Lind 1991), a paper on small enterprise

(Gibb & Manu 1990), and field experience in India. The core concept is that a gap may exist between the design of an ICT4D application and the contextual realities into which it is introduced. The larger that gap, the greater the risk that the ICT4D application will fail. There are various ways in which the gap between design and reality could be understood but it is most typically assessed on seven "ITPOSMO" dimensions as shown in Figure 1.8:

- **I**nformation: includes both formal and informal information and data, held on both ICT-based and other types of information system.
- **T**echnology: mainly focuses on ICT in its broadest sense, but can cover other types of technology such as production machinery.
- **P**rocesses: the activities undertaken including all information value chain elements; not just the data-handling tasks of CIPSO but also decision-making, communication, learning and development implementation actions.
- **O**bjectives and values: often the most important dimension since the "objectives" component covers issues of self-interest and politics, and informal and formal strategies; the "values" component covers culture: what stakeholders feel are the right and wrong ways to do things.
- **S**kills and knowledge: covers both qualitative and quantitative aspects of human competencies for undertaking ICT4D-related processes.
- **M**anagement systems and structures: the overall management systems required to organise the organisations or communities around the ICT4D application plus the way in which the organisations or communities are structured, both formally and informally.
- **O**ther resources: time and money.

Figure 1.8 Dimensions of design–reality gaps



The design–reality gap model will be referred to at a number of points in the book, helping understand barriers and risks underlying ICT4D initiatives. Also referred to will be the second ICT4D-specific model – the ICT4D value chain – which is explained at the start of Chapter 2.

Additional material

Discussion questions

1.1.1. Should ICT actually be called DCT since it handles data, not information?

1.1.3. What are the arguments for and against restricting ICT4D to developing countries only?

1.1.5. Identify an example ICT4D case study: discuss what affordances and broader changes the case study illustrates.

1.2 Which development paradigm do you feel is best, and why? What are the implications for your views about ICT4D priorities?

1.2.1. Which of the critiques of ICT4D is the most problematic?

1.2.2. If ICT4D 2.0 has been around for some years, should we now be talking of moving to ICT4D 3.0? (A question we will return to in Chapter 9.)

1.3 Is theory useful and necessary in a field like ICT4D, or is it just a way for academics to talk nonsense to each other?

Assignment question

Explain the meaning and components of "ICT4D".

Further reading

If you would like to know more about . . .	1.1.1. data, information and knowledge	. . . then take a look at . . .	1.1.1. the introductory chapters of most information systems textbooks e.g. chapters 1 and 2 of Bocij, P., Greasley, A. & Hickie, S. (2015) *Business Information Systems*, 5th edn, Pearson, Harlow, UK >Covers the basics of data, information, decisions and information systems
	1.1.5. affordances and ICT(4D)		1.1.5. Conole, G. & Dyke, M. (2004) What are the affordances of information and communication technologies?, *Association for Learning Technology Journal*, 12(2), 113–124 >Discusses a list of high-level affordances of ICT Andrade, A.D. & Doolin, B. (2013) Affordances and agentic orientations: an examination of ICT4D users, paper presented at *SIG GlobDev Sixth Annual Workshop*, Milan, 14 December >Strongly theory-based investigation of affordances, and their perception and enactment by refugee families
	1.2 development paradigms		B. Willis, K. (2011) *Theories and Practices of Development*, 2nd edn, Routledge, Abingdon, UK >Provides detailed explanation of all key development paradigms
	1.2 the Sustainable Development Goals		B. https://sustainabledevelopment.un.org/ >Details the goals plus related actions and discussions
	1.2.1. the link between ICTs and development		B1. Thapa, D. & Saebo, O. (2014) Exploring the link between ICT and development in the context of developing countries: a literature review, *The Electronic Journal of Information Systems in Developing Countries*, 64(1), 1–15 >Reviews the different meanings of "D" in ICT4D research, illustrates this by looking specifically at application of the Capabilities Approach, and draws research conclusions
	1.2.2. ICT4D 2.0		B2. Heeks, R. (2009) *The ICT4D2.0 Manifesto*, Development Informatics Working Paper 42, IDPM, University of Manchester, UK >Develops and explores the notion of "ICT4D 2.0"

	1.3 theories and ICT4D		C. Heffernan, C., Lin, Y. & Thomson, K.I.M. (2016) Drawing from development: towards unifying theory and practice of ICT4D, *Journal of International Development*, 28(6), 902–918 >Looks at different theories applied to ICT4D especially development and communication theories, and discusses how best they can be applied Andersson, A. & Hatakka, M. (2013) What are we doing? Theories used in ICT4D research, in: *Proceedings of the 12th International Conference on Social Implications of Computers in Developing Countries*, N. Hayes & R.L. La Rovere (eds), University of the West Indies, Mona, 282–300 >Reviews the ICT4D research (i.e. development informatics) literature and classifies the theories used in that research

2 Foundations of ICT4D

In reading this chapter, you will learn to:

- explain the ICT4D value chain and information value chain models, and their implications;
- categorise the technological and human infrastructure of ICT4D;
- identify key ICT4D stakeholders;
- explain ICT4D policy content and governance;
- analyse ICT4D financing;
- critique and explain digital inclusion and the digital divide.

Chapter 1 looked at the various constituent parts of the term "ICT4D" including their connections, but the perspective was often quite abstract. This chapter moves closer to practice. It introduces an ICT4D framework directly drawn from field experience: the ICT4D value chain. It then explores part of this in order to understand the foundations of ICT4D: all of the underlying layers and components that need to be put in place for ICT4D to work.

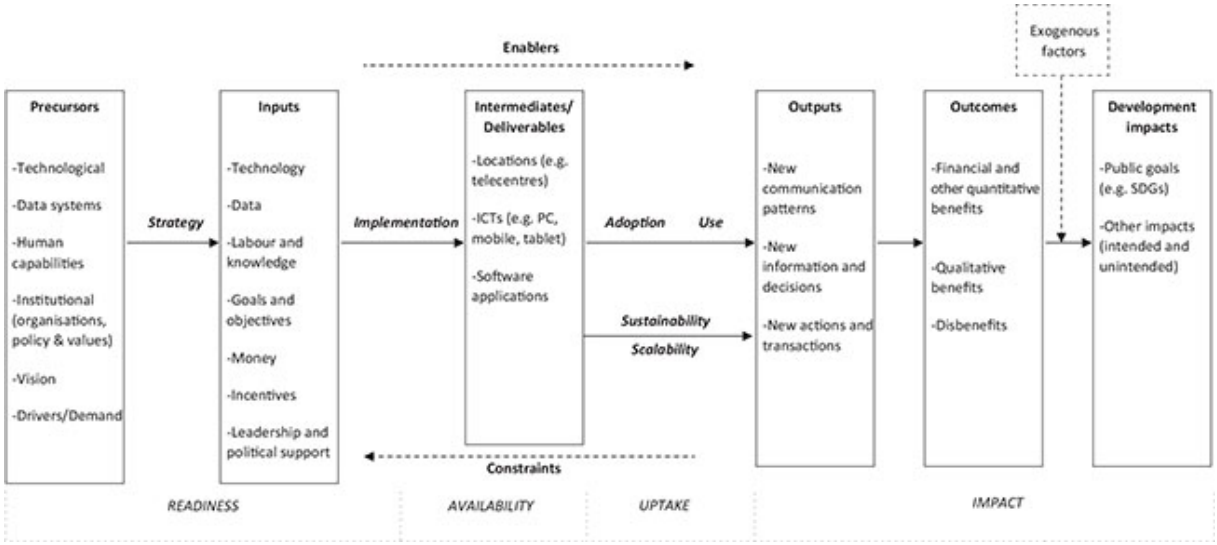
2.1. The ICT4D value chain

One of the most basic concepts for understanding the world is the idea of a process: an action that takes an input and changes it into an output. On the assumption this creates value for someone, then the chain of input->process->output can be called a value chain. As noted in Chapter 1, technology such as

ICT is fundamentally involved in taking action to process inputs into outputs. Thus a value chain can be a good way to think about ICT4D which, if we're lucky, will take inputs and turn them into development.

In reflecting on field experience, the simplicity of input->ICT process->development becomes, unfortunately, rather more complex and a current version of the ICT4D value chain (adapted from Heeks 2014b) is shown in Figure 2.1. You may be able to identify within the chain, all of the ITPOSMO elements introduced in Chapter 1. However, the model is best understood via the four domains shown at the bottom. One relates to inputs: "readiness"; two relate to process: "availability" and "uptake"; and one relates to outputs: "impact".

Figure 2.1 The ICT4D value chain



I will now explain each of the domains in a little more detail (adapting from Heeks 2010e):

- Readiness: shown in this domain are the systemic prerequisites for any ICT4D initiative. There are the foundational precursors that we might think of mainly at the national level such as ICT infrastructure, skills and policy. And there are

the more specific inputs that feed into any individual initiative; both "hard" inputs like data and money and technology, and "soft" inputs like knowledge and motivations and political support. These inputs could be made available via a specific strategic plan for the ICT4D initiative. As Box 2.1 describes, there have been a series of e-readiness indexes over the years that help to measure progress in this domain.

- Availability: implementation of an ICT4D initiative turns the inputs into a set of tangible ICT deliverables; typical among which might be anything from a telecentre or cybercafé with publicly accessible Internet-connected PCs to an app on a smartphone or tablet.

- Uptake: ICT4D cannot process anything until it is actually adopted and used; both of which are covered in this domain of the value chain. But the value of such adoption and usage will be limited unless it sustains over time and can be scaled up to touch the lives of large numbers of people; hence both sustainability and scalability are recognised here. The ability of the ICT4D initiative to be implemented, adopted, used, sustained and scaled can be facilitated by a set of enablers (mainly presence of the necessary precursors and inputs), and can be held back by a set of constraints (mainly absence of the necessary precursors and inputs).

- Impact: which can be divided into three sub-elements:

    - *Outputs*: the micro-level changes associated with technology use;

    - *Outcomes*: the wider costs and benefits associated with ICT;

    - *Development impacts*: the contribution of ICT to broader development goals but also its other impacts (not all of which may be seen as positive).

All domains of the value chain are important, though the focus of interest in the ICT4D field has changed over time, as Box 2.2 explains.

Box 2.1

ICT4D readiness indexes

Some key quantitative e-readiness indexes that have emerged include:

- The *Digital Opportunity Index* set up for the World Summit on the Information Society (see Section 2.4) encompassed technological measures based on three elements: opportunity (mobile coverage plus affordability of mobile telephony and Internet access relative to local income), infrastructure (household penetration of telephone fixed lines, PCs and Internet access, plus mobile and mobile broadband access), and utilisation (proportions of Internet users, broadband subscribers and mobile broadband subscribers) (International Telecommunication Union (ITU) 2007).

- The *ICT Opportunity Index* which – rather confusingly – ran in parallel with the Digital Opportunity Index, and was itself a merger of an earlier Digital Access Index of the ITU and a Digital Divide Index from Orbicom which had both been developed in 2003 (ITU 2007). It also was largely technological, measuring networks (telephone fixed lines, mobile subscriptions and Internet bandwidth), uptake (proportions of Internet users, TV sets and PCs), and intensity (broadband subscribers and international outgoing telephone traffic); but also added some human infrastructure (literacy, educational enrolment rates). Both it and the Digital Opportunity Index were short-lived from 2005 to 2007.

- The *ICT Development Index* superseded the previous two ITU indexes from 2008 (ITU 2014). Again, it is heavily oriented to technology, but gives equal (40 per cent) weight to measuring ICT access (fixed lines, mobile subscriptions, Internet bandwidth, households with PCs and Internet access) and ICT use (Internet users, fixed and mobile broadband subscription rates) alongside a 20 per cent weighting to ICT skills (literacy, secondary/tertiary educational enrolment rates).

There are also indexes that mix in more qualitative assessments such as:

- The Economist's *E-Readiness Index* that ran from 2000–2009, and was then replaced for one year by the *Digital Economy Index* (EIU 2010), which

included measures of technological infrastructure and use but also incorporated assessments of the business, social, legal and policy context.

- The World Economic Forum's *Networked Readiness Index* which has run continuously since 2001, albeit with some modifications such as addition of an impact sub-index in 2012 (Di Battista et al. 2015). It has four main sub-indexes: policy and business environment; ICT infrastructure, readiness and skills; individual, business and government use; and economic and social impacts. There are 53 individual indicators, with a number being qualitative assessments.

Looking at the trajectory of the indexes, one can see they mirror technological developments: fixed line telephony fading in importance, mobile Internet and broadband increasing in importance. And they also follow the changing interests over time represented in Box 2.2, focusing largely on infrastructure and its availability at first but with later indexes giving greater weight to usage and even impact. Indeed, they have progressed from being just measures of readiness to more holistic ICT measures.

Criticisms of these indexes (Minges 2005, Hanafizadeh et al. 2013) mirror the data quality issues discussed in Section 2.2: lack of openness about why particular measures are included or excluded, and about the weightings given to particular elements; lack of completeness for those that miss out important ICT4D value chain elements; lack of accuracy given the questionable nature of many of the underlying statistics; and lack of relevance with a tendency to include indicators that are already available or easy to measure rather than those which are truly appropriate: one aspect of this being aggregation at national level which hides many sub-national inequalities (a topic returned to in Section 2.6).

Despite these issues, e-readiness indexes remain important markers, particularly in helping drive political will and investment. As an example, Uganda's national plans for ICT include a specific target for improvement in its ICT Development Index ranking (RoU 2015).

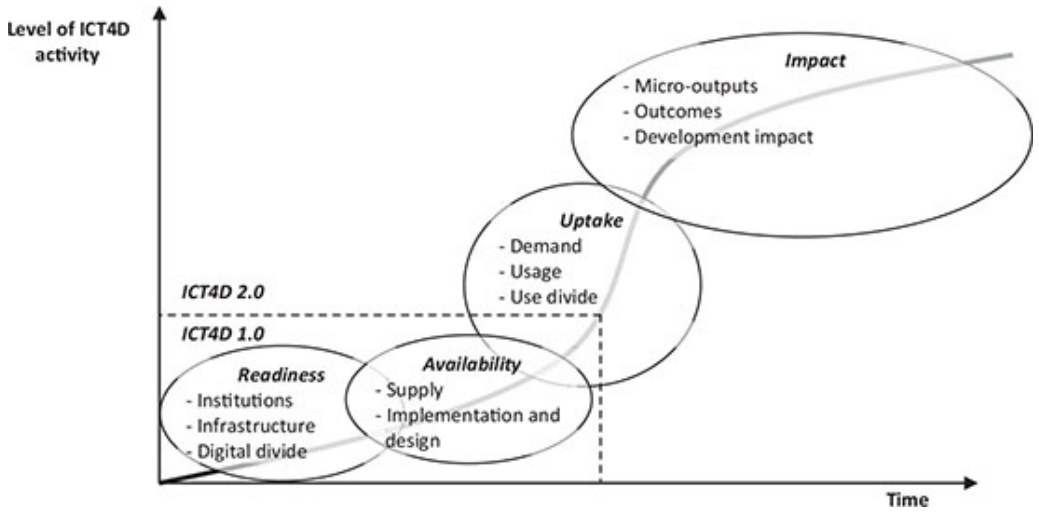
Box 2.2

Changing ICT4D value chain interests over time

As ICTs diffuse ever further into developing countries, the later stages in the value chain become more relevant. This can be understood in terms of a difference between the first and second phases of ICT4D:

"Of course, readiness and availability and uptake issues will remain relevant for at least a generation; indeed, forever as new waves of technology emerge. And they present ongoing needs for innovation in infrastructure, hardware and software. But mobiles are already a reality, and Internet-connected PCs are a growing possibility, particularly for the urban and peri-urban poor. So, where ICT4D 1.0 was about getting the foundations in place, and proof of concept such as piloting largely supply-based uptake, ICT4D 2.0 can turn part of its attention elsewhere. It can stop thinking solely about pilots, and can instead think more about sustainability, scalability and impact".

Figure 2.2 Changing focus of ICT4D priorities over time



(Heeks 2009a:29)

This chronology is summarised in Figure 2.2 (adapted from Heeks 2009a, 2014b). It can be seen reflected in the actions of key ICT4D stakeholders and development informatics researchers, who gradually took a greater interest in adoption, use and impact of ICTs from the mid-2000s onwards.

Although connected to field experience, the ICT4D value chain is a theoretical framework, albeit one that is quite "lightweight" compared to some others we will cover. As noted in Chapter 1, it will therefore have two aspects. First, it serves as a theory of knowledge: a way of simplifying and understanding and discussing the world; guiding us to focus on some elements and relations rather than others.

The ICT4D value chain also serves as a double theory of change (Talantsev et al. 2014). It explains in a general sense how ICTs can help deliver development outcomes and, prior to that, it explains what is required to create the ICT deliverables that enable development. You could, for example, use the left-hand side as a checklist for the planning of ICT4D initiatives. With that in mind, we will now look at those left-side elements in more detail, categorising them into four overall areas: technological, human, institutional and financial.

2.2. Technological foundations of ICT4D

The technological foundations of ICT4D are best understood as a series of layers, building one on another, as shown in Figure 2.3, which builds on Figure 1.4 in the previous chapter.

2.2.1. Technological infrastructure

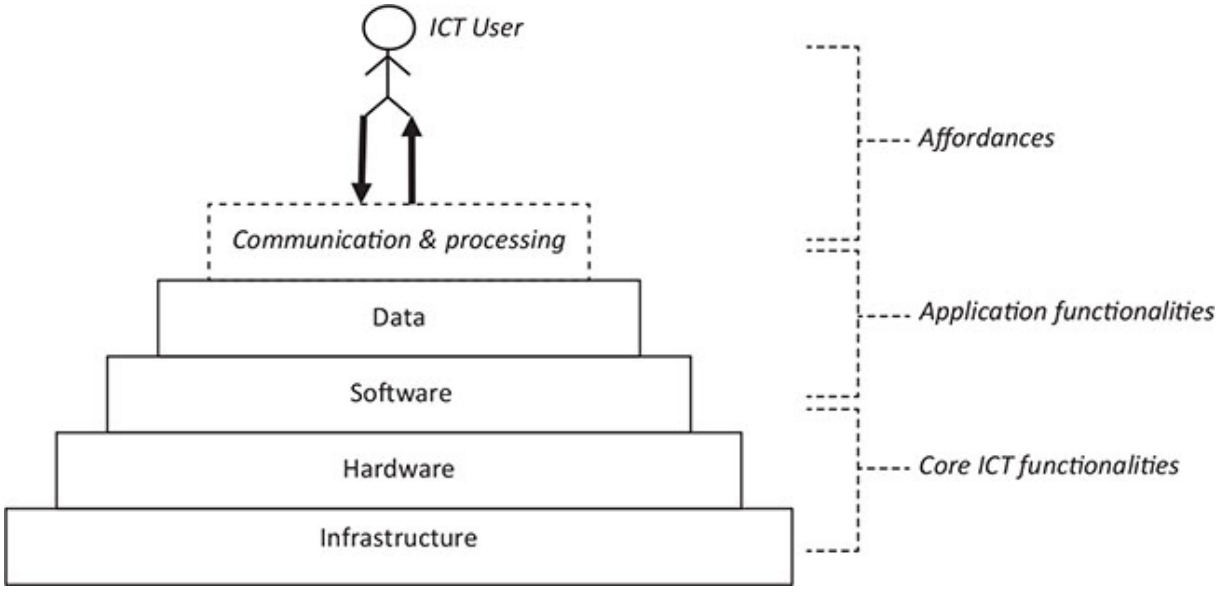
There are two types of widespread infrastructure that ICT4D requires:

Power: ICT cannot work without electricity and the lack of power infrastructure in developing countries has long been seen to hamper effective use of ICT (Bhatnagar 1992). Things are improving in many ways – the spread of the main electrical grid; expansion in national generating capacity; diffusion of low-capacity generating devices (diesel generators, batteries, solar panels, etc); declining ICT power consumption requirements,

especially for mobile devices. However, electricity remains a basic and continuing constraint on ICT4D. Only about 50 per cent of the population in developing countries has access to mains electricity (GSMA 2015a), and even those that do have problems – as an example, 65–80 per cent of users in particular medium and large organisations in West Africa experienced power disruptions and a majority of these said their ability to work with ICTs was hampered as a result (Ewusi-Mensah 2012, Kotingo et al. 2014).

Telecommunications: to move beyond stand-alone devices, data must be moved from one place to another. This will involve the telecommunications network (see Figure 2.4). At wide-scale, a number of typical technologies include:

Figure 2.3 *The technological foundation layers of ICT4D*

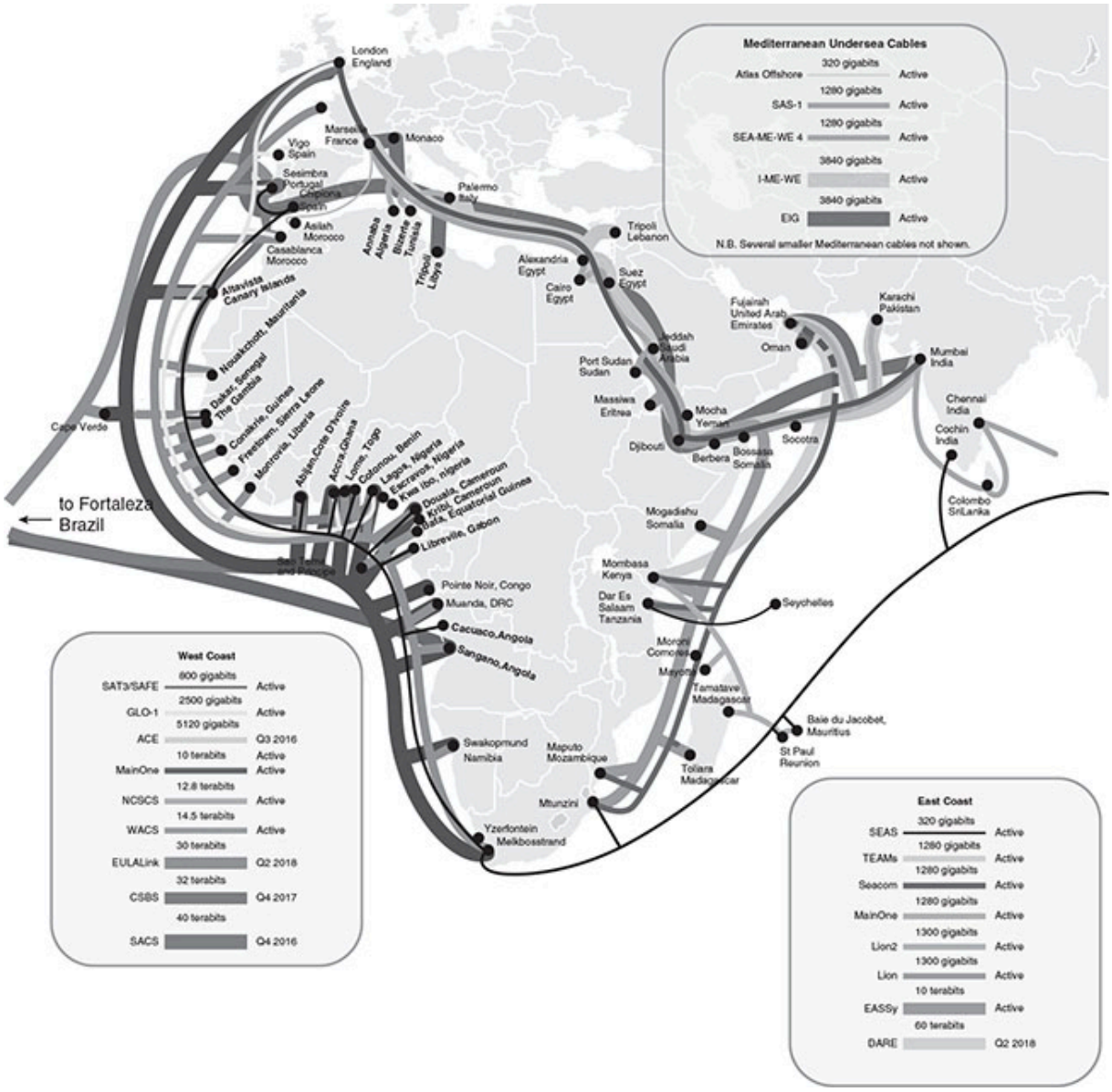


- Wireless: transmission via satellites and earth stations; and microwave or related transmissions from antennae such as those used to form the basis for the mobile phone network. Increasing speed over the years has allowed the standards for transmission to rise through the generations with 3G and 4G now the most common and 5G emergent.

- Wired: transmission via the copper wire used as the basis for the landline telephone network, or via fibre-optic cables (see Figure 2.4 (Song 2016)).

Later versions of 3G and subsequent wireless generations, fibre-optic cables and copper wire can all run *broadband* services. The definition of broadband changes over time: originally running at around 1 million bits of data per second (Mbps), this has subsequently risen to 20Mbps and beyond. But the key functionality of broadband is that it makes Internet-based interaction and transaction properly feasible. It does this using particular *protocols* for sending data: *TCP/IP* (transmission control protocol/Internet protocol) is the basic convention for moving data around the Internet; *HTTP* (hypertext transmission protocol) is the protocol (i.e. rules and procedures) for moving data between a Web document (i.e. a Web page) and the Web browser that is used to view that page.

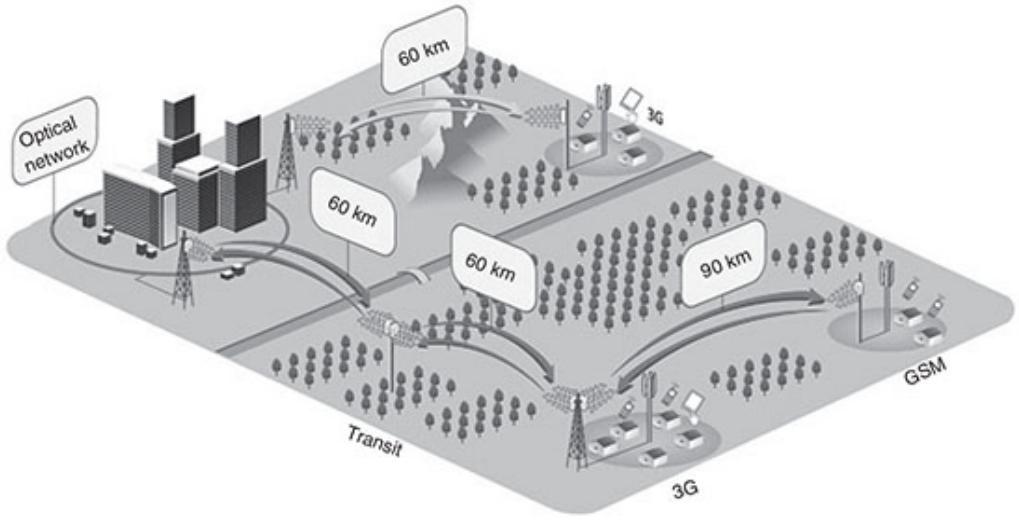
Figure 2.4 African undersea cables



Together these technologies form the network of communication networks that is the Internet. Access to this is steadily increasing: from under 8 per 100 people in developing countries in 2005, to more than 40 per 100 in 2016 (ITU 2016). As with electricity, though, there are still problems: the same West African studies quoted above found 80 per cent of users reporting telecommunications reliability problems with a similar number in public sector organisations unable to access the Internet (Ewusi-Mensah 2012, Kotingo et al. 2014); and the majority of those with Internet access lack broadband access (WB 2016).

Innovations that seek to improve telecommunications are happening at a whole variety of scales. As television shifts from analogue to digital, the old broadcast frequencies are being released – so-called TV "white space" – and can be re-used for broadband transmission in rural areas (UNCSTD 2015). Rural broadband can be delivered by a variety of other emergent technologies alongside traditional means. For example, next-generation small satellites are light, small and relatively cheap, putting them within reach of developing countries (ibid.). Micro-satellites are intended to last up to three years. High-altitude transmission platforms with a three-month lifespan but much lower costs include balloons and other so-called unmanned aerial vehicles (such as drones) that operate in the stratosphere (D'Oliveira et al. 2016). Digital multinationals such as Google and Facebook have been experimenting with these aircraft to provide rural Internet services. Back on the ground, innovations by individual ICT4D actors tend to be at a smaller scale, using standards for local transmission like Bluetooth which operates over a restricted area of some metres, WiFi which has a short range but can be scaled up, and cell networks such as low-cost GSM (see Figure 2.5; Micran 2017), or WiMax/LTE which has a broader range of some miles (Nandi et al. 2016). These can be used to build bottom-up, small-scale networks that, for example, provide telecommunications for a single community.

Figure 2.5 An example telecommunications network



For both electricity and telecommunications, the main measures we could use to assess the foundation would be quantity and quality. Quantitatively, how much of the population is covered by electrical and telecommunications supply; and what telecommunication speed is offered? Qualitatively, how reliable is the service?

2.2.2. Hardware

At the intersection of hardware – the physical devices that handle digital data – and infrastructure are *servers*: high-capacity computers that provide large-scale data storage and specific software and computing services over a network. When that network is the Internet, the location of the servers may be unknown as they form part of the *cloud*.

For individual users to access digital data, they also need a physical device. We can associate the domination of different devices with the different phases of ICT4D outlined in Chapter 1:

> *Radio/television (ICT4D 0.0)*. During the 1950s to 1990s, before other hardware became significantly available, the main electrical means by which data was received by citizens in developing countries was radio and, to a lesser extent, TV. These technologies had many shortcomings compared to later ICTs: one-way broadcast of data preventing interactivity; difficulty or additional cost of recording and redistributing data received; lack of access to broadcast channels for ordinary users. With the switchover from analogue to digital only gradually occurring in developing countries, radio and TV will not be a main focus in this book. However, they should not be entirely excluded for three reasons:

- Reach: although mobiles are catching up and in some cases exceeding it in terms of reach, radio still reaches a very high proportion of the population in developing countries, and television reaches a significant proportion. Figures vary greatly but a typical profile would be that radio reaches around 60 per cent of households and TV around 30 per cent (ITU 2010). As a result, radio especially is still reported as one of the most widely used sources of information, particularly for those in rural areas (Okon 2015).

- Innovation: the shortcomings noted above can be partly overcome through innovations. For example, there has been a steep growth in community radio stations – "not-for-profit radio services designed to operate on a small scale and to deliver community benefits" (Myers 2011:7) – with tens of thousands operating worldwide. These are generally run participatively, allowing community access to broadcast channels. Used in combination with mobile phones, they allow interactivity: for example, users can text or call to participate in programmes.

- Convergence: digital switchover means a convergence of technology platforms and services – one of a number of technological trends (see Box 2.3). For example, one can listen to digital radio on a smartphone; one can surf the Internet via a TV. In future, then, radio and TV will just become one in a range of digital devices and services. Similarly, video recordings are now digital, greatly increasing the range of platforms on which video can be watched.

Box 2.3

ICT trends

Two "laws" identify key ICT trends (Laudon & Laudon 2016):

- Moore's Law is typically said to state that the number of transistors per computer chip would double every 18 months, with implications for shrinking ICT cost and size.

- The Law of Mass Digital Storage states that the amount of digital data stored roughly doubles every year, but that the costs of storage per byte (or per gigabyte or per exabyte) reduce by more than that every year. We are close to the situation where storing data is virtually costless.

These and other technological innovations lead to a series of trends in ICT infrastructure and application. These underpin and accelerate the affordances and broader changes outlined in Chapter 1, and awareness of them led to

development of the information, knowledge and network society paradigms discussed in Chapter 1:

- Ubiquity: ICT is increasingly found everywhere and is embedded in everything from cars to washing machines. This and the following trend in part derive from the shrinking size of ICT due to Moore's Law.

- Mobility: developments in mobile and wireless applications are making digital services available anywhere and at any time.

- Performance: the cost/performance ratio of ICT is improving continuously. This is often illustrated by historical comparisons: for example, that there is more computing power in a basic feature phone than on the Apollo spacecraft that went to the moon in 1969, or more power in a musical birthday card than existed on the whole planet in 1950 (Nordstrom & Ridderstrale 2002, Friedman 2015).

- Interconnectivity: this occurs as transmission technologies spread, and as global standards make interchange of data easier (sometimes referred to as *interoperability*). This is reflected in the spread of *open systems*: systems that work even though they mix hardware from different vendors and software from different vendors. And it is reflected in *convergence*: the "erosion of boundaries" between digital services, between networks, and between technological platforms, all of which are increasingly integrated (Singh & Raja 2009).

- Complexity: applications are becoming more complex and *portals* and *middleware* are needed to integrate data and information from different information systems.

- Massive digitisation: as discussed further in Chapter 9, digitally held material now constitutes the majority of the world's data. This happens as it becomes easier and cheaper to digitise a wider variety of data, as increasing amounts of ICT come into use, and as the data that is available can be transferred to more people more quickly than ever before.

- Increasing importance of software compared to hardware: this change has taken place as hardware costs fall faster than software costs, and as software is increasingly recognised as the more important part of ICT in delivering development impact.

Personal computer (ICT4D 1.0). Reflecting the Box 2.3 trends, performance:cost ratio and portability of PCs are improving year-on-year, with laptops overtaking desktop models and with popularity of notebooks also. Nonetheless, PCs remain relatively rare – for example with an estimated 35 per cent household penetration rate in developing countries overall and only an 11 per cent household penetration rate in Africa in 2016 (ITU 2016). Because of this, while declining relative to private access models, public access points remain important. These take a number of forms:

- Kiosk: a single unit just consisting of an Internet-connected PC; see Figure 2.6. Sometimes, the kiosk may be attended by a human owner or helper.
- Telecentre: "a physical space that provides public access to information and communication technologies, notably the Internet, for educational, personal, social and economic development" (Reilly & Gomez 2001:1). Telecentres are often run by NGOs for non-commercial purposes.
- Cybercafé: commercial provision of Internet-connected PCs.
- Embedded: a public access space hosted by another organisation, such as a public library.

Perhaps surprisingly, a large number of those using these public access points have a PC with Internet access at home. They continue to use public access PCs for various reasons including: "better equipment, faster connections, access to infomediaries [explained below] and peers for needed help, and the sharing experience" (Sey et al. 2015:80).

Mobile (ICT4D 2.0): "Mobile communication has arguably had a bigger impact on humankind in a shorter period of time than any other invention in human history" (Minges 2012a:11). While the nature and size of mobile's

impact might be questioned, the rapidity of its diffusion cannot, driven by its simplicity, flexibility, low-cost and of course mobility. In 2005, for example, there were only 23 mobile subscriptions per 100 people in developing countries. By 2016, that had risen more than four-fold to 94 per 100 (ITU 2016). Care must be taken with these figures (Heeks 2009b):

Figure 2.6 A PC kiosk



Source: www.alamy.com

- A single statistic hides much beneath it – Botswana had more than 160 subscriptions per 100 in 2015; Chad had only 40 – and digging below national level will reveal more inequalities (see Section 2.6).

- Multiple and lapsed subscriptions mean these figures overestimate mobile's penetration, but conversely, shared use of mobiles means these figures underestimate the impact of the technology.

Care must also be taken with what we mean by "mobile" (Minges 2012a). The first type of mobile was a *basic phone* that could only be used for calls and text messages. Then came *feature phones* with added features like a calculator, light, camera, speaker, music player, voice recorder, and then also a basic and slow capability to access the Internet. Then came *smartphones* which were phones that incorporated PC-like features: their own operating system, their own software applications, and faster, better access to the Internet. And simultaneously emerged *tablets* which we could say are PCs with phone-like features: small size, touchscreens, intelligent voice interfaces, etc. Each succeeding generation brings more power and functions; but it also brings more resource requirements in terms of the money, skills, infrastructure, etc that it requires.

There is a danger that we over-emphasise the new generations of mobile technologies; for example, that we focus so much on smartphones that we forget the majority of developing country users have basic and feature phones. But there is also a danger that we under-emphasise the new generations of mobile technologies; for example, focusing on Internet-connected PCs when the majority of those in developing countries who access the Internet do so via mobile devices (Stork & Calandro 2014, Sam 2015).

Internet of Things ("ICT4D 3.0"?). As size:performance ratios for ICT continue to shrink, ICT can be embedded into increasing numbers of objects and places. Many of these can be understood as *sensors* which gather data on various aspects of their environment. These may be *dumb sensors* which just gather and transmit data (for example a device measuring rainfall or

temperature in a farmer's field), or *smart sensors* which can also make decisions (for example triggering irrigation of crops when the soil is measured as being too dry). We will look at some of the implications of the Internet of Things and at the idea of ICT4D 3.0 in Chapter 9.

This foundation will mainly be assessed in quantitative terms: for example, how many households own or have access to the particular ICT.

2.2.3. Software

Software represents the instructions that make hardware work, and it comes in two types. Applications software ("apps") does useful work by carrying out a particular task or application for the user. Systems software controls the basic internal operations of the ICT system, and it can be thought of as a "go-between" that sits between the hardware and the applications software. A core part of the systems software is the operating systems (Linux, Windows, iOS, Android, etc).

We can re-use the list of affordances in Chapter 1 to give some examples of apps:

- Information: a management information system giving details about current expenditure on a development project.
- Communication: email communicating between project stakeholders.

- Computation: a spreadsheet used to calculate return-on-investment predictions for the project.
- Creation: word processing used to generate key project documents.
- Transaction: e-commerce that enables items for the project to be bought online.
- Distribution: social media that shares news about the project with others.
- Collaboration: a wiki that enables project stakeholders to work together to create a store of knowledge about the project.

- Coordination: a workflow system that enables different processes in different parts of the project to be organised so that they work together.

The penetration of particular types of software – such as the proportion of the population using social media – is one fairly common measure of this foundation.

However, the main focus for ICT4D foundations has been less on these specific types of software, and more on application to particular development issues or sectors. Thus policy interventions (see Section 2.4) have sought to expand use of sectoral applications such as e-business, e-health, e-education and e-governance; all of which are also discussed in later chapters.

2.2.4. Data

All of the ICT4D foundations to date are empty shells until they have some specific data that fills them and makes them useful. The quantitative volume of data being produced is one way to measure readiness, but data is more often measured qualitatively. From the specificity of the data in an individual application up to the idea of a national "data infrastructure" for a whole country, we can judge data according to five criteria (developed from Heeks 2006a):

- Openness: the extent to which data is available and can be shared by users, applications, organisations, etc. As discussed in Chapter 9, openness is a growing trend, but much data remains secret or in non-digital form or in proprietary form that cannot readily be shared.

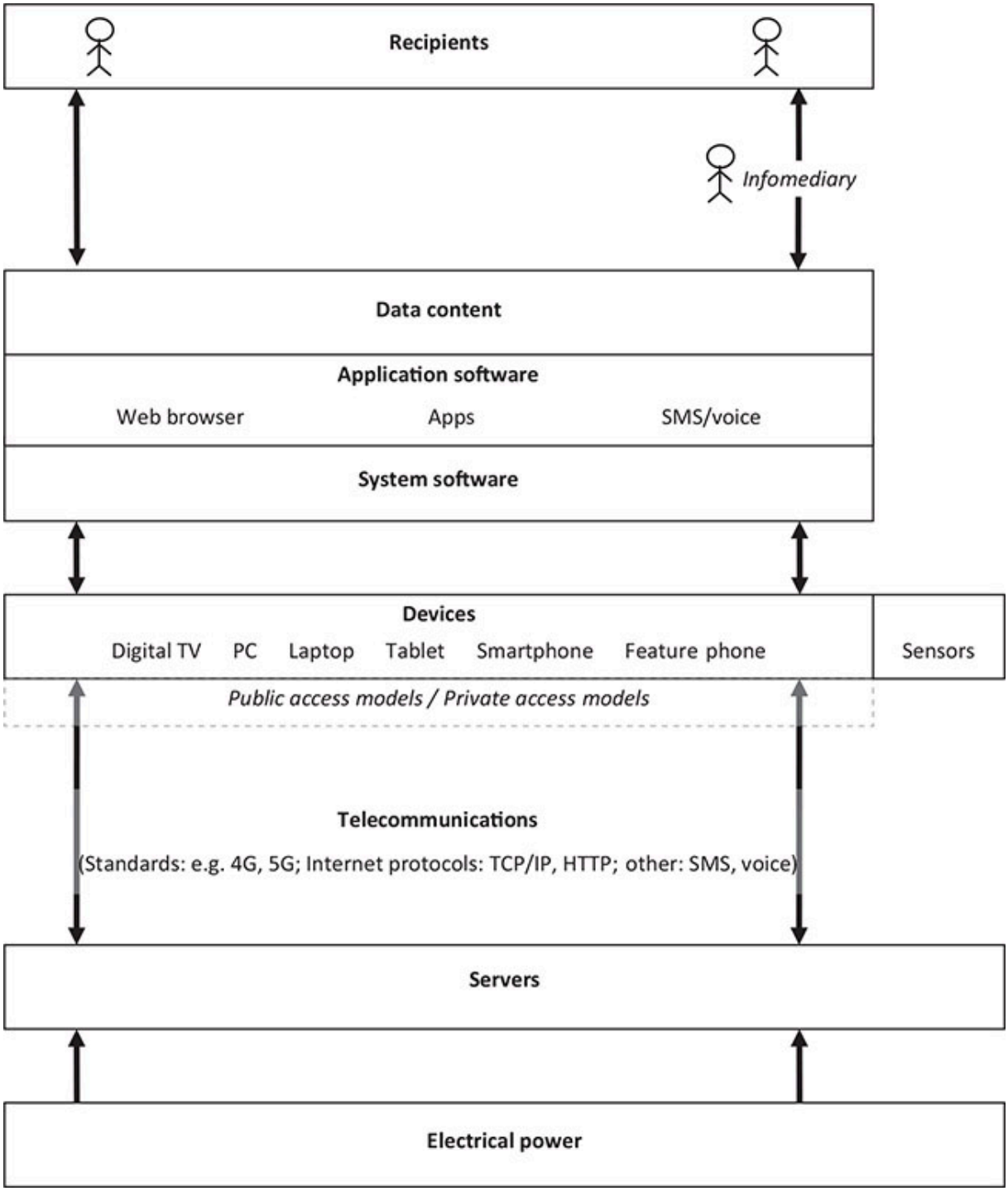
- Completeness: how much of a domain is covered by data in terms of both breadth and depth. At national level, countries' data infrastructures tend to start being populated most with entertainment and static data like news, but over time move towards user-generated and business-oriented data (el-Darwiche et al. 2015).

- Accuracy: the level of errors within the overall dataset. Judging data accuracy can be difficult and users often use a proxy measure instead; of how much they *trust* the source of the data.

- Relevance: the degree to which data is appropriate to the needs of users. A key aspect to this is *localisation* of data: is data related to the specific local context, or does it relate to matters outside that context. Another aspect will be the *timeliness* of the data: data which is old or infrequent is likely to be of less relevance.

- Appropriateness of presentation: the degree to which data is intelligible to recipients. For developing countries, a key aspect here may be the *form* of the data as text vs. audio-visual given the relatively high rates of illiteracy that exist, markedly in rural areas.

Figure 2.7 The technological architecture of ICT4D



You may note the number of times that users appear in this “OCARA” checklist, pointing to the fact that the core value of data (as explained in Chapter 1) is the

extent to which it can be processed into information that is useful to a recipient.

We can put this all together to expand Figure 2.3 and map the technological architecture of ICT4D (see Figure 2.7, developed from Heeks 2001 and Doerflinger & Gross 2011).

2.3. Human foundations of ICT4D

The technology described in the last section can, and increasingly will, undertake development processes without human intervention: that is the definition of smart ICT4D as in the example of automatic irrigation of dry farmland. However, for at least the medium term, ICT4D will mainly involve people and therefore there is a human foundation that is required if ICT4D is to work effectively.

As with technology, there needs to be a "human infrastructure" of ICT4D. This consists of two parts: a "demand side" dealing with human motivations, and a "supply side" dealing with human capabilities. We will now discuss each in turn.

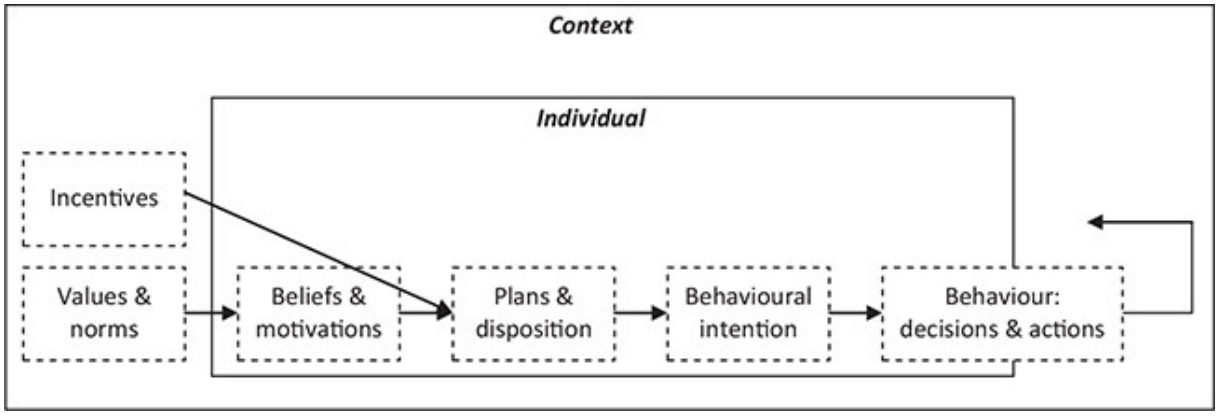
2.3.1. ICT4D motivations

By and large, the other foundations discussed in this chapter – technical infrastructure, human capabilities, institutions, finance – are *enablers*. That is, they can help the progress of ICT4D initiatives if they are present or constrain it if they are absent or in poor shape. But they are largely passive factors. To make ICT4D happen it requires impetus; it requires *drivers*. To use an analogy, all the other factors are like the components of a bicycle. But it just lies on the floor without a human who decides they want to go somewhere, to pick up the bicycle and start pedalling. To repeat the phrasing above, the other elements are largely supply side but we must also consider the demand side that creates a rationale and a use for that supply.

To understand the demand-side drivers for ICT4D, we can consider a basic motivational model; shown in Figure 2.8. This is a simplified version of the Technology Acceptance Model (Davis et al. 1989) adapted to incorporate more explicit consideration of motivation (e.g. Venkatesh et al. 2002).

In more detail, we can explore the components of the model which help explain the role of a number of the elements in the ICT4D value chain:

Figure 2.8 Model of human motivation



- Values and norms: alongside the formal institutions discussed in Section 2.4 – the strategies of stakeholder organisations, the policy and regulatory environment – there are "informal institutions". These are the values and norms of the prevailing culture, which may operate at different levels, may be dynamic, and are not necessarily heterogeneous. They would include broad elements like national culture but also more specific factors like demonstrations of leadership and political support for an ICT4D initiative. For example, the presence of positive portrayals of ICTs as an aspirational good in popular culture in India has shaped views of potential users (Pal 2010) whereas, in the same country, the absence of clear expressions of leadership commitment to a set of e-government initiatives led to their failure (Kumar & Best 2006).

- Incentives: these would-be situation-specific "extrinsic motivations" that shape behavioural attitudes, though filtered through the lens of existing beliefs and motivations. These could be relatively concrete incentives such as money, or more abstract such as recognition or gratitude of an important individual, or perceived competition from others. As an example, the lack of financial incentives is seen as a key constraint to development of digital content for low-income users in developing countries (Enriquez et al. 2015).

- Beliefs and motivations: these cover background elements such as a person's general views about ICTs, but of core interest would be a person's "intrinsic motivations". These are the internal drives – both broader perceived visions and hopes and aspirations for the future (Heeks & Krishna 2016), and narrower perceived wants and needs and urges (Patel 2010) – that shape their behaviour including what goals are valuable or not, and their self-perceived ability to achieve those goals. For example, examination of inequalities in use of ICTs in schools in south India showed the importance of what Van Dijk (2006) calls "motivational access": a number of children – girls particularly – were "want nots" rather than "have nots" who could access ICTs but were not motivated to do so (Venkataswamy 2015).

- Plans and disposition: this represents the translation of the background motivations into specific goals and objectives of relevance to ICT4D, plus attitude towards the goals and objectives of others. One would also include personal emotional frame of mind, understanding this covers more persistent and more volatile components. And this would incorporate specific attitudinal dispositions towards a particular ICT4D initiative: from the Technology Acceptance Model, two key factors would be the perceived usefulness and ease of use of the ICT. For instance, the perceived utility of telecentres in helping to find market prices and to send personal communications, and the perceived helpfulness of staff in facilitating use of technology are both correlated with higher use of telecentres (Pick et al. 2014).

- Behavioural intention and behaviour: the former is what the person intends to do in relation to the ICT4D initiative, and the latter is the decisions and actions they undertake. These feed back into the context and into all the other individual elements so that actions shape beliefs and motivations and plans (Bandura 1986). For example, increasing use of the Internet is – not surprisingly – seen to increase users' perceived digital self-efficacy: their self-confidence in their ability to use ICTs (Khasawneh 2009).

2.3.2. ICT4D capabilities

The ICT4D human capability infrastructure consists of people plus a set of organisational arrangements which can provide necessary skills and knowledge. The latter will include schools, colleges, universities and also digital

arrangements such as access to online learning, and informal networks that can spread competencies. But what type of skills and knowledge are required?

A good way to understand this – material below adapted from Heeks (2014d) – is via the notion of the *roles* that people play through ICTs; a role being both who you are and what you do. Developing from the concept of roles within the workplace (Biddle 1986, Huvila 2008), we can define a role as a set of tasks and behaviours that are performed by an individual. Those roles can be represented as a ladder, as shown in Figure 2.9. In simple terms, climbing the ladder could be read as a greater intensity of engagement with the technology. It is also a ladder of technological capability; each step reflecting higher-level competencies (skills, knowledge and perhaps also attitudes) that are required for this type of ICT use but which are also created by this type of ICT use.

As shown in Figure 2.9, the roles can be broken down into three main areas.

Digital non-user

In these roles, developing country citizens are not direct users of either the technology or the information and services it carries:

- Delinked: there is no obvious connection between particular ICT applications and the individual. An example might be applications within a large corporation in the country which does not produce goods or services of relevance to the individual.
- Indirect: this represents a category of ICT applications in organisations in which the individual has no direct connection with the ICT, but in which the ICT application does deliver some benefit. An example would be use of ICTs to provide fair trade information to consumers in the global North which then drives better working conditions for farm workers in the global South.

Digital consumer

In these roles, individuals in developing countries make direct use of either the technology or the information and services it carries:

- Intermediated consumer: the individual benefits from the outputs of ICTs but they do not directly use the ICTs; instead someone else – an intermediary (see below) – does that on their behalf. An example would be a farmer in a government service centre where the public servant uses the computer to access e-government services for the farmer.

- Passive consumer: a role in which there is direct use of the ICTs but just to receive "broadcast" information; for example, a pregnant woman reading a text message on pre-natal health sent by her local paramedic.

- Active user: digitally enabled interaction and transaction with socio-economic contacts; for example, the remittance of "mobile money" from urban migrants to rural relatives.

Digital producer

In these roles, individuals in developing countries make direct use of ICTs to create something digital:

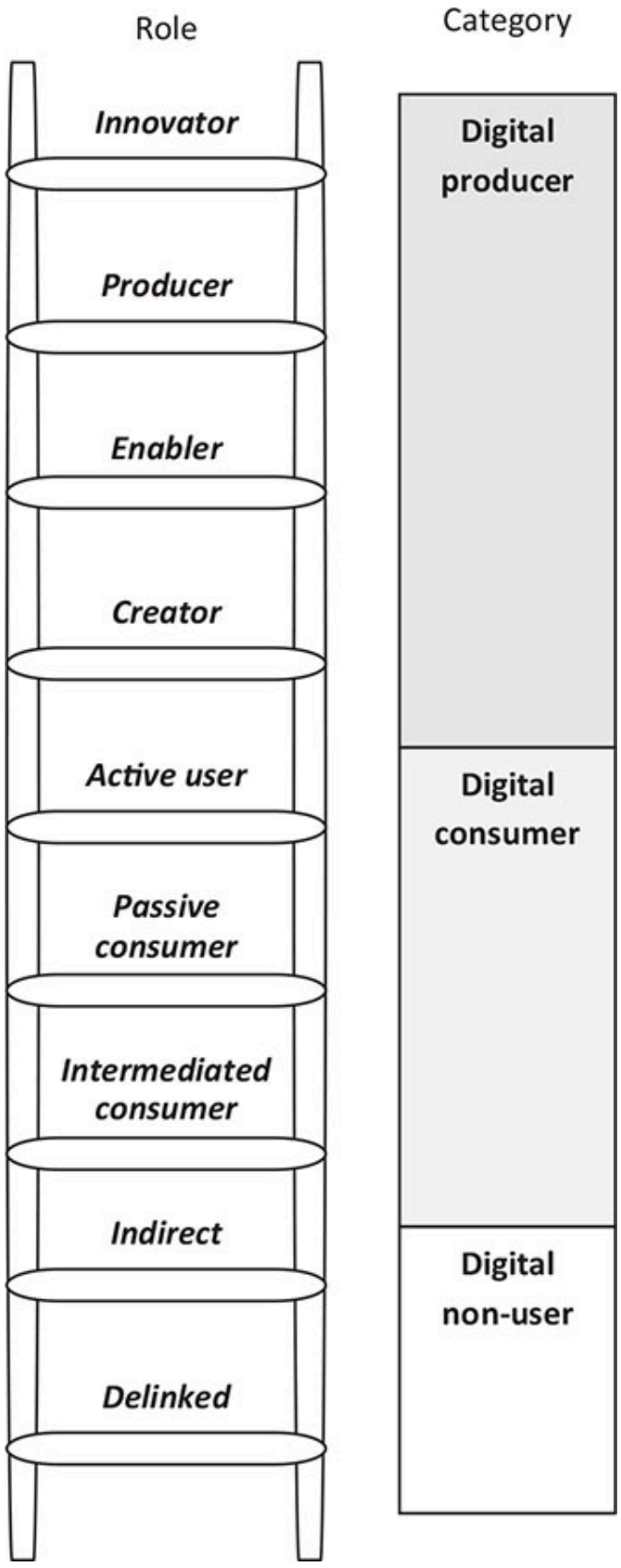
- Creator: creation of enduring digital content. Examples include a musician recording and sharing their work as mp3 files or someone employed to undertake data entry.

- Enabler: provision of digital goods or services that assist others in making use of ICTs. Examples include the intermediaries noted above, ICT trainers, and also those involved in the retailing and distribution of ICTs.

- Producer: creation of digital goods and services. Examples include individuals who assemble and maintain hardware such as PCs or phones, and programmers who write software code.

- Innovator: development of new ICTs. This could range from minor adaptations such as the “street hacks” that alter mobiles to accept dual SIMs, through design of new software applications, up to creation of whole new digital platforms.

Figure 2.9 Ladder of ICT-related roles


Role
Category
Innovator
Producer
Enabler
Creator
Active user
Passive consumer
Intermediated consumer
Indirect
Delinked
Digital producer
Digital consumer
Digital non-user

Moving up the ladder not only represents higher-level engagement with ICT and higher-level competencies, it also represents greater value from and control over ICTs. A key task for ICT4D institutions will therefore be to work out how to enable the emergence of higher-level roles, whether at the level of individual projects or whole nations.

I'll look at three issues arising from ever-higher steps on the ladder: digital literacy, infomediation and technology appropriation.

Digital literacy

In Chapter 1, we saw that individuals cannot just turn data into information: they require knowledge in order to do that, and we can call that knowledge, "literacy". Though basic literacy levels are high and growing, many are excluded from the majority of ICT applications because they are illiterate: more than 750m adults worldwide – most in Africa and South / West Asia – cannot read or write (UNESCO 2016). In the context of ICTs, though, we can go further and talk of "digital literacy". In simple terms, we understand literacy just as being able to read. But if you think more about it, being able to read breaks down into elements – for a book, you must be able to know where to find books, read the text on the page, understand that text and, unless just for entertainment, make use of that text.

The same is true of digital literacy, which we can divide into three key areas of knowledge, summarised in Figure 2.10 via a simplified version of the information value chain from Chapter 1:

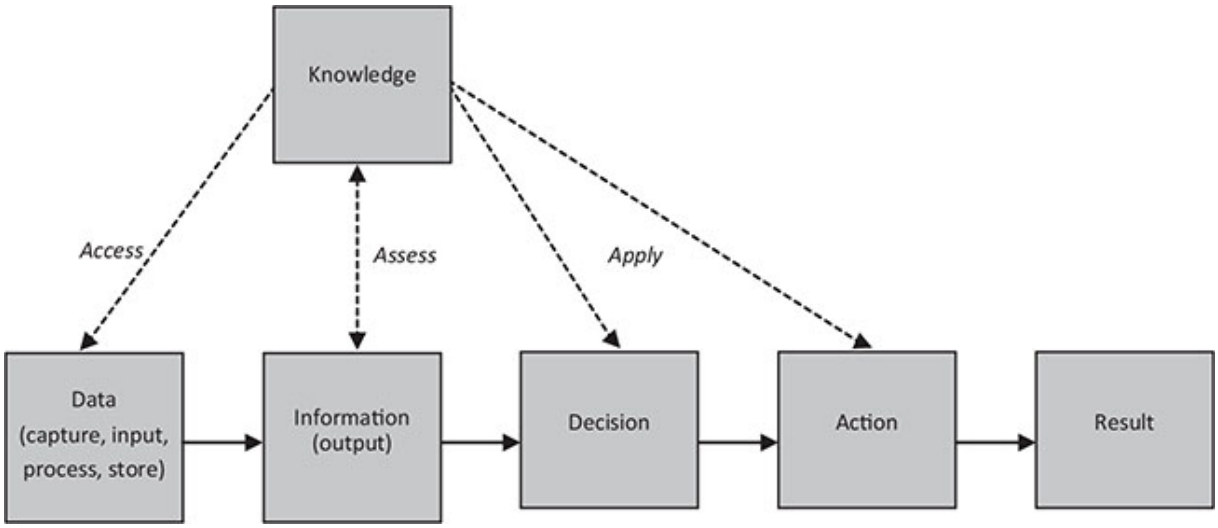
- Access: users must have knowledge of how to access digital data. This will include knowledge of how to use ICTs including features such as search. But it will also include meta-knowledge, such as knowing what data is available online to be searched for.

- Assess: users must have knowledge of how to assess digital data. Users must be able to understand the data they access: if text-based, then, they must be able to read the language of the text. But there is a deeper assessment of the

qualities of the data along the lines of OCARA presented above: how relevant is the data to their needs; how accurate is it; etc.

- Apply: users must have knowledge of how to apply digital data – users must know how to make use of information in decisions and know how to translate those decisions into actions. For example, a farmer might be able to access and understand a weather forecast they find online, but it will be of no value unless they know how to apply that forecast to their agricultural decisions and actions around planting, managing and harvesting their crops.

Figure 2.10 The role of knowledge in the information value chain



This notion of digital literacy has a number of implications. For instance, in planning an ICT4D training programme, it would not be sufficient to just impart skills; one must also develop knowledge. And it would not be sufficient just to develop knowledge about one aspect of digital literacy – say, just knowledge of accessing data online – one must develop knowledge in all three areas. Likewise, an ICT4D initiative overall would need to understand what digital literacy users already have; what digital literacy – access, assessment and application – they would need for the ICT4D to work effectively; and how any knowledge gaps would be filled. As another example, the particular profile of digital literacy in developing countries helps to explain the value and growing use of local language and audio-visual interfaces and materials (Cai et al. 2015, Khurana et al. 2015).

But the information value chain model shows these are not enough on their own to turn data into development results.

Infomediation

One of the key roles identified above was that of intermediaries. Since they intermediate between an individual and one or more of the steps of the information value chain, they are often called "infomediaries". They could be organisations, such as agencies that make open datasets accessible and understandable to the general public (Van Schalkwyk et al. 2016). But more often they are understood as individuals. An example would be a telekiosk owner who accesses information and services on behalf of a client who does not know how to use ICTs (Gomez 2014), or an agricultural extension officer who translates online resources for the benefit of low-literacy farmers (Ninsiima 2015). Their role could be permanent, or could be temporary and developmental: for instance, showing a client how to undertake a digital task so they can do it by themselves the next time.

In the examples given above, infomediaries have been formal roles but they can also be informal: the child who searches online to help their parents; the friend who fixes a broken printer; the neighbour who passes on contents of a text message (Sambasivan & Smyth 2010). Whether formal or informal, infomediaries are frequently shown to have a vital role in ICT4D, meaning they need to be recognised – perhaps also nurtured – in the process of ICT4D planning and implementation.

Digital literacy means that what you know determines how ICT can help you developmentally. Infomediation means that who you know – your social capital and contacts – determines how ICT can help you developmentally (ibid.). Those who have infomediaries within their social network are more likely to benefit from ICTs than those who do not.

Technology appropriation

The design–reality gap model in Chapter 1 argued that "a gap may exist between the design of an ICT4D application and the contextual realities into which it is introduced. The larger that gap, the greater the risk that the ICT4D application will fail". Central to avoiding such failures is greater local appropriation of ICTs in developing countries.

Appropriation means to take psychological ownership and control over the technology by changing it from technology-as-designed to technology-in-use that meets the users' needs (FAO 2003, Gaskin & Lyytinen 2012). This will always require some form of adaptation, though it may be adaptation of current reality, adaptation of technology design or adaptation of the interface between the two. As an example, mobile money agents in Kenya help users appropriate mobile phones into their lives by showing them how to use mobiles in specific ways that address their particular needs and context (Foster & Heeks 2013a). For instance, they explain "to low-income customers how to use 'beeping' – calling a contact at no cost by just registering a missed call – in order to get a call back when out of airtime" (ibid.:344). Such adaptation can require higher-level roles: one might place "adapter" as somewhere between enabler and producer on the Figure 2.9 role ladder.

This relates to appropriation of technology by individual or group users. But we can also think of appropriation at the national level: countries taking more ownership and control of ICTs. Why would they wish to do this? Mainly to capture more of the economic benefits of ICTs.

A very sweeping generalisation would say that the lower ladder roles pay the costs of ICT while the higher roles reap the benefits. This greatly over-simplifies, but it does help explain why some have argued that ICT is a tool of dependency (see Chapter 1), helping transfer income from the poor global South to the rich global North (Heeks & Kenny 2002). This happens because the majority of highest-level roles (innovators, producers) are in the global North, while the majority of people in the global South occupy lowest-level roles.

Whether we consider appropriation at individual, group or national level, the implications are always the same: the need to drive development of higher-level roles. One problem, though, has been too many projects and policies stuck in an ICT4D 1.0 mindset: focused on developing digital consumer not digital producer

roles. There needs to be greater recognition that digital producer capabilities are a foundation for future ICT4D in the global South.

2.4. Institutional foundations of ICT4D

The word "institution" has two rather different meanings. In common language, we tend to use institution as a synonym for "organisation", meaning some formal or informal collectivity. For a particular ICT4D initiative, we can see these as being equivalent to the stakeholders: those who may significantly affect or be significantly affected by the initiative.

But, arising from late twentieth-century institutional theory ("neo-institutionalism"), there is a different definition: "Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" (North 1990:3). These can also be divided into formal and informal constraints.

On this basis, we can divide the institutional foundations of ICT4D into a 2 × 2 matrix, as shown in Figure 2.11, which can be conceived as operating at various levels: community, regional, national and global. All four types of institution at all four levels matter to ICT4D, but in the following discussion we will focus largely on the formal side of the matrix; looking at ICT4D-relevant organisations and then policies.

Figure 2.11 ICT4D institutions

	Formal	*Informal*
Institutions as stakeholders	Established organisations: government agencies, NGOs, private firms	Affiliations including affiliations of identity: community, "users", social networks
Institutions as behavioural constraints	Official rules: laws, policies, strategies	Unofficial conventions: norms, values (culture)

2.4.1. ICT4D stakeholders

Traditional ICT4D stakeholders

Most widely associated with ICT4D are three stakeholder groups which will plunge us headlong into death-by-abbreviation:

Development agencies. This covers the multilateral development agencies that fall under the umbrella of the UN system (see Figure 2.12). Chief among these are:

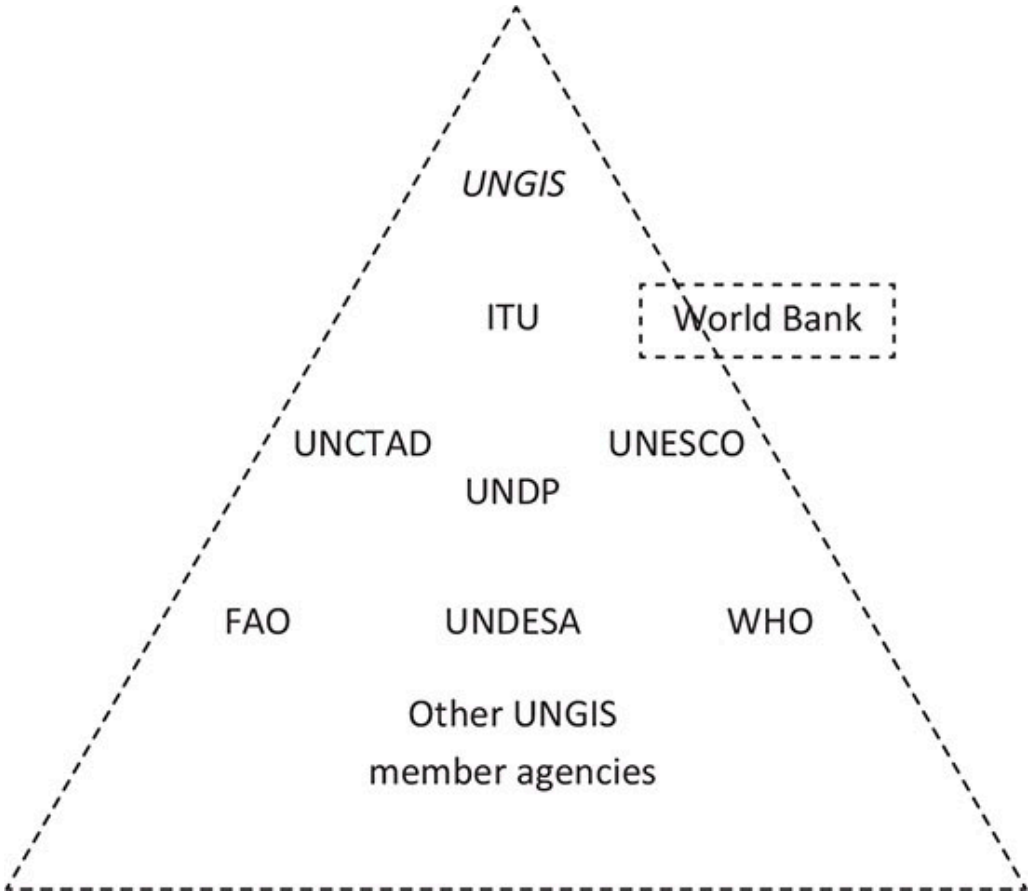
- World Bank: for some time during the late twentieth and early twenty-first centuries, the World Bank was a leading actor in ICT4D with its large Global ICT department and quasi-autonomous infoDev programme funding dozens of ICT4D projects from 1995. Dissolution of the department and infoDev's drift into innovation, entrepreneurship and climate change have meant a lesser, though still important, role during the 2010s.

- ITU: the lead UN agency with responsibilities for telecommunications, this has expanded somewhat to other digital technologies but always retaining a strong focus on technical infrastructure rather than other aspects of ICT4D. It is particularly known for its ICT4D statistics available via "ICT-Eye" and the work of its development arm, ITU-D.

- UNGIS lead agencies: the UN Group on the Information Society (UNGIS) is the umbrella group for ICT4D activity since 2006. Alongside the ITU, three other UN bodies play a lead role: UNCTAD (UN Conference on Trade and Development); UNDP (UN Development Programme); UNESCO (UN Educational, Scientific and Cultural Organization). Each of these has an arm or section dealing with different aspects of ICT4D: UNCTAD with e-business and e-commerce; UNDP with regional ICT4D initiatives; UNESCO with e-learning, e-science, and ethical and cultural ICT4D issues. An overall summary would be that UNGIS as a collective body has been much less than the sum of its parts.

- WSIS action line agencies: as explained further in Box 2.4, key events in the ICT4D timeline were the two World Summits on the Information Society (WSIS). Responsibility for the follow-up from these rests with the four main UNGIS agencies and three others who have been active in ICT4D: FAO (Food and Agriculture Organization) on e-agriculture; UNDESA (UN Department of Economic and Social Affairs) on e-government; and WHO (World Health Organization) on e-health.

Figure 2.12 Significant ICT4D actors within the UN system



Box 2.4

Key ICT4D initiatives, events and publications

Key events (see Figure 2.13 timeline) include:

- The Information Society and Development (ISAD) 1996 conference, held in Midrand, South Africa. Chaired by Nelson Mandela, this was the first major global policy/practice conference for ICT4D.

- Global Knowledge Partnership (GKP) 1997 conference, held in Toronto, Canada. This had major development agency and private sector involvement, with a particular focus on ICT infrastructure.

- World Summit on the Information Society (2003 in Geneva, 2005 in Tunis) are the two largest ICT4D events to date, with many thousands of attendees from all sectors. In summary, WSIS "raised awareness of the importance of ICT4D and laid out important key principles for the implementation of strategies to use ICTs to help achieve development objectives, but it failed to agree on substantial new funding mechanisms [a proposed Digital Solidarity Fund], and got bogged down in somewhat acrimonious debates about Internet governance" (Unwin 2009:144). It did succeed in creating the Internet Governance Forum, which still acts as a locus for multi-stakeholder discussion, though it did not take on any formal oversight role of ICANN, which administers key operational elements of the Internet. And it created the WSIS action lines: C1 (The role of public governance authorities and all stakeholders in the promotion of ICTs for development); C2 (Information and communication infrastructure); C3 (Access to information and knowledge); C4 (Capacity building); C5 (Building confidence and security in the use of ICTs); C6 (Enabling environment); C7 (ICT applications: e-government, e-business, e-learning, e-health, e-employment, e-environment, e-agriculture, e-science); C8 (Cultural diversity and identity, linguistic diversity and local content); C9 (Media); C10 (Ethical dimensions of the information society); and C11 (International and regional cooperation).

- WSIS+10 Events: though nowhere near as large-scale as the original summits, a series of meetings was held during 2015 reviewing progress on ICT4D, and culminating in a two-day high-level meeting of the UN General Assembly in December 2015, which largely echoed the statements of principle emerging from the earlier WSIS summits.

Key multi-stakeholder initiatives include:

- G8 Digital Opportunities Taskforce (DOTForce): set up in the wake of the G8 summit in Okinawa, this can be seen as helping set the policy agenda and modus operandi for other such initiatives, including action plans, facilitation of other initiatives and funding of pilot projects. Its work – and also that of the somewhat lower-profile Global Digital Divide Initiative of the World Economic Forum – was handed on in 2001/2002 to the UN ICT Task Force which helped provide a continuing focal point for discussion and

agenda-setting. In turn, its work was handed over in 2006 to the UN Global Alliance for ICT and Development (UN-GAID) which struggled to achieve anything much at all, and was quietly put to sleep a few years later.

- Global Knowledge Partnership: a partnership mainly of ICT4D development agencies and NGOs, which hosted a series of conferences and workshops, and funded some pilot projects. Its foundational conference in 1997 was the most important; those held in Kuala Lumpur in 2000 and 2007 less so, and the organisation largely ceased to function in 2009.

Key early publications from ICT4D's "pre-history" could be cited from many of the cognate disciplines identified in Figure 1.6 in Chapter 1, but examples include:

- From communication-for-development, *Mass Media and National Development: The Role of Information in the Developing Countries* was an example of work from a modernisation perspective that linked communication of information to human behaviour change (Schramm 1964).

- From computing-for-development, *Automation in Developing Countries* is one of a number of reports that emerged in the 1960s and 1970s providing policy recommendations on computers in developing countries (ILO 1972).

- From telecommunications-for-development, *The Maitland Report* – formally titled, "The Missing Link: Report of the Independent Commission for World Wide Telecommunications Development" – was the result of a two-year commission set up by the ITU and chaired by Sir Donald Maitland, reporting in 1984. Where earlier reports had looked at the IT of ICT, this was the first major report to consider the role and policy agenda for the CT, and thus laid the foundations for the later interest that would emerge during the 1990s in ICT as the Internet started to spread (ITU 1984).

- From information systems in developing countries, *Information Technology in Developing Countries* marked the origins of academic work in this domain (Bhatnagar & Bjorn-Andersen 1990).

The main period covered within this book is book-ended by two major publications:

- *Knowledge for Development*: the 1998/99 World Development Report from the World Bank, which – following the models at the start of Chapter 1 – argued that the key factor of development through which data, information and ICTs should be understood was knowledge (WB 1999).

- *Digital Dividends*: the 2016 World Development Report, which reviewed evidence on the impact of ICTs on development – both pros and cons – and identified the complementary inputs needed to maximise positive impact (WB 2016).

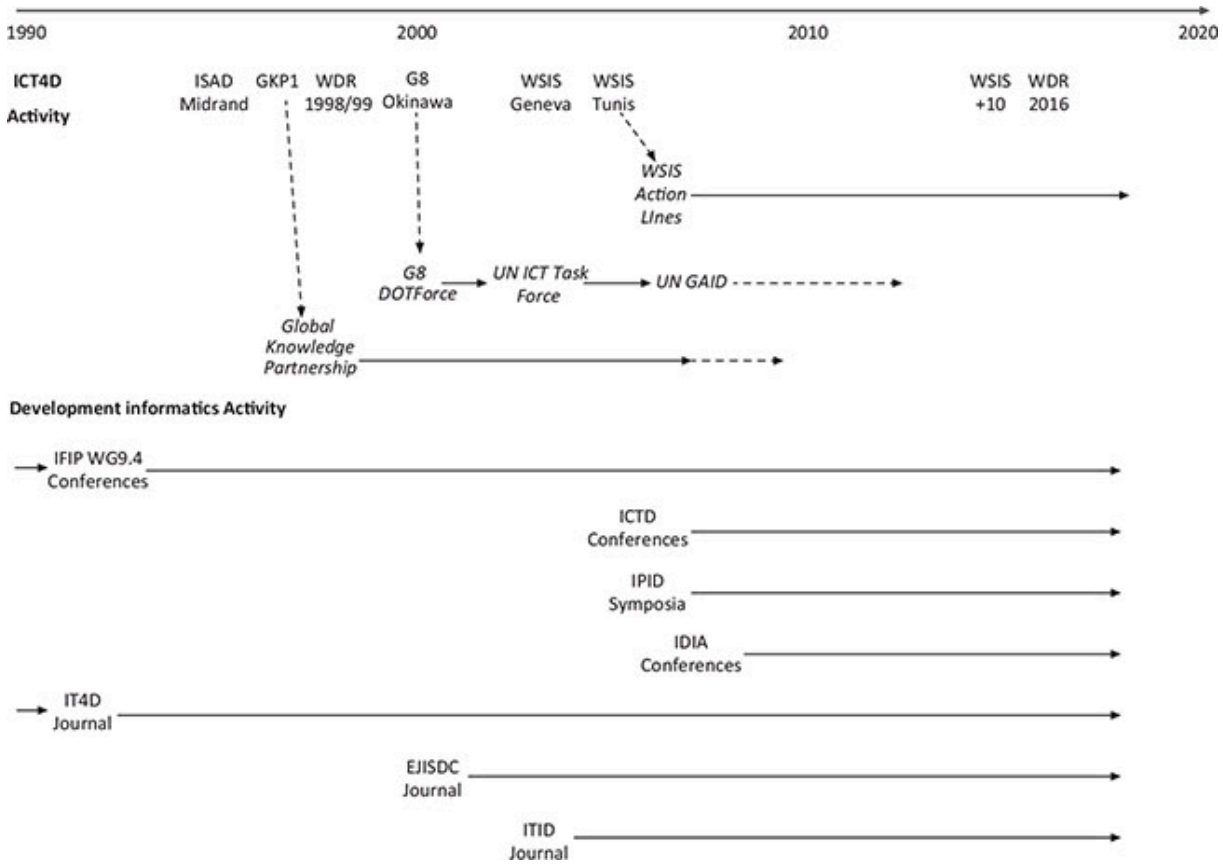
Source: developed from Unwin (2009) and Fuchs (2013)

The development agency stakeholder group also covers bilateral development agencies; that is, those emanating from an individual country. Particularly active in ICT4D have been:

- Canada's International Development Research Centre (IDRC). Not actually Canada's bilateral agency but a government-funded entity that has been foundational to ICT4D. Key global initiatives include Bellanet which coordinated ICT initiatives among donors from the 1990s and Telecentre.org which has provided support for telecentres since the mid-2000s. There have also been regional initiatives: PAN-Asia, PAN-Americas and Acacia (Africa).

- The Swiss Agency for Development Cooperation (SDC) was especially active in ICT4D during the first decade of the twenty-first century. It was instrumental in setting up the Global Knowledge Partnership which, as noted above, was a multi-stakeholder network that for some time during the 2000s was a key ICT4D hub.

Figure 2.13 ICT4D and development informatics timeline



• Nordics: all four of the Nordic bilaterals – DANIDA (Danish development cooperation), NORAD (Norwegian Agency for Development Cooperation), SIDA (Swedish International Development Cooperation Agency) and Finland's Ministry of Foreign Affairs – have been strongly supportive of ICT4D. Of especial note is Sweden's SPIDER – the Swedish Program for ICT in Developing Regions – that has worked mainly on use of ICTs for socio-political development.

• The UK Department for International Development (DFID) was, like many of the agencies here, significantly involved in ICT4D investments and activity during the early 2000s, but then faded away in the years after WSIS 2005.

• The US Agency for International Development (USAID) drove foundational telecommunications and policy programmes from the 1990s such as the Leland Initiative, and has particularly continued to work on development of ICT infrastructure.

One common pattern seen in these agencies is that initially they "sidestreamed" ICT4D (Heeks 2014b). That is, they created a specialist unit dealing solely with the issue, typically around the turn of the century. But during the latter part of the 2000s – as ICTs started to diffuse far more into

development activity, and as ICT4D 1.0 gave way to ICT4D 2.0 – they started to "mainstream". This meant dissolving their specialist units and assuming ICT would be an integral part of all activities. This was positive in helping avoid earlier techno-centric views that saw ICTs as a development end in themselves. But it was negative in that these agencies lost thought leadership, expertise and oversight of ICT4D. Without a small core of ICT4D expertise, operational lessons are continuously and wastefully being re-learned, there is no strategic perspective on ICT innovations or the technology's cross-cutting role, and there is no vision for the emergence of "Development 2.0" (see Chapter 9).

Government agencies. Although digital ICTs have been around since at least the 1940s, it was only during the 1990s – around the start of ICT4D 1.0 – that most developing countries began to consider the need for a high-level agency dealing just with ICT policy issues. While ICT was initially seen as a separate policy area, convergence and other trends discussed in Box 2.3 have steadily brought together a number of once-disparate policy areas. Today, Ministries usually cover responsibilities for up to four different but related areas:

- Information: often with historical roots in propaganda, this covers development and dissemination of government information, public communication (e.g. public health campaigns), and may extend to responsibilities for government data and information services such as libraries.

- Media: this covers policies on the mass media – newspapers, radio, TV – including broadcast and ownership policies, and oversight or even ownership of national broadcasters and other media.

- Telecommunications: often with historical roots in the postal service and then telephony, this covers responsibility for the telecommunications infrastructure (including mobile and broadband) and phone operators.

- ICT: the content of ICT4D policy is discussed later but it can cover development of the technological and human foundations discussed earlier, application areas such as e-government or e-business discussed in later chapters, development of the ICT sector, and ICT-specific policies such as cybersecurity.

History and politics often determine the name of the ministry that takes responsibility for ICT, with a wide variety of variants that mix a number of set terms in various ways, often with slightly different spellings. Some countries specifically use ICT, so there are Ministries of Information and Communication Technology (e.g. Namibia, Thailand, Uganda) and Ministries of Communication and Information Technology (e.g. Afghanistan, Egypt, India). There are ministry names with various combinations of the four areas above, often with Broadcasting or Communications added somewhere; and there are combinations with additional responsibility areas – Transport for those looking to combine infrastructural responsibilities; Culture for those looking to combine creative sectors; Science for those seeing ICT as part of overall science and technology.

Non-governmental organisations. With governments sometimes slow to act or out of favour with donors, NGOs have played an important role in driving ICT4D forward, especially in areas – such as the whole domain during much of the ICT4D 1.0 phase – into which the private sector has been hesitant to invest. Some were international with partners in multiple developing countries: the Dutch *International Institute for Communication and Development* was particularly active in sectoral ICT4D projects such as e-agriculture and e-health, and the *Association for Progressive Communications* has worked especially on more ICT rights- and policy-oriented issues such as ICTs and gender, and ICT access. Others have been more national in focus, such as *IT for Change* which has developed its wider advocacy work from an in-depth engagement in ICT projects in south India. Alongside these ICT4D-focused NGOs, many others have ICT4D programmes or projects. A number of international NGOs with relevant activity collaborate via *NetHope*, which has focused significantly on use of ICTs in disaster response. Many of these have been involved in action research, and therefore overlap with development informatics research stakeholders (see Box 2.5).

Box 2.5

Development informatics research stakeholders

Alongside ICT4D policy and practice stakeholders, there are also stakeholders working in the related research field of development informatics (see Chapter 1). As noted, there will be overlaps since many ICT4D stakeholders undertake action research themselves, or commission research on their projects such as impact assessments. Looking at the development informatics field, three types of stakeholder can be identified:

- Research units: these may be academic groups such as the author's own Centre for Development Informatics at the University of Manchester; may be non-governmental organisations: all the NGOs mentioned earlier have research components to their work; or may be private sector such as Microsoft Research's Technology for Emerging Markets group.

- Professional associations: the main group here is the IFIP Working Group 9.4, "Social Implications of Computers in Developing Countries", which has been holding regular conferences since 1988. The International Development Informatics Association has held annual conferences since 2007, and – though not a professional association – the ICTD group's conferences, beginning in 2006, are also key points of knowledge-building. Finally, there is IPID, the international network for postgraduate students in the area of ICT4D which has held annual symposia since 2006.

- Journals: a slightly unusual type of stakeholder but most clearly represented through their editors and editorial boards. Even more than the conferences, they provide a nodal point for aggregation of research knowledge about ICT4D. Start dates for the three main development informatics journals (Heeks 2010d) – *Information Technology for Development* (1986), *The Electronic Journal of Information Systems in Developing Countries* (2000) and *Information Technologies and International Development* (2003) – are shown in the Figure 2.13 timeline, alongside conference details.

Mention should also be made of research programmes – funded collections of research projects that bring together groups of development informatics researchers – such as UK DFID's "Building Digital Opportunities"

programme and Canadian IDRC's "Strengthening Information Society Research Capacity Alliance" programme.

Emerging ICT4D stakeholders

Development and government agencies and NGOs continue to play a key role in ICT4D. But other stakeholders have also been important, particularly from the mid-2000s, entering the ICT4D 2.0 phase (Heeks 2009a) (see Figure 2.14):

- Private firms: non-profit agencies dominated the early days of ICT4D because they were "ahead of the market": taking ICT into developing country sectors and locations that private sector firms saw as outside their scope. But privatisation, deregulation and realisation that the poor can find money to pay for ICT steadily changed that during the twenty-first century. The private sector is now central to ICT4D. Large firms more often than not provide the technological foundations: telecommunications, hardware, software, data systems and sometimes power. Private sector providers are widespread in ICT training. And at the grassroots, ICT micro-enterprises are common: for example, for-profit cybercafés long ago became more widespread than non-profit telecentres.

- Hybrid organisations: a growing number of ICT4D actors are hybrids that straddle the worlds of commerce and development. That combination is the essence of social enterprises, which come in many varieties of ownership and relationship to profit, but which seek to combine in some way private sector processes with developmental ideals. An example is Sulá Batsú, a self-managed cooperative that uses ICTs to promote citizen and community development in Costa Rica. ICT4D philanthropic foundations are another type of hybrid: often arms of large ICT firms that draw on the resources of those firms to promote use of ICTs in development. Core examples include Facebook's Internet.org, Microsoft Philanthropies and – on a collective basis – the GSMA Foundation. Those with some ICT4D involvement include the Gates Foundation and Google.org.

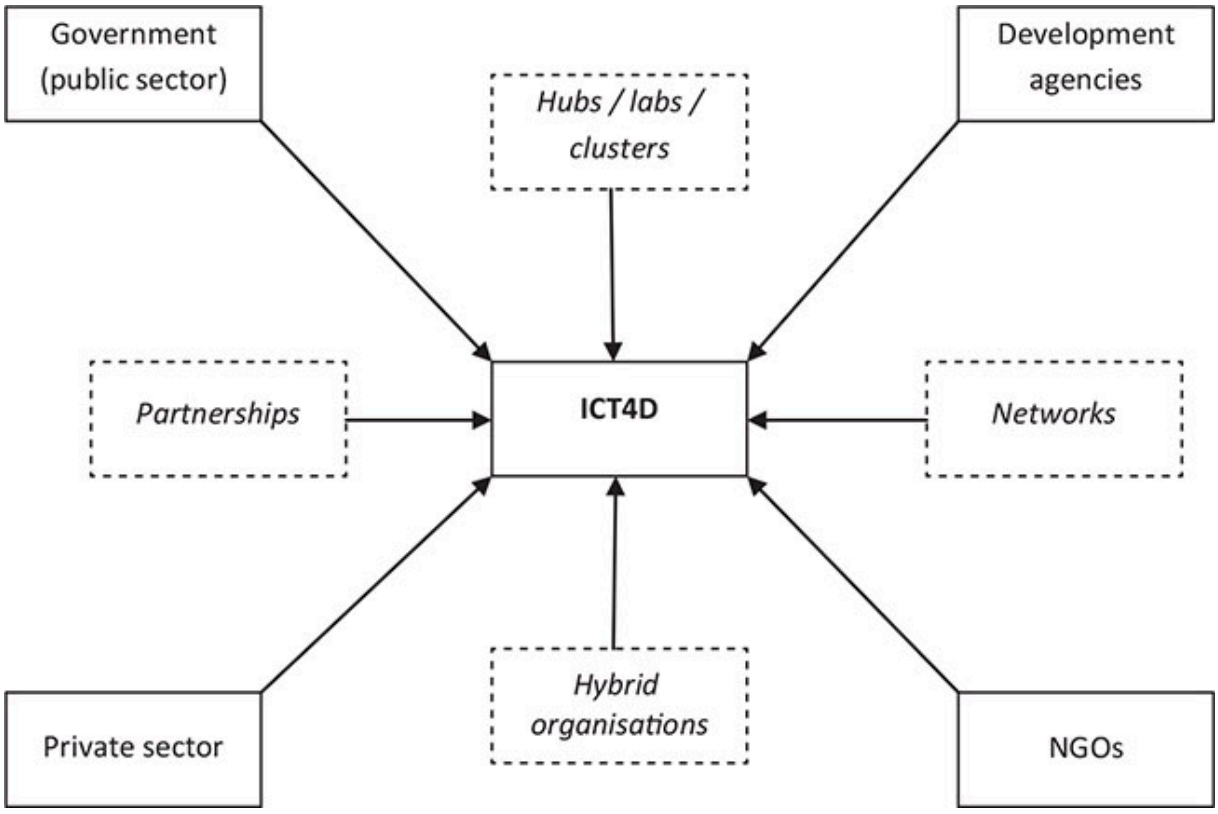
- Partnerships: partnerships are a taken-for-granted part of development, including ICT4D, but have only really flourished during the twenty-first century. Early multi-stakeholder partnerships such as the Global Knowledge Partnership and the UN ICT Task Force provided a model of bringing together private, public and civil society actors, which was then reproduced; for example, in many of the activities related to WSIS and beyond. Multi-stakeholder partnerships have worked well in the field where they integrate complementary resources and help all partners achieve their goals; but less well where they lack trust, are unable to align interests and spend their energies on addressing these tensions (Greener 2004, Geldof et al. 2011). Public–private partnerships have also expanded, seeking to bring together – in stereotypical terms – the reach and power of the public sector with the resources and dynamism of the private sector. These can be relatively symmetrical, such as the agreement between UNESCO and Microsoft to promote use of ICTs in education and community development (Barla 2014). Or they can be relatively asymmetrical, such as the roll-out of ICT-enabled "information and service centres" in Bangladesh; a partnership between the Prime Minister's Office and thousands of individual entrepreneurs who would run the centres with the support of local government (Rahman 2016). Public–private partnerships are also a type of hybrid organisation and similarly face the challenge of trying to steer between the tensions of commercial vs. welfare logics.

- Networks: appropriately, digital technology has enabled the emergence of virtual networks in the ICT4D field. Some of these – such as various Facebook and LinkedIn ICT4D groups – are quite loose communities of practice that rarely provide the basis for aggregation of knowledge and expertise. Others are more purposively created communities of practice with a specific focus and support framework for knowledge-building, such as those created by the International Institute for Communication and Development (Hulsebosch et al. 2006). Others still are more action- than knowledge-oriented, such as UN Online Volunteering which allows individuals anywhere to make virtual contributions to ICT4D and other development projects.

- Hubs/labs/clusters: the terms above in this bullet list describe the ownership or structure of emergent ICT4D actors, but hubs, labs and clusters refer to location: to geographic concentrations of ICT4D activity. Hubs and labs

typically refer to activity in a single building, clusters to activity in one area of a city. Numbers grew rapidly during the 2010s with, for example, more than 100 hubs in Africa by 2016, and over 300 FabLabs in the global South: "fabrication laboratories" that use digital tools to create physical objects (WB 2016). Hubs/labs are often partnerships of some kind and support a wider network of members. Their main intention is to build ICT-related skills and entrepreneurship, often acting as incubators for digital micro-enterprises. They do this by providing the other ICT4D foundations listed in this chapter: supplying ICT infrastructure, building skills, sharing knowledge and offering access to finance.

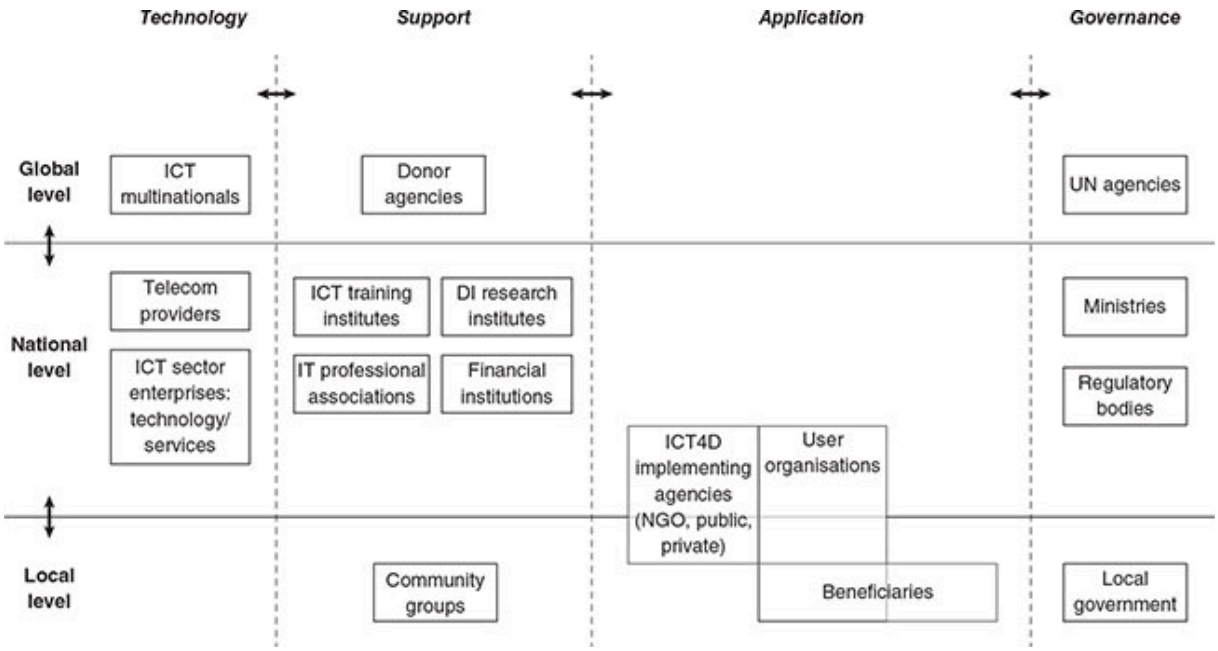
Figure 2.14 Main ICT4D stakeholders



Analysing ICT4D stakeholders

Stakeholders come together to form a network of organisations that impact an ICT4D initiative. It has become common to refer to this as an "ICT4D ecosystem" (though it is rare for the formal meaning of this to be taken seriously, which would require following system's principles – the ideas of boundaries, holism, emergent properties, entropy, etc (Bee & Bee 2005) – and their specific application within ecosystems using principles such as survival, selection, adaptation and resilience (Kim et al. 2010)). A typical example of an organisational ecosystem is shown in Figure 2.15 (adapted from Bailur 2006, Kelly & Minges 2012, Johnson & Thakur 2015). This could be extended into a broader ecosystem concept by adding in other elements from this chapter such as the information infrastructure of data and ICTs, people and their capabilities, institutions such as policy, and money.

Figure 2.15 A generic ICT4D organisational ecosystem



Cutting across the formal organisational descriptions provided above are a series of stakeholder roles associated with any given ICT4D initiative (adapted from Heeks 2006a; see also Figure 2.16):

- Clients: the primary beneficiaries who will be on the immediate receiving end of what the ICT4D initiative does or outputs; there may also be secondary clients affected indirectly by the initiative.

- Implementers: those who implement the ICT4D initiative. For an ICT4D system, these would include those who design and build the system, and those who operate the system.

- Sponsor: the person (or group) who pays for the expense and effort required to develop the ICT4D initiative.

- Owner: the leader of the organisation, group or unit centrally responsible for the ICT4D initiative.

- Champion: the person (or group) who drives the ICT4D initiative forward and seeks to justify its implementation.

- Others: who have a significant influence on the project or on whom the project will have a significant influence.

For any ICT4D initiative, it will be useful to ask some analytical questions such as (adapted from ibid.):

- To what extent are the roles present? If there is no champion, for instance, it is unlikely the initiative will succeed.

- To what extent is there overlap between the roles? If, for example, the sponsor, owner and champion are all the same person, this bodes well for the initiative.

- If roles are separated, to what extent is there conflict or cooperation between the different stakeholders? When there is conflict, the initiative may not succeed.

A common stakeholder technique is to plot stakeholders on a power-interest grid (adapted from Scholes 2001). For each stakeholder, this makes an assessment of the level of power they have to impact the development and implementation of the ICT4D initiative, and their level of interest in the ICT4D initiative. An example is shown in Figure 2.17 taken from an open government data initiative in

Chile (adapted from Gonzalez-Zapata & Heeks 2015). Stakeholders with most power and most interest would be those on whom to focus most attention.

Figure 2.16 ICT4D initiative stakeholder roles

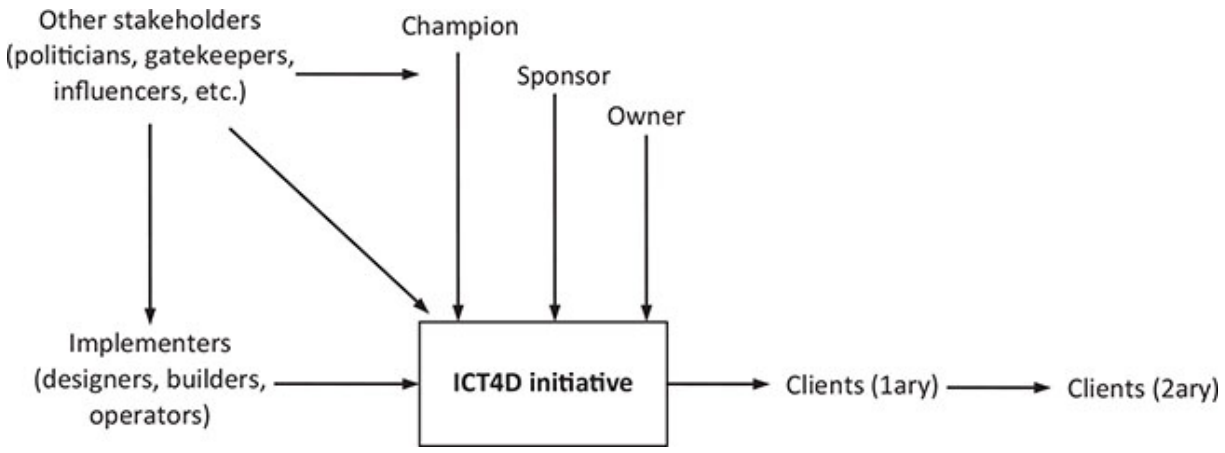
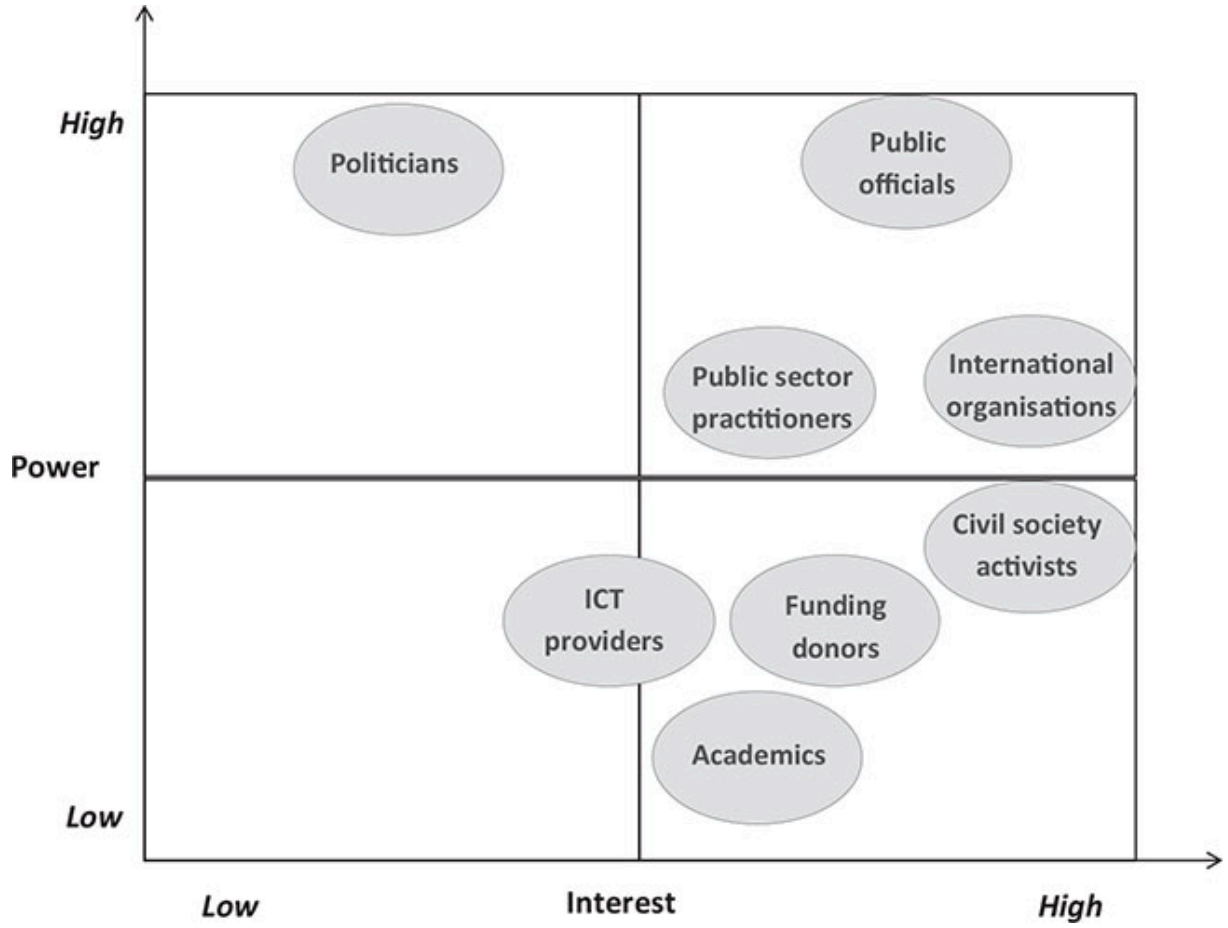


Figure 2.17 Sample power–interest stakeholder analysis



Alongside the level of interest, one can also analyse the nature of that interest. This could mean analysing stakeholders into resistors who will likely oppose the ICT4D initiative, and adopters who will likely support it. It can also mean analysing the interests that stakeholders serve; especially whether or not they serve the interests of the intended beneficiaries of the initiative.

2.4.2. ICT4D policies

It is taken for granted but also evidentially demonstrated that having relevant policies can help accelerate the beneficial application of ICT for development (Pick & Azari 2008). Why is policy needed? A typical argument is that policy is justified where three criteria are met: a) market mechanisms are not delivering desired development goals, b) market mechanisms are not likely to deliver those

goals in the near future, and c) government has the capabilities to make an appropriate intervention (Chaminade & Edquist 2010).

Generic examples of areas for ICT4D policy intervention include (adapted from Foster & Heeks 2015 and echoing the components of the ICT4D value chain):

- Innovation failure: the innovation system does not produce ICT applications of the type needed to deliver development goals.
- Access failure: potential development beneficiaries cannot access the technological infrastructure, for example due to lack of diffusion or lack of affordability.
- Use failure: development goals undershoot because ICT applications are used ineffectively or inefficiently or fail wholly or partially.
- Impact failure: negative development impacts arise from use of ICTs.

The boundaries of failure change over time. In the early 2000s, these failures were universal for those at the base of the pyramid, and extensive intervention was required – given the lack of state capacity, policy interventions had to be heavily guided by international development agencies. By the late 2010s, the private sector was extensively involved in ICT4D innovation, access and use, and the requirement space for state intervention had shrunk. Conversely, impact failures in the form of digital harm were continuously emerging, creating a requirement space for new policies.

We will consider two aspects of this: ICT4D policy content, and ICT4D policy governance.

ICT4D policy content

The typical areas for ICT policy are summarised in Figure 2.18 (developed from Heeks 2016a), with specific examples of policy objectives, goals and instruments relating to each of those areas shown in Table 2.1.

Figure 2.18 Domains of ICT4D policy

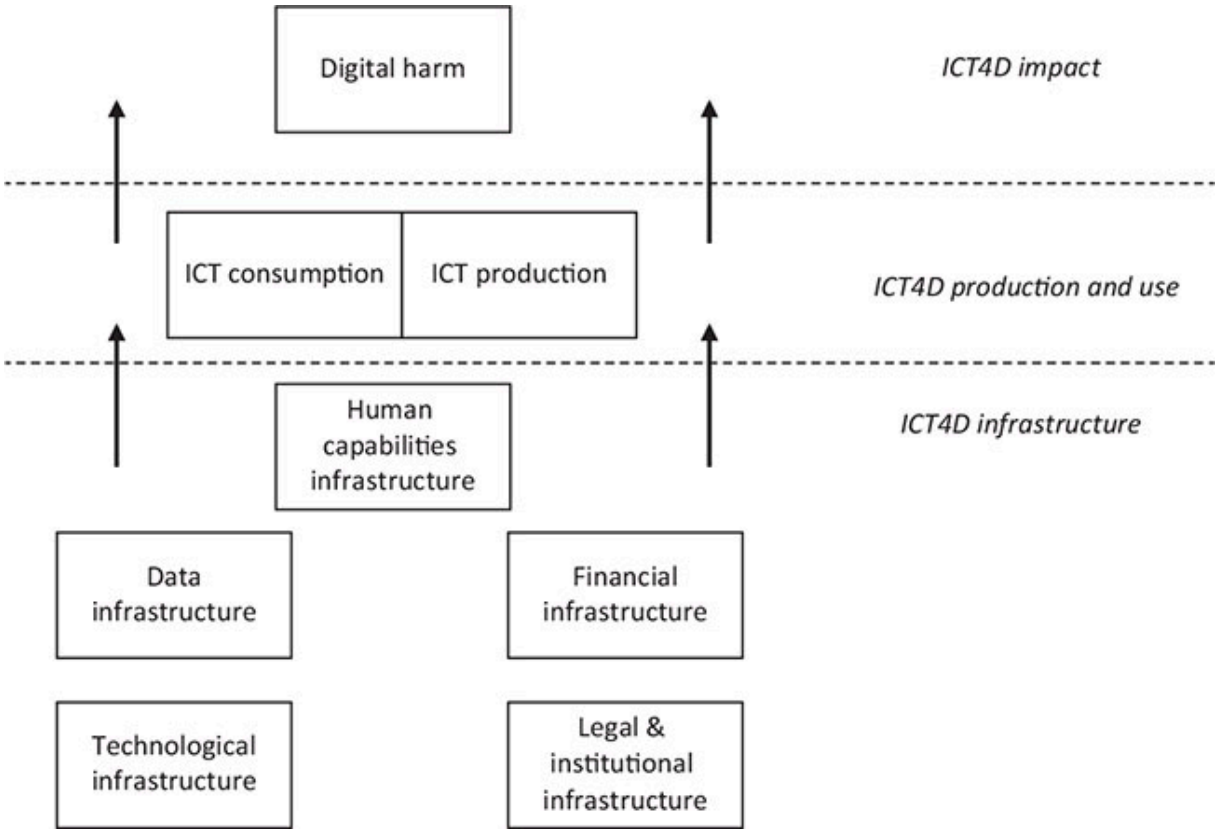


Table 2.1 ICT4D policy goals and instruments

Policy domain	*Policy goals*	*Sample policy instruments*
***ICT4D infrastructure policy**. Objective: to ensure a pervasive infrastructure and effective ecosystem for ICT4D*		
Technological infrastructure	A pervasive, high-capacity, interoperable technological infrastructure	• Invest directly in telecommunications infrastructure including broadband • Encourage private sector investment in telecommunications infrastructure • Ensure independent regulation of telecommunications infrastructure • Regulate cost-based interconnection between networks • Develop country-level Internet Exchange Points • Set minimum and universal access speed requirements • Legislate on net neutrality / zero-rated services
Legal & institutional infrastructure	The necessary legal and institutional framework to enable ICT4D	• Promote legal recognition for digital signatures, contracts and transactions • Develop public-private partnerships to address other policy areas • Support other ICT4D partnerships and networks
Data infrastructure	A pervasive, high-quality, interoperable data infrastructure	• Promote or mandate use of interoperable data standards • Invest in capacity for data capture, analytics and visualisation • Introduce regulations on data integrity, retention, consent, usage and administration
Financial infrastructure	A high-volume flow of financial investment with long-term perspective	• Steer development financing into ICT investments • Provide direct funding for ICT investments • Encourage private sector funding of ICT including use of public–private partnerships
Human capabilities infrastructure	A pervasive, full-spectrum set of ICT consumption and production capabilities	• Introduce ICT skills as a component of primary, secondary and tertiary education curricula including higher-level ICT entrepreneur and innovator capabilities • Provide subsidies or tax breaks for in-service ICT-related training • Identify and develop digital development champions
***ICT4D production and use policy**. Objective: to maximise the appropriate production of ICTs and effective use of ICTs in order to deliver development goals*		
ICT consumption	Maximum delivery of development goals through use of ICTs	• Intervene to promote ICT application in all development sectors (e-health, e-education, e-agriculture, e-governance, e-business, etc) • Ensure appropriate level of import tariffs and sales taxes on digital goods and services
ICT production	The necessary structures and processes to support the ICT sector	• Provide business development services specifically for ICT sector enterprises, including cluster and hub services • Support ICT sector enterprises through other investments and incentives e.g. around research and development • Support ICT4D innovation through direct funding, subsidy and tax breaks including co-creation • Ensure infrastructure interventions meet specific needs of the ICT sector

***ICT4D impact policy**. Objective: to reduce the negative impacts associated with ICT production and use*

Generic	Public understanding of negative impacts	• Undertake publicity and awareness campaigns on ICT impacts
Digital inclusion	Ensure the benefits of ICTs are shared by all	• Target infrastructure development for marginalised groups including capability-building, financing streams, and universal service funds or obligations for mobile, Internet and other ICT infrastructure • Support for inclusive digital innovation (IDI) including IDI partnerships, funding, information flows, and promotion of inclusive digital innovation design and usability principles • Support ICT embedding by others (NGO, private sector) delivering information and services to marginalised groups • Accelerate affordability via financial support (subsidy, tax exemption, etc) for inclusive ICT goods and services
Digital sustainability	Ensure current ICT production and use does not compromise the ability of future generations to meet their needs	• Introduce sustainability initiatives such as green ICT actions for design and sourcing of ICT • Ensure effective recycling of e-waste via recycling capacity building and/or extended producer responsibility • Provide funding and capacity building for smart applications (power, motors, buildings, transport/logistics) • Support ICT application for climate change policy-making, modelling and monitoring, and for application to climate change adaptation in agriculture and other sectors
Cybercrime	Reduce levels of cybercrime	• Ensure appropriate legislation to outlaw hacking • Create cybersecurity agencies and capabilities • Create appropriate anti-cyberterrorist and anti-cyberwarfare agencies and capacity at national and international level • Extend conventional crime legislation to cover online activity (espionage, fraud, grooming, child pornography, hate crime, bullying, stalking, etc)
Rights	Protect and extend digital rights	• Ensure appropriate legislation for protection of online privacy, freedom of opinion and expression, and intellectual property rights • Support open development initiatives including open data, open standards and open source
Monopoly	Reduce the disbenefits of ICT monopolies	• Ensure effective regulation and stimulation of competition in provision of ICT infrastructure • Introduce anti-trust, anti-monopoly regulation and other competition law covering online activity • Improve monitoring of digital financial and trade flows

It is likely that only a minority of the policy instruments identified above will be passed into law. Three common legislative areas in developing countries are: telecommunications regulation and competition law (often including the formation of an independent or quasi-independent regulator), electronic transaction law and cybersecurity law (Miroro & Adera 2014). Many other aspects may be covered through policies and initiatives that do not always form part of the legal statute. An example national policy is discussed in Box 2.6.

Box 2.6

Uganda's ICT policy

The 1997 Uganda Communications Act liberalised the telecom sector, led to the formation of an independent regulator – the Uganda Communications Commission – and laid the basis for competition and privatisation of telecoms, with full liberalisation completed in 2006 (Nasasira 2013). Other than this, the main laws have been three bills passed into acts in 2010 dealing with electronic signatures, electronic transactions and cybercrime.

Uganda's main ICT policy was published in 2003 (MWHC 2003). "The policy was formulated through the Uganda National Council for Science and Technology that initiated a consultative and participatory process to formulate the policy, and a National ICT Policy Task Force was set up to oversee the process. The Task Force was multi-disciplinary and multi-sector with representatives of all key ICT stakeholders from government, NGOs and the private sector" (Duncombe 2013:16).

The policy was formally adopted in 2005, leading to the creation of a separate Ministry of Information and Communications Technology, with overall responsibility for all ICT issues. In 2009, the National Information Technology Authority-Uganda was created under the Ministry by Act of Parliament "to coordinate, promote and monitor IT development within the context of national social and economic development" (NITA-U 2010:4). In 2013, a review of the 1997 Uganda Communications Act (including creation of a new Act) led to an expanded remit for the Uganda Communications Commission as a super-regulator with responsibilities for post, telecom, media and broadcasting.

The ICT policy has been under continuous review, with major reviews in 2010 and 2012–13 (MICT 2010, 2012; Nasasira 2013) and incorporation of key objectives into the 2014/15–2019/20 second National Development Plan (RoU 2015) and into annual statements (e.g. MICT 2016). However, the main focus has been relatively stable, and corresponding closely to the content of this chapter:

- Telecommunications infrastructure: such as roll-out of broadband fibre-optic cables as part of a National Backbone Infrastructure.

- ICT applications: particularly development of e-government but also e-commerce, e-health and ICTs in schools among others.

- Human capital infrastructure: incorporating ICTs into school, college and university curricula.

- Legal and institutional infrastructure: creation of the various laws and bodies outlined above plus more specific policies such as broadband, e-waste and e-government.

- ICT sector development: especially expansion of business process outsourcing.

- Cybersecurity and standards: such as creation of national Computer Emergency Response Team.

National performance is audited every year. In 2015, for example, the Ministry was praised for developments including expansion of Internet speed and usage, growth in ICT sector employment, and enactment of e-government regulations (MFPED 2015). But it was criticised for failure to invest intended amounts in the National Backbone Infrastructure.

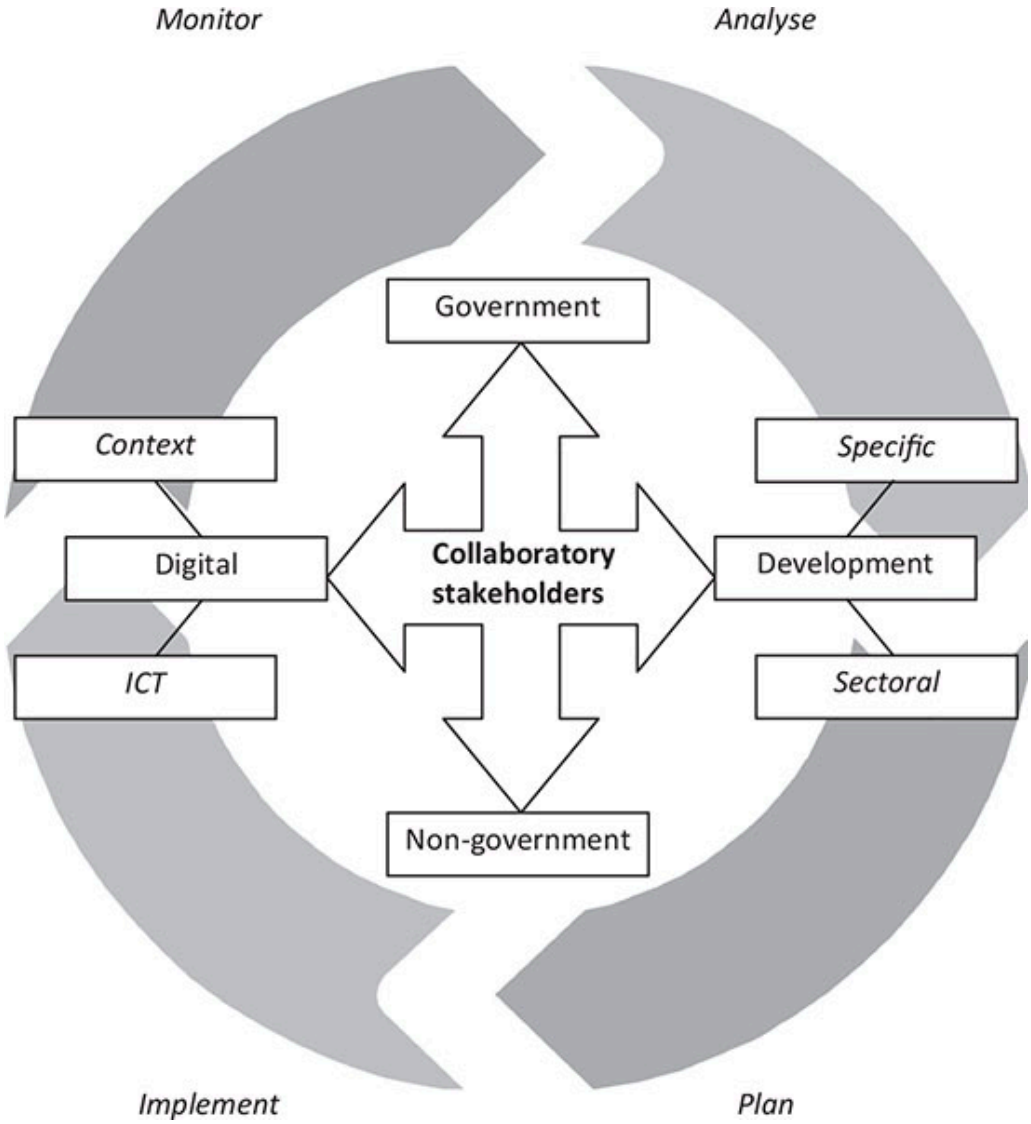
As noted earlier, international development agencies have also had an important role in dual-failure situations, where neither the market nor the state can deliver ICT-enabled development goals (Kenny 2006). This has included funding pilot applications of ICT4D, supporting development of policies and capacities within developing country governments, and lobbying the global organisations shown in Figure 2.20 on behalf of developing countries.

ICT4D policy governance

For effective ICT4D to be encouraged, more than new policy content is needed (Heeks et al. 2010). Policy makers must also consider the governance of ICT4D policy, especially the structures and processes through which ICT4D policy is made and implemented: Box 2.6 gave examples of these.

A cross-cutting structure will need to be created, and best practice suggests something like an "ICT4D Policy Collaboratory", summarised graphically in Figure 2.19 (text adapted from Heeks 2016a). The collaboration element of "Collaboratory" relates to structure, with a dual bridging role, drawing in horizontally policy actors from both ICT and development (and context); and drawing in vertically those connected with both government and other sectors. This is required as ICT4D policy morphs from being the discrete responsibility of an ICT ministry, to an issue that touches all aspects of development and hence all stakeholders in development.

Figure 2.19 ICT4D Policy Collaboratory: process and structure



Experiences with various types of ICT policy suggest the value and merits of autonomous and capable state agencies, combined with strong representative bodies for both the private sector and civil society, and a mechanism for robust interaction between these three groups (Heeks 2009a, Howard & Mazaheri 2009, WB 2016). This therefore recognises that policy is not solely the preserve of government. For example, the strategic decisions of large ICT firms can affect the ICT4D ecosystem as much as government policy can.

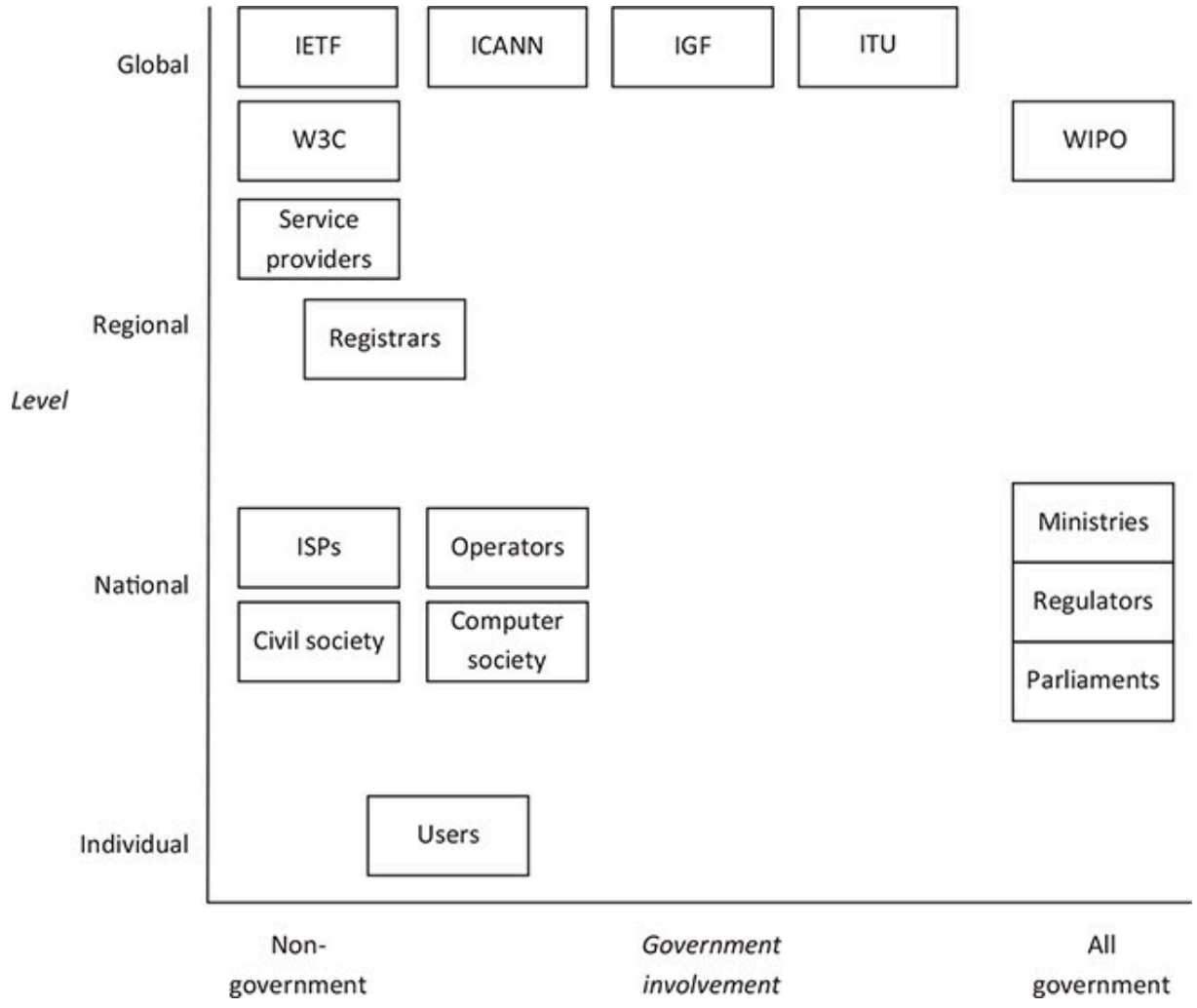
In process terms, the laboratory element of "Collaboratory" reflects the value of adopting an experimental and iterative approach to policy, allowing incremental learning and policy revision (Heeks 2009c). There are limits to this, however, since some degree of policy stability is needed if actors are to be encouraged to

invest their time and money in ICT4D (Enriquez et al. 2015). The iterative cycle also ensures due emphasis on implementation: there are plenty of cases in which a sound ICT4D policy has been undermined by poor or absent implementation (Mofleh et al. 2008, Aker & Mbiti 2010).

In turn, the emphasis on implementation throws a light on state capacity, or lack thereof. This in part explains why governments have turned to autonomous bodies to assist with implementation – as is typically the case with independent telecommunications regulators – and to public–private partnerships. Regulators have become a steadily more important part of the ICT4D governance landscape. This has happened particularly as technological convergence provides a growing remit for them to become "super-regulators" – as seen in the Box 2.6 case – who cover all aspects of post, media, telecommunications and online activity.

All of this, of course, associates policy with individual countries but there are other policy forums such as those at global level. Figure 2.20 summarises some of these (adapted from WB 2016), representing a more ICT policy-specific version of the ecosystem of stakeholders shown in Figure 2.15.

Figure 2.20 Stakeholders in Internet governance



Most of these organisations are relatively technically- and governance-focused: the Internet Engineering Task Force (IETF) looking at standards, the Internet Corporation for Assigned Names and Numbers (ICANN) governing domain names and servers (its work is managed through a set of regional registries and domain name registrars), the World Wide Web Consortium (W3C) setting standards for the Web, and the Internet Governance Forum (IGF) providing a multi-stakeholder forum for discussion. The ITU has a much broader remit across all ICTs and telecoms and the World Intellectual Property Organization (WIPO) includes digital intellectual property within its remit.

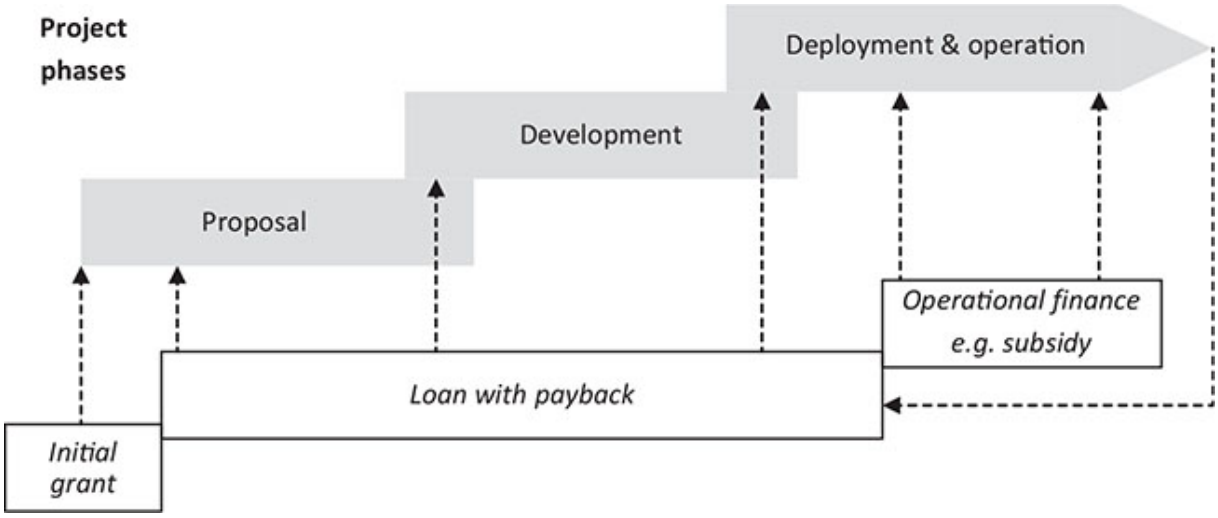
The private sector – service providers, Internet service providers (ISPs) and operators – mainly provide services but will input to and influence governance,

alongside the other non-government stakeholders: as they did in Uganda – see Box 2.6. Their ability to do so depends on the governance model adopted. Broadly, organisations on the left side of Figure 2.20 have tended towards a multi-stakeholder model that is broad and participatory, whereas those on the right side take a more multilateral or inter-governmental model that brings together national governments on a more top-down basis (ibid.).

2.5. Financing ICT4D

The money to pay for ICT4D initiatives can come from "internal" sources: a farmer using their own income to pay for a mobile phone; a company reinvesting profits in better digital systems; a government financing ICT infrastructure from its tax receipts. But these would lead to very slow progress, so "external" sources of financing are used to accelerate the use of ICTs to achieve development goals. There are many different sources of financing but the main ones involved in ICT4D would be: international donors (bilateral and multilateral), development and commercial banks, government, private sector investors and businesses, and partnerships of two or more of these actors. The amounts involved are huge: the global South spends well over US$1 trillion per year on ICTs (OECD 2013).

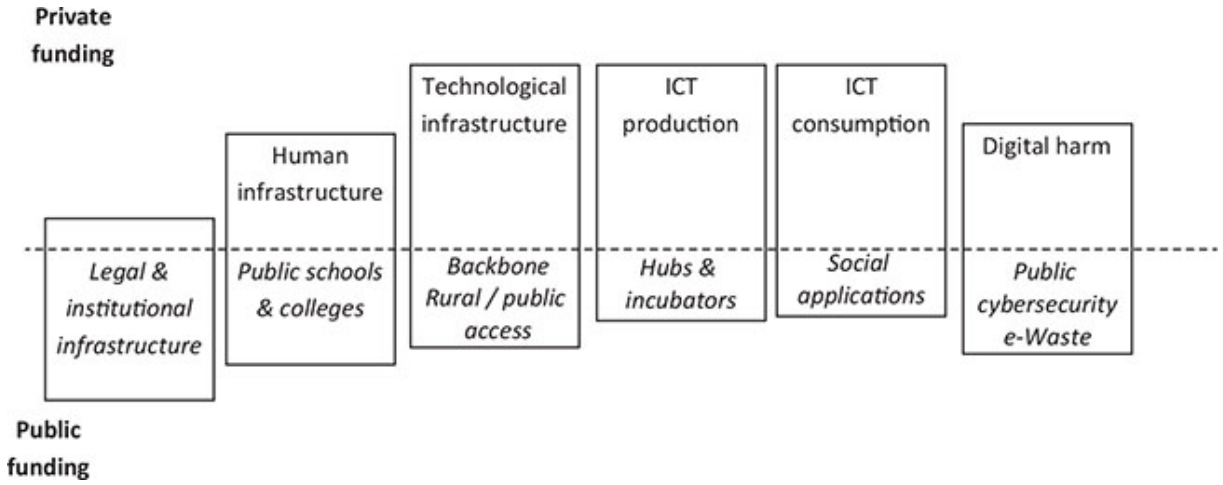
Figure 2.21 Financing at different stages of an ICT4D project



The types of ICT4D financing include: grants (straight donations of money), loans (which are expected to be paid back either with or without some additional interest), equity financing (which takes a financial share of the invested organisation), subsidy (an ongoing grant payment), credit guarantees (which will pay back the investor in the case of a default), and payment guarantees (which guarantee to purchase a certain amount of the ICT4D services provided over time). Different types of financing are likely to be appropriate for different stages of an ICT4D project. For example, Figure 2.21 (adapted from Galluser 2003) shows an ICT4D project being started with a grant, developed and deployed via loan support, and then being operated by other financing such as a subsidy. Further scaling could occur by additional grants or loans.

There is a key difference in financing between private/commercial and public/non-commercial sources. As identified above for policy, the rationale for public funding – such as by development donors – is that it should step in for initiatives that will deliver development goals but which the private sector is not currently funding. This does not mean funding every ICT4D project: there will be those where the development returns do not justify the donor investment. But the history of ICT4D has been of steadily moving boundaries with the private sector funding an increasing proportion of ICT4D activity, and a decreasing proportion not justifying investment. At the early stages of ICT4D 1.0, for example, the private sector would not fund telecentres anywhere in developing countries, so donors had to step in. At the same time, lack of capacity and demand meant rural telecentres were not suitable for funding (hence many that were funded, failed). By the late 2010s, the private sector would fund ICT provision in most areas of developing countries, leaving just a few rural areas requiring non-commercial support, and with very few locations not suitable for some form of ICT4D finance.

Figure 2.22 Example areas of public ICT4D funding



This notion of different areas for different funding types applies also to the domains of ICT4D activity. We can illustrate that by re-drawing Figure 2.18 as Figure 2.22 (developed from Townsend 2009), which shows that significant areas of ICT4D will be private sector-financed, but that there remain sub-areas for which public funding is suitable: most of the legal and institutional infrastructure; provision of public sector ICT education and training; funding of the backbone infrastructure such as broadband, rural access telecommunications, and public access points in low-income communities; locations to help kick-start ICT sector enterprises; social applications including e-government, e-health and local social content; and public contributions to generic harm issues such as cybersecurity, e-waste, green ICT, etc. As well as these direct areas for investment, public funding can also be used to catalyse private funding either directly (e.g. via co-funding or by creating innovative financing mechanisms) or indirectly (by improving the wider institutional environment for investment).

There are operational challenges that face public funding of ICT4D (Mathison 2004, Ezenwa & Brooks 2014, Mow 2014): delays or blocks on money flowing to the intended beneficiaries due to corruption or inefficiencies; inadequate investment levels due to failure to budget the total cost of a project (including both initial capital and ongoing operational and maintenance costs); sudden cessation of funding due to changed strategic priorities; and failure of the project to scale or sustain sufficiently to provide a return on investment ("forever pilot syndrome"). As a specific example, universal service funds (USFs) – funding rural and public access to telecommunications – have a mixed record. "Some USFs have performed well, notably those that use competitive mechanisms to distribute funds . . . But USFs generate funds that often remain unspent or go for

unintended purposes. Unspent USFs amounted to more than US$11 billion" (WB 2016:211).

And there are more political challenges. This includes arguments about where the finance boundary lines should lie – for example the extent to which various items (Internet provision, information provision, ICT skills) are public goods that might justify ongoing subsidy. It includes arguments about private sector capture of returns to public funding: for example, the hundreds of millions of US dollars of profit that Kenyan firm Safaricom has derived from the M-Pesa mobile system; a system that was initiated with the help of a c.US$1.3m grant from the UK's DFID (Bansal 2011). Lastly, there is the "golden rule": whoever has the gold makes the rules. Whether public or private funding is involved, this creates a tendency for ICT4D initiatives to be top-down in terms of structure and interests, so that the voice and interests of users and other beneficiaries can be lost (Schwartz et al. 2015).

2.6. Digital inclusion and the "digital divide"

The 1990s marked the first decade of mass-scale excitement about the possibilities of ICTs to help deliver international development. As the decade wore on, though, commentators became increasingly concerned about the flip-side: if ICTs were going to bring benefits, then those without ICTs were going to lose out. These concerns have been voiced in various ways: defining the inability to access and use basic ICTs as "digital poverty" and/or arguing that such access and use, particularly Internet-related, is a fundamental human right (McIver et al. 2003, Barrantes 2007). But the more enduring terminology has been that of the "digital divide".

For the reasons just given, the agenda of the "digital divide" started to move into the ICT4D field in the late 1990s (Davison et al. 1999) though, prior to that, there were worries about gaps in digital production technologies, computers and telecommunications (Rada 1985, Hoffman & Hobday 1990). Initially, this was understood to mean a division between countries: those which had ICTs divided from those which did not. But, once academics started to get their hands on the issue, it began to get a lot more complicated. As we shall see.

2.6.1. Digital divides

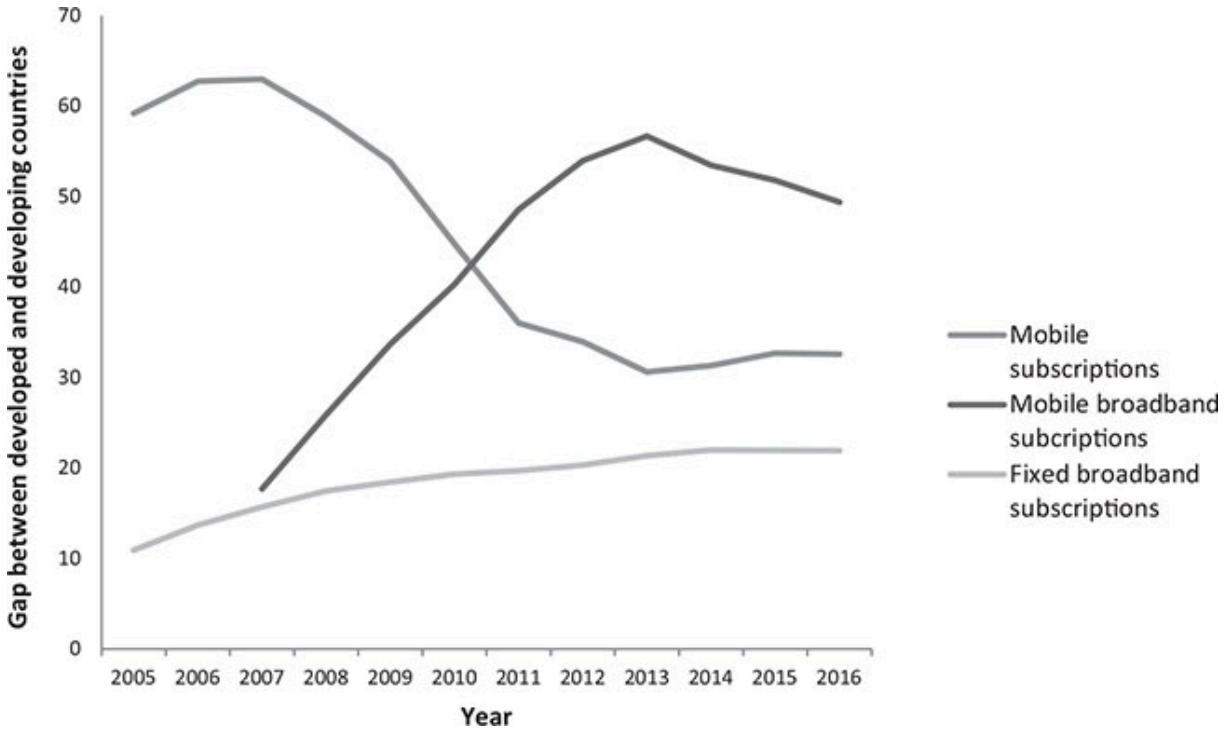
Rather than a single digital divide, it is necessary to talk about digital divides: multiple divisions that are split along technological and social and value chain dimensions.

Technological divisions

One of the main problems with ICTs is innovation. By the time you've understood / obtained / effectively used some digital technology, it has already been superseded by a newer, better, cheaper model. As a result, the technology of concern for the digital divide has tended to change over time. We can examine the pattern for three different technologies, as shown in Figure 2.23, measuring the absolute gap between developed and developing countries in terms of subscriptions per 100 population (data source: ITU 2016).

Explicit discussion of a "mobile divide" first emerged at the turn of the century (Nanthikesan 2000), but looking at Figure 2.23 one can see "peak divide" in 2007 and then a steady decline to a rough plateau: in 2016, the relative ratio between developed and developing countries was only 1.3. But as the mobile divide began to close, the focus moved more towards broadband. As the statistics show, the mobile broadband divide peaked in 2013 but the fixed broadband divide grew throughout the period, with a relative ratio of 3.7 in 2016.

Figure 2.23 Different technological divides over time



This pattern is consistent. The digital divide for any one technology closes over time – quickly for mobile technologies; more slowly for others – but is replaced by a new digital divide for the next generation of technologies.

Social divisions

Recognition of a digital divide between countries has run alongside recognition of a digital divide within countries and between different groups. Key dimensions include:

- Income: the prime and most persistent division. At its most blunt this means the rich have ICTs and the poor do not. As a less extreme example, 64 per cent of Sri Lankan farmers earning more than US$25 per month owned a mobile phone compared to only 36 per cent of those earning less than that amount (Dissanayeke & Wanigasundera 2013). There is a divide here, though it's not quite as sharp as have vs. have not – an issue discussed in Box 2.7.

- Gender: for example, 35 per cent of male-headed households in rural Malawi had a mobile phone compared to only 8 per cent of female-headed households

(Steinfeld et al. 2015).

- Education: for example, three-quarters of those using an East African human rights MOOC were degree holders (Jobe & Hansson 2014).
- Age: for example, less than 10 per cent of those aged over 50 had mobile Internet access in Thailand compared to more than 20 per cent of those aged under 40 (Srinuan et al. 2012).
- Ethnicity: for example, 6 per cent of African-descent families in Brazil owned a computer compared to 23 per cent of non-African-descent families (Wainer & Covic 2010).

- Disability: for example, disabled citizens in India are half as likely to have Internet access as those without a disability (Kumar & Sanaman 2013).
- Geography: for example, 27 per cent of households in urban Namibia had an Internet connection compared to 2 per cent of rural households (Stork & Calandro 2014).

Each of these factors will contribute to the divide in some way. In other words, each of these divides is real. However, the primary digital divide relates to income: women, those less-educated, older people, ethnic minorities, the disabled, and rural populations are all poorer on average than their mirror images. As one example, income explains 55 per cent of the ethnicity gap from Brazil discussed above (Wainer & Covic 2010). The secondary digital divide is education: again all the groups above tend to be less well-educated than their mirror images, and education explains 13 per cent of the ethnicity gap above. Returning to the "*cui bono*?" question of Chapter 1, we can therefore answer that it is richer and better-educated citizens who benefit more from ICT4D than their poorer, less-educated neighbours. And similarly, ICT4D benefits flow more to men, to younger citizens, to ethnic majorities, to those without disabilities, and to urban dwellers.

Box 2.7

Digital divide or continuum?

The picture of a digital divide – the lucky on one side, the unlucky on the other – has been valuable and powerful in helping to motivate action on ICT4D. But it isn't a particularly good reflection of reality for two reasons, and is better thought of as a continuum.

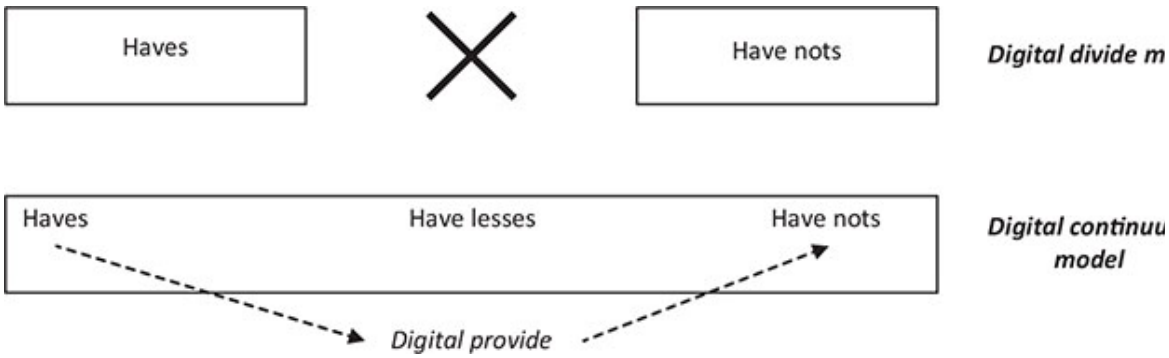
First, if you look at all the categorisations noted earlier, you'll see that none of them is black-and-white; all are shades of grey. So it's not that the global North has mobile broadband while the global South does not; it's that the former has more mobile broadband than the latter. And it's not that richer Sri Lankan farmers have phones and poorer farmers do not; it's that more of the former own a phone than do the latter.

Second, alongside the digital divide is also a "digital provide": benefits from ICTs that extend to those who neither own nor use ICTs. These benefits can be systemic spillovers – general gains to a market or other system due to introduction of ICTs. For example, when fishermen in India began using mobile phones, they could check markets and land their catches at locations more likely to trade. As a result, less fish went to waste and the fishermen could afford a lower price per kg for their fish; so prices fell, benefiting consumers who made no use of mobile phones (Jensen 2007). Or those benefits may be specific spillovers, which we've already described through the mechanism of infomediaries: those who use ICTs on behalf of non-using others with the latter benefiting from the digital information and services. Farmers in Ghana, for instance, who used their mobile phone to arrange meetings with agricultural extension officers, would pass on details of those meetings to non-phone-using farmers (Smith 2010). And ICT-using family members in China would set up Skype calls, videos and digital text for non-ICT-using members (Oreglia 2014). We have also seen earlier how ICTs may be shared, so that those who do not own ICTs can still benefit from them: public access ICTs are one example, as is the sharing of mobile phones within low-income communities, with up to one-third of mobile phone users not being mobile phone owners (Diga 2013a).

The term "digital divide" is so well-rooted that we have to stick with it, but all this suggests we should amend the core model to one of "digital

continuum", as shown in Figure 2.24.

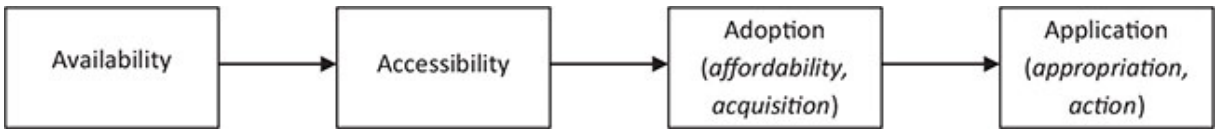
Figure 2.24 Digital divide vs. digital continuum



Value chain divisions

Look again at the language used so far to discuss the digital divide. If you have read closely, you'll see that different words have been used; sometimes talking about access to ICTs; sometimes talking about ownership of ICTs; sometimes talking about use of ICTs. These can be interpreted as steps within a value chain, each one of which may have a divide. We can represent this as shown in Figure 2.25, building on key earlier models (Selwyn 2004, Van Dijk 2005; see also Dodel 2015a).

Figure 2.25 Value chain dimensions of the digital divide



Looking in more detail and noting that, over time, the focus of the divides would likely shift away from availability and towards application, there is an:

- Availability divide: in some locations, a particular ICT is simply unavailable to the population. For example, around half a billion people live in an area

that has no mobile phone signal (WB 2016).

- Accessibility divide: where ICTs are available there may still be a divide of those for whom the technology is not accessible. Barriers come in many guises: the knowledge barrier experienced by non-users in India who were simply unaware of the existence of nearby telecentres (Pick et al. 2014), or the cultural barrier that women in some contexts are not allowed out of the home in order to use a public access point (Gomez & Camacho 2013).

- Adoption divide: where ICTs are available and in theory accessible, there will still be a divide for those who do not adopt the technology. For example, well over a billion people live within range of a mobile signal but do not directly use a mobile phone (WB 2016). Some are not motivated to use ICTs: a major block to adoption of e-government in East Africa is citizens' belief that it will not deliver anything of value for them (Sika et al. 2015) while lack of trust is a major barrier to expansion of e-commerce in India (Mathew & Mishra 2014). Some do not adopt because they cannot afford to use ICTs: more than a quarter of those still not using mobile phones in rural China cited lack of sufficient money as the reason (Minges 2012b), and lack of affordability is a key barrier to Internet and broadband adoption in developing countries. In the global North monthly broadband typically costs less than US$10 in purchasing power parity terms; in most of Africa the cost is more than US$100 (WB 2016). Even if they can use the technology, there is a further acquisition gap between those who own the technology and those who do not since ownership confers a level of control that non-owners lack – for example, phone-owning farmers in Malawi had better access to external information than those who did not own phones (Steinfield et al. 2015).

- Application divide: where ICTs have been adopted, there may still be a usage divide. For example, use of Facebook in a Nairobi slum was gender-differentiated, with women's use more restricted as they sought to avoid online harassment from men (Wyche 2015). Application differences can be interpreted as an appropriation issue: that users cannot take psychological ownership of the technology and adapt its use to fit their specific needs and circumstances. And it can be interpreted as an action issue: that use of ICTs cannot be turned into wider development results – poorer farmers in Zimbabwe could use ICTs to get information about livestock health but could not then buy the vaccinations that were needed (Oosterlaken 2015). This is a

direct reminder of the information value chain (see Section 2.3.2); something to which we now return.

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2.6.2. The information value chain and the politics of ICT4D

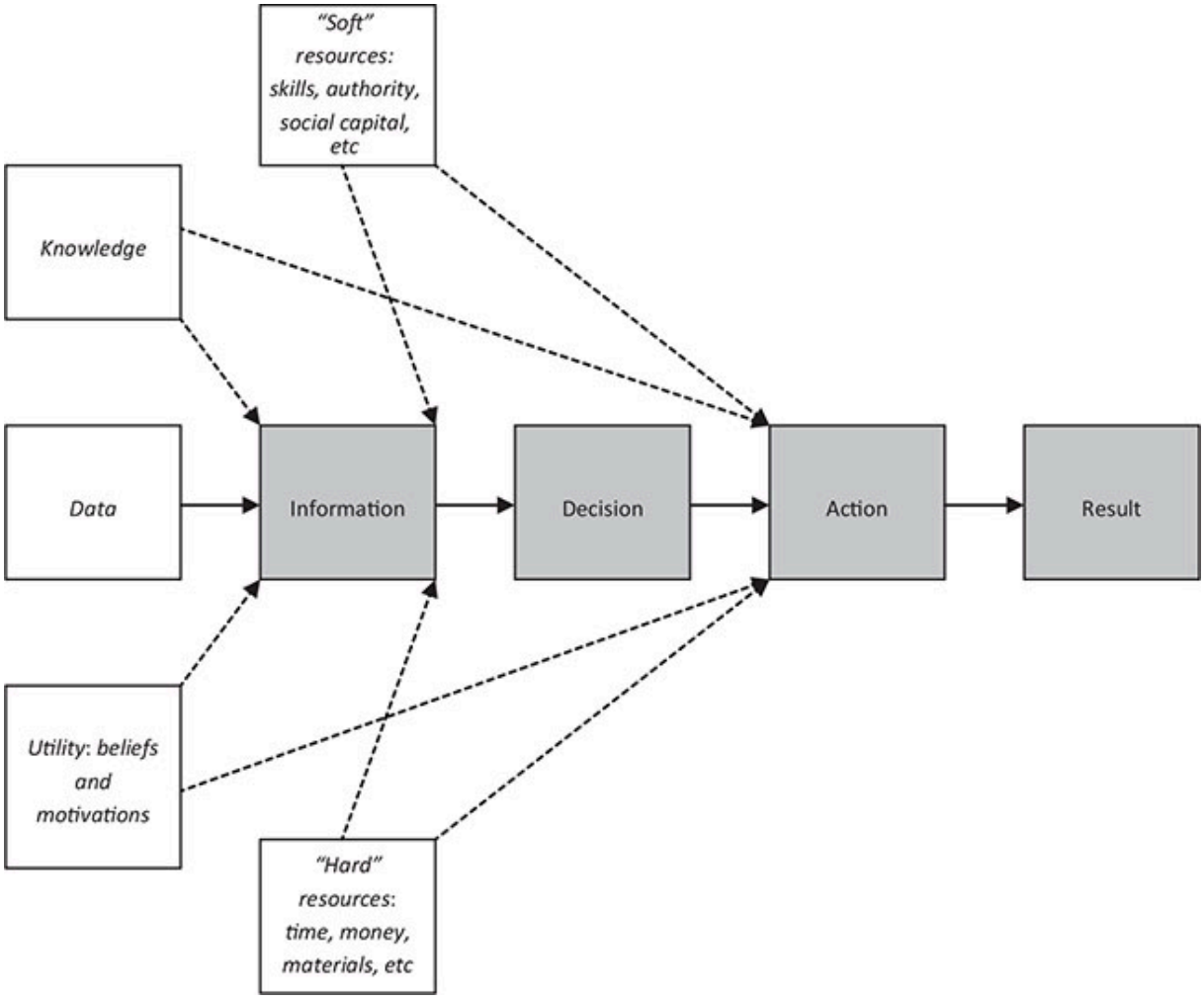
So far, we have examined the nature of the digital divides – or continua – but only indirectly mentioned their cause. To understand that, we can combine two things from the discussion above, as shown in Figure 2.26. First, the idea of the information value chain of steps, all of which must be completed. Second, the idea of resources: technology, money and knowledge were already discussed, and we can expand the list of relevant resources using other key digital divide models (DiMaggio & Hargittai 2001, Warschauer 2002).

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This shows that full digital inclusion – turning data into development results – requires a whole set of resources (of which Figure 2.26 only shows a sub-set):

- Data: must be available in the first place.
- Knowledge: as discussed in Section 2.3.2, awareness, understanding, insight are all required for the information value chain to function.
- Soft resources: those involved must have the skills and authority to access and apply the data, and turn it into actions; and social support drawn from contact networks will assist this.
- Hard resources: those involved must have the time and money to undertake the information value chain processes, and must access, adopt and apply "materials" – particularly ICTs but also other materials that might be needed to take action (for instance, to turn information into results via action a farmer might need land, seed, fertiliser, transport, etc).

Figure 2.26 Resources required for the information value chain



- Utility: repeating a point from Section 2.3.1, all the other resources are enablers; but the information value chain also requires a driver – those involved must perceive a value from engaging with the chain: some goal they will realise through its functioning.

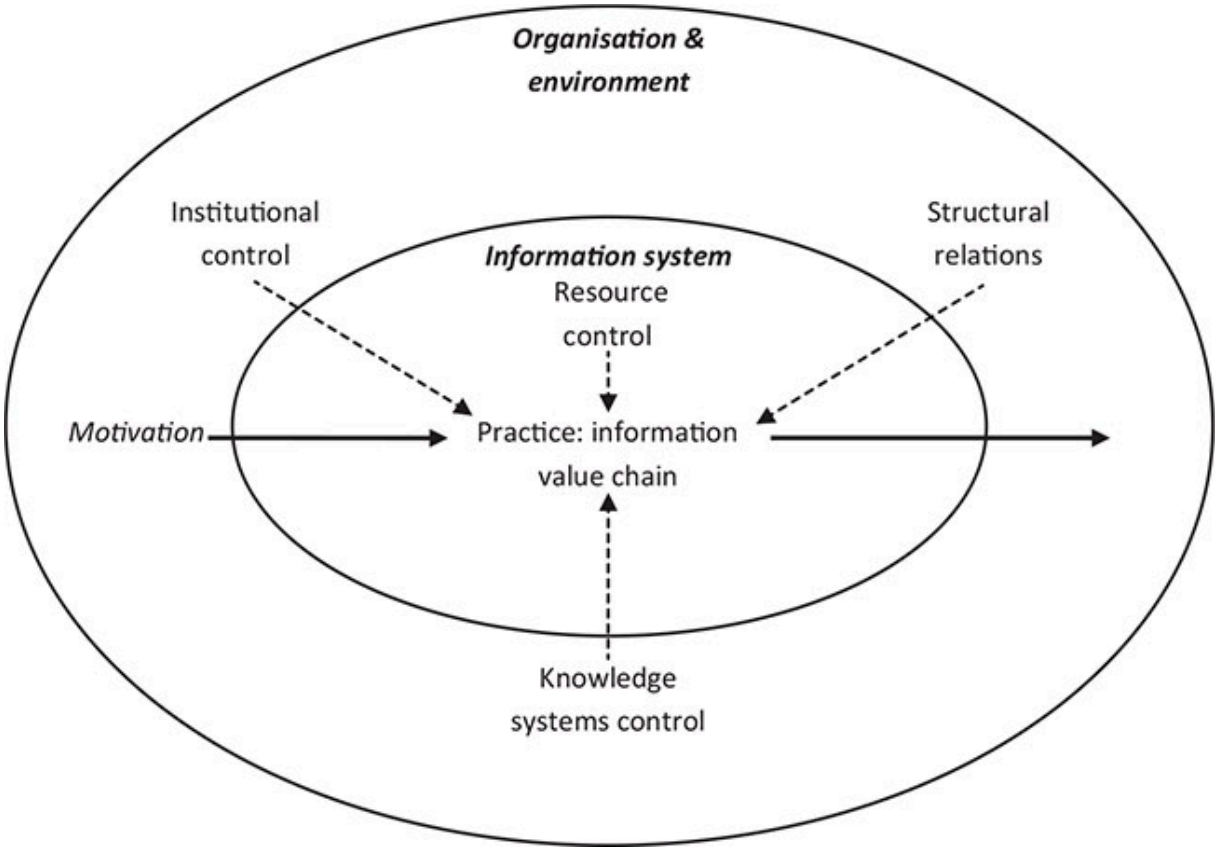
(In some ways, this represents the converse of what will be discussed in later chapters. Here, we identify the impact of various forms of capital assets on ICT adoption and use. In those later chapters, we investigate the impact of ICTs on various forms of capital asset.)

One practical implication of all this is that ICT4D initiatives must take a holistic approach. They cannot simply deliver the technology but they must also attend to

all the other resources that have to be in place for the information value chain to fully run. Is the necessary data content available and appropriate? Have skills, knowledge and authority been provided? Do those involved have enough money to participate as intended? Will intended users be motivated to participate? And questions should also be asked about the nature of divisions and inequalities: what value chain and social inequalities of resource access exist – income, gender, education, age, etc – and what can be done to address them?

The digital divides exist because some people have these resources and others do not. Or, using our alternate term, digital continua exist because these resources are unevenly distributed. But why are they unevenly distributed? That draws us into the politics of ICT4D and the origins of power in society. Power comes from control over resources, such as those identified in Figure 2.26, but also from three other things that themselves determine control over resources: control over institutions, position within structural relations, and epistemic control over knowledge systems (Hardy & Phillips 1998, Hearn 2012). We can summarise this with a very simplified and politics-oriented version of Chapter 1's onion-ring model, as shown in Figure 2.27.

Figure 2.27 The politics of information and ICT4D



From this we can identify those who are likely to benefit from ICT4D and those who are not. This again links back to the "*cui bono*?" question posed in Chapter 1 and the ideas of adverse incorporation. It also links back to the many foundations of ICT4D discussed in this chapter, dividing groups and benefits in terms of:

- Motivation: e.g. those who are motivated to use an ICT4D application vs. those who are not.
- Resources: e.g. those who have access to ICT4D-related data, skills, knowledge, technology, money, contact networks vs. those who do not.
- Institutions: e.g. those who are in formal positions of authority within local institutions involved with an ICT4D initiative vs. those who are not.
- Structural relations: e.g. those who employ others in an ICT4D initiative vs. those who do not.

- Knowledge systems: e.g. those who determine the discourse and meaning of ICT4D vs. those who do not.

All of these elements contribute to the digital divides and continua, and they raise the question of the impact of ICT4D. Does ICT4D have a more incremental impact on the practices and resources of information systems, or does it have a more transformational impact on the wider institutions, structural relations and knowledge systems? This is an issue we will return to in later chapters which can now be seen as part of a wider two-way interaction: resources, systems, institutions, structures all impact ICT while ICT impacts resources, systems, institutions, structures; this latter part being the "4D" component. Given what we already know about the digital divides and continua, the potential for reinforcement can be seen – that the rich and powerful make more and better use of digital technology, and that technology will make them richer and more powerful, exacerbating rather than reducing inequality. As we will see in later chapters, this is not just a potential but also a real outcome.

Additional material

Discussion questions

2.1.1. How could you use the ICT4D value chain in practice in an ICT4D project?

2.2.1. Find the latest version of ITU statistics on phone and broadband subscriptions, and PC and Internet use. What do they tell you about current trends in technological infrastructure?

2.3.1. Does ICT4D pay sufficient attention to drivers: specifically, intrinsic and extrinsic motivations within ICT4D?

2.3.2. Identify an example ICT4D case study: which of the "role ladder" roles does it illustrate?

2.4.1. Identify an example ICT4D case study: which of the Figure 2.15 ecosystem stakeholders were involved?

2.4.2. Which should we pay more attention to: the content, process or structures of ICT4D policy?

2.5. Which is preferable: public or private financing of ICT4D?

2.6.1. Which are more important: the technological, social or value chain aspects of the digital divide?

2.6.2. In what way could we pay more attention to the politics of ICT4D?

Assignment question

What are the key foundations that need to be in place for ICT4D?

Further reading

If you would like to know more about . . .	2.1. the ICT4D value chain	. . . then take a look at . . .	2.1. Kivunike, F., Ekenberg, L., Danielson, M. & Tusubira, F. (2014) Towards a structured approach for evaluating the ICT contribution to development, *International Journal on Advances in ICT for Emerging Regions*, 7(1), 1–15 >Discusses use of the ICT4D value chain – and other frameworks – as an evaluation tool
	2.2. the technologies of ICT		2.2. the technology chapters of most information systems textbooks, e.g. chapters 5, 6, 7 and 9 of Laudon, K.C. & Laudon, J.P. (2016) *Management Information Systems*, 14th edn, Pearson, Harlow, UK >Cover telecommunications, hardware, software and data in detail
	2.3.1. motivation and ICT4D		2.3.1. Sengupta, A., Chang, K., Wan, M.P.H. & Yi, W. (2014) Icon types, extrinsic and intrinsic motivations and behavioral intention of use for semi-literate users, paper presented at *AMCIS 2014*, Savannah, GA, 7–9 August >One of very few papers to directly engage with issues of motivation other than through "perceived usefulness" in adoption models; it looks at how different icon designs impact motivation of semi-literate users in rural India

			Kang. J. & Maity, M. (2012) *Texting Among the Bottom of the Pyramid*, LIRNEasia, Colombo, Sri Lanka >An example of applying the Technology Acceptance Model, and demonstrating that perceived usefulness (among other variables) is significantly correlated with ICT use; in this case SMS texting
	2.3.2. digital skills and capabilities		2.3.2. Mutula, S.M. & Van Brakel, P. (2007) ICT skills readiness for the emerging global digital economy among small businesses in developing countries, *Library Hi Tech*, 25(2), 231–245 >Provides some overview of digital skills requirements, though case study is specific to Botswana
	2.4. ICT4D stakeholders and policies		2.4. Unwin, T. (2009) ICT4D implementation: policies and partnerships, in: *ICT4D*, T. Unwin (ed.), Cambridge University Press, Cambridge, UK, 125–176 >Provides a detailed overview of the key stakeholders, initiatives and policies of ICT4D 1.0 Heeks, R. (2014b) *ICT4D 2016: New Priorities for ICT4D Policy, Practice and WSIS in a Post-2015 World*, Development Informatics Working Paper 59, IDPM, University of Manchester, UK >Includes ideas for ICT4D policy priorities for the SDG era
	2.5. financing ICT4D		2.5. Galluser, R. (2003) *Financing ICT4D Projects*, SDC, Berne and Mathison, S. (2004) Innovative financing mechanisms for ICT4D, in: *ICT4D – Connecting People for a Better World*, G. Weigel & D. Waldburger (eds), SDC, Berne, Switzerland, 230–238 >Both focused on financing during ICT4D 1.0 but still good overviews of the topic area
	2.6. the digital divide		2.6. Dodel, M. (2015) An analytical framework to incorporate ICT as an independent variable, in: *Impact of Information Society Research in the Global South*, A. Chib, J. May & R. Barrantes (eds), Springer, Singapore, 125–144 and Hanafizadeh, M.R., Hanafizadeh, P. & Bohlin, E. (2013) Digital divide and e-readiness: trends and gaps, *International Journal of E-Adoption*, 5(3), 30–75 >Both undertake historical reviews of digital divide models and literature

3 Implementing ICT4D

In reading this chapter, you will learn to:

- explain the steps of ICT4D strategy;
- describe good practice in ICT4D implementation;
- utilise the design–reality gap model in ICT4D implementation;
- identify key determinants of ICT4D adoption and use;
- summarise key ICT4D evaluation frameworks and issues.

In Chapter 3, we retain the focus on the ICT4D value chain that we had in Chapter 2, but we switch from the boxes to the arrows – from components to processes – and we will extract four main steps from the ICT4D value chain: strategy, design and implementation, adoption and use, and monitoring and evaluation. Where the Chapter 2 approach used the value chain as a structural theory of change, this chapter therefore uses it as a processual theory of change: identifying those processes necessary to enable ICTs to deliver development results.

3.1. ICT4D strategy

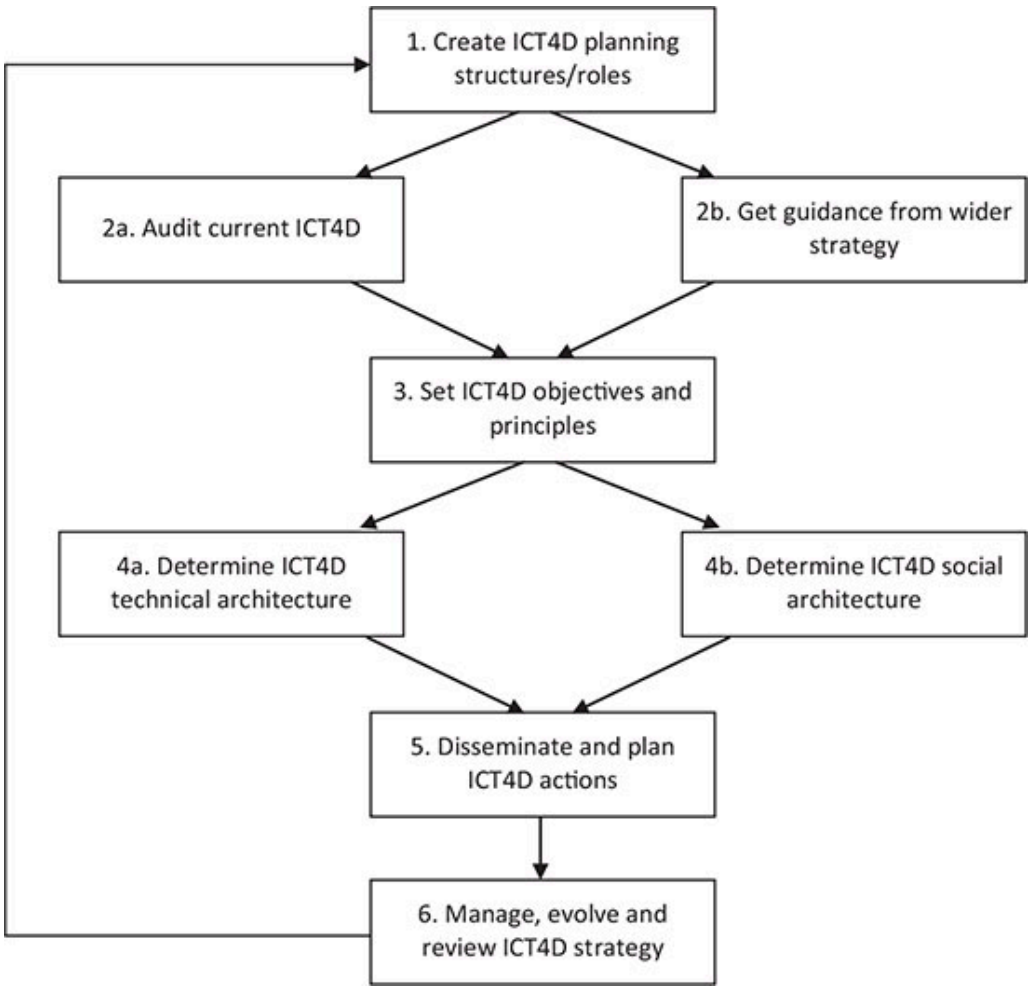
An ICT4D strategy is a plan for ICT4D initiatives and their supporting infrastructure which maximises the ability of organisations to achieve international development objectives. The idea that you need a strategy for any activity is powerful and widespread: “If you fail to plan, you plan to fail” and such like. For example, there were problems with ownership, management,

implementation and use of e-government in a number of Tanzanian public sector agencies due to the lack of strategic planning (Nfuka et al. 2009).

In very simple terms, ICT4D strategy can be broken down into three questions:

- Where are we now: what is the current status of ICT4D?
- Where do we want to get to: what should be the future of ICT4D?
- How do we get there: what actions should be taken to transform the current situation into the future one?

Figure 3.1 The steps of ICT4D strategy



ICT4D strategy can be conceived as a set of steps undertaken systematically over a period of a few days or weeks or months depending on the scale and depth of the ICT4D initiative (see Figure 3.1; text and model adapted from Heeks 2006a).

In greater detail:

1. *Create ICT4D planning structures/roles*: this might involve an ICT4D Strategy Group drawn from the most powerful project stakeholders (see Section 2.4) with a role of commissioning or undertaking the strategy; making and communicating strategic decisions; securing and allocating resources; and monitoring and controlling operationalisation of the strategy.

2a. *Audit current ICT4D*: can be understood from the abbreviation's components – what data and information are available at present in the context (I); what data flows, interactions and transactions take place (C); what digital and other technologies are available and used (T); and what is the general state of socio-economic development (D). The audit would look at both working systems and problems and, within the "D" element, would cover the status of the other precursors and inputs of the ICT4D value chain including the cultural and political context.

2b. *Get guidance from wider strategy*: the audit answered, "where are we now?" This step answers "where do we want to get to?" by striving to align ICT4D with wider strategy. This seeks to avoid a common failure of ICT4D projects to make any broader contribution to development. An obvious further question here is: "who is *we*?": which stakeholder(s) is seen as central to the strategy-making process? This step could answer this with an upward-facing approach: seeking to align ICT4D strategy with the strategies of higher-level stakeholders such as national government or international donors. Or it could answer this with a downward-facing approach: seeking to align ICT4D strategy with the priorities and strategies of lower-level stakeholders such as intended low-income users and other beneficiaries.

3. *Set ICT4D objectives and principles*: if it does anything, an ICT4D strategy should set some objectives for the ICT4D initiative – what change is it intended to deliver? But this may also be accompanied by a statement of principles. For example, at the broadest level, an ICT4D strategy could have

the developmental objective of delivering one or more of the Sustainable Development Goals and follow the three SDG principles:

– Inclusive: ICT will be open to all designers, producers and users.

– Transformative: ICT will enable structural change in the existing political economy.

– Sustainable: ICT will meet the needs of the present without compromising the ability of future generations to meet their own needs.

An example of a mid-level approach is shown in Box 3.1, with objectives and principles that fit a particular development organisation.

Box 3.1

Example ICT4D strategic objectives and principles

SIDA's Department for Democracy and Social Development's ICT4D strategy had three objectives:

"a) needs-based integration of ICT in all relevant projects and programs

b) promotion of and support to relevant ICT4D efforts in partner countries

c) development of synergistic linkages and networks of collaboration"

And five principles:

- View ICT as a means to achieve development goals not an end in itself.
- Prioritise the social value added through information and communication, rather than the technology per se.

- Integrate ICTs on the basis of development needs.

- Allow for a continuum of approaches from those adding small ICT components to those that are built around ICT.

- Allow for unintended consequences of ICT.

Source: SIDA (2003)

Or principles could be defined at an even more specific level for individual ICT4D projects. These could be project selection principles: a mix of impact (benefit) and implementation (cost) factors. Impact selection criteria would depend on the particular development goal(s) of the project: highest income generated; greatest capabilities generated; strongest solution to existing development problem; etc. Implementation selection criteria could include: lowest risk/highest feasibility, lowest cost, or fastest time to implement. Or these could be ICT4D Project Implementation Principles, as discussed in Section 3.2.

4a. *Determine ICT4D technical architecture*: ICT4D strategy can be seen as needing to lay out the ITPOSMO dimensions for the future (see the design–reality gap model in Section 1.3). The information, technology and process dimensions are together the ICT4D technical architecture; sometimes known as the "information infrastructure" (though that can also include more human and organisational aspects). As summarised in Figure 3.2, this can consist of one or more of:

- A data model: showing the structure of core data items to be shared across the ICT4D initiative.

- A process model: showing the key development processes the ICT4D system(s) will undertake and support.

- An ICT model: showing the overall design for the three technological foundations of ICT4D described in Chapter 2; telecommunications, hardware and software. A generic example of this was shown in Section 2.2, and Figure 3.3 shows a more specific example of such a model – called the

"Bottom Billion Architecture" – implemented in South Africa (Doerflinger & Gross 2011).

- A data flow model: the connection between data and processes showing how data is communicated to support different processes.

- A data management model: the connection between data and ICTs showing how the information value chain CIPSO functions (see Chapter 1) will be divided across the ICT architecture.

For an ICT4D policy or programme, this would be very high level only and probably focused mainly on the ICT model; for a project, more detail would be provided.

4b. *Determine ICT4D social architecture*: the ICT4D technical architecture just described dealt with the first three ITPOSMO dimensions, but the final four must also be strategically considered: objectives and values, skills and knowledge, management systems and structures, and other resources. If not already part of placing the ICT4D initiative within its wider strategic context, general strategic decisions may include: stating the change management approach; specifying required collaboration and management structures; allocating ICT4D systems development responsibilities, procedures and methodologies; identifying major competency gaps and approaches to closing them; identifying financial approaches to be adopted. This may include building external relationships and partnerships.

Figure 3.2 Elements of ICT4D technical architecture

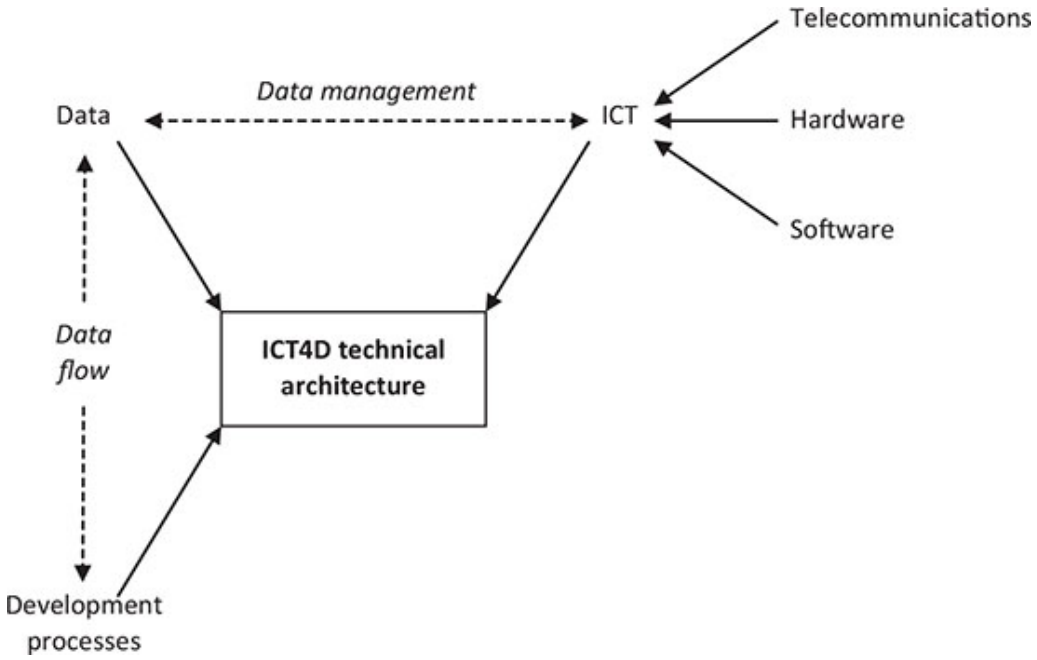
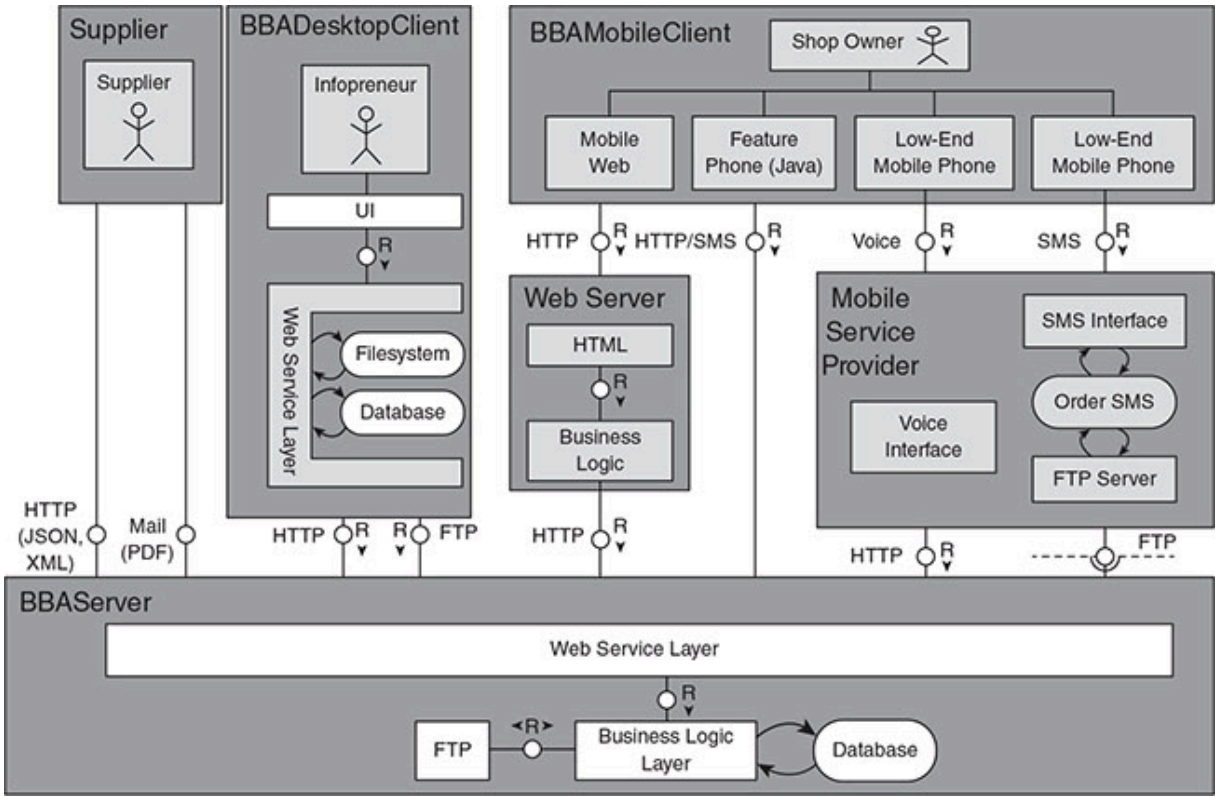


Figure 3.3 Example ICT model architecture



5. *Disseminate and plan ICT4D actions*: the defined ICT4D strategy statement can now be disseminated. It can then be broken down into more detailed implementation plans. The latter might include details of sub-components such as individual projects and deliverables along with their timetables and resource requirements; plus measures of impact against which the projects will be evaluated. An example of an ICT4D strategy statement is shown in Box 3.2.

Box 3.2

Example ICT4D strategy content

Executive summary

– Core rationale, process and plans

Context

– Why ICT4D?

– Why strategy?

– Key ICT4D trends and drivers

Strategy

– Organisational strategic focus

– ICT4D portfolio development strategy

– ICT4D internal support structure development

– ICT4D external relationship development

– ICT4D business process change

Implementation

– Near-term work plan ("establish an ICT4D knowledge exchange program . . . build and maintain an ICT4D portfolio . . . build commitment to use of ICT4D solutions . . . develop CRS' capacity to deploy ICT4D solutions")

Source: CRS (2010)

6. *Manage, evolve and review ICT4D strategy*: strategic planning is intended to work as a continuous cycle and thus one task of the ICT4D

Strategy Group will be to monitor implementation: performance against objectives; unintended benefits and problems; resource usage; contextual changes. Such review may cause incremental or more major changes to the strategy; the latter leading the full cycle to be repeated.

Strategy is sometimes conceived as a large-scale, top-down, proactive exercise but this is rarely the case in reality. ICT4D actors may lack the capacity for such exercises, the "wider strategy" may not exist, the ICT4D arena often lacks certainty and stability, and the assumption of humans as wholly-rational actors is misplaced (Avgerou 2002, Odit et al. 2014). As a result, ICT4D strategies in practice are often fairly low-resource and light-touch activities. They set a flexible guiding framework rather than providing "tablets of stone" that must be exactly adhered to. And alongside their rational purpose of guiding decision-making, they are equally cognitive (helping stakeholders make sense of the emerging relation between ICTs and development) and political (seeking to secure resources and support for ICT4D).

3.2. ICT4D design and implementation

Most ICT4D projects fail. The evidence base for that claim is more limited than it should be given the importance of the topic. But alongside examples of individual project failures (Barnett 2012, Musiyandaka et al. 2013, Van Reijswoud 2014) including multi-site projects (Best & Kumar 2008), we also have examples of cross-project analyses that point to failure being the majority story, with a recurrent figure that around 70 per cent of initiatives are failures (Heeks 2003, IEG 2011, Dodson et al. 2013). Some care is needed here:

- There is nothing to suggest that ICT4D is particularly cursed in terms of failure. We have evidence to support the view that the majority of ICT projects (Standish Group 2015), the majority of development projects (EWB 2011) and indeed the majority of projects (Kerzner 2014) fail. The figure of 70 per cent is again recurrent.

- "Fail" can mean different things (Heeks 2003). Only a minority of these cases are *total failures*: projects never implemented or implemented but immediately abandoned. So most are *partial failures* of some kind in which major goals for the initiative were not attained and/or there were significant undesirable outcomes. Examples would include *sustainability failures* that succeed initially but are then abandoned after some time (Heeks 2006b), *replication failures* that succeed in one place but cannot be repeated elsewhere (Heeks 1999), and *process failures* that specifically overrun their time/money budgets (Lyytinen & Hirschheim 1987). But note any partial failure can also be seen as a *partial success* since some goals are wholly or partly attained, in which case failure may be a disappointment but not a disaster.

- Failures – even total failures – may bring benefits if those involved and others learn from the experience. That is the intention of all the sources cited above and dozens of other reports of ICT4D failure: to try to wrest some gain from the waste of hundreds of millions of dollars-worth of investment, and to try to reduce such waste in future, by understanding why the failure occurred and how to stop it happening again. This section summarises those lessons.

Given the prevalence of failure, the packaging of lessons as models for ICT4D success comes from multiple disciplinary directions (see Figure 1.6 in Chapter 1 as a reminder). Examples include:

- Development studies: the process approach to development that in contrast to the "blueprint" approach, advocates beneficiary participation, flexibility, learning and use of local institutions (Walton & Heeks 2011).

- Informatics: agile methodology for software development that focuses on iterative, incremental working by self-directed teams communicating frequently with clients (Haikin 2013).

- Informatics: various design methodologies that arise particularly from those working on human-computer interaction and, behind that, from design science (Johri & Pal 2012). These include participatory design which has political origins in advocating empowerment of ICT users, and user-centred design

which has more instrumental origins in seeking more effective development methods (Maail 2011).

- Development informatics: the design–reality gap model (Heeks 2002b) was introduced in Chapter 1 and will be discussed further later.
- Development informatics: lessons from ICT4D failure have been distilled into a set of nineteen critical success factors (Pade-Khene et al. 2011) and a set of nine "Principles for Digital Development" (DP 2015).

Despite these very different origins, there is a great deal of overlap in the recommendations these different approaches make. These can be distilled into a set of core guidelines. Indeed, this has already been done a number of times; most notably in the aforementioned Principles for Digital Development. This section largely follows those Principles but makes some amendments to more fully incorporate key lessons from past failure, and to provide a clearer overall structure (see Figure 3.4). For want of anything better, we'll call these the "ICT4D Project Implementation Principles".

Figure 3.4 ICT4D Project Implementation Principles

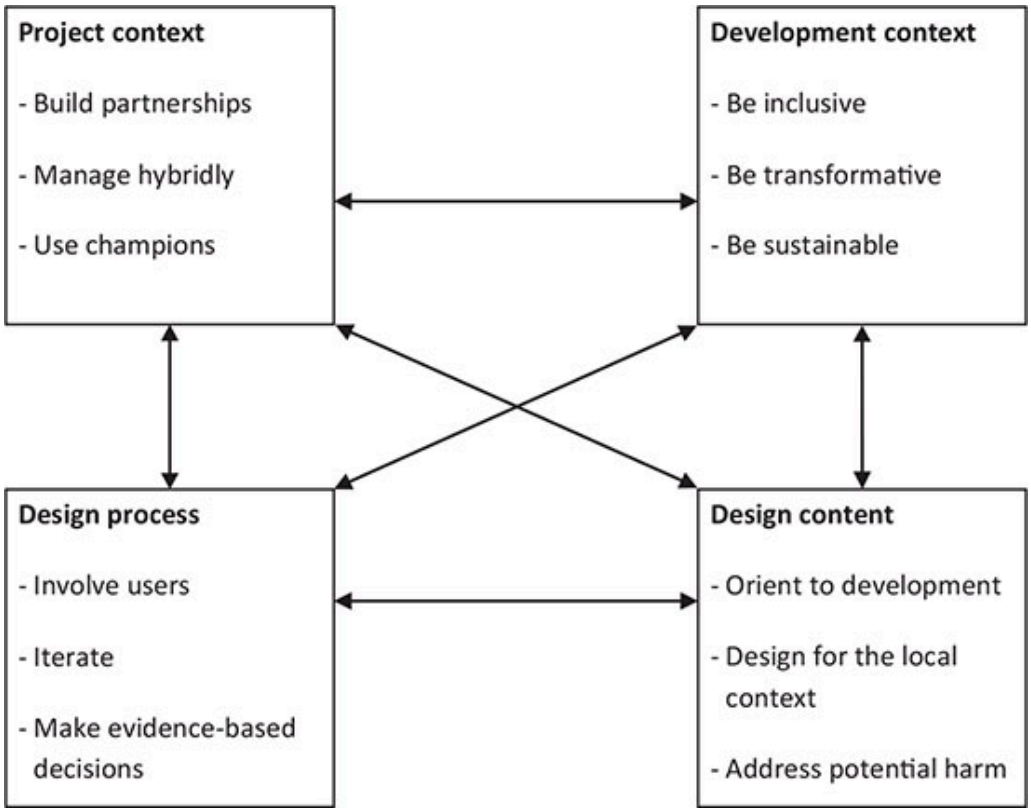
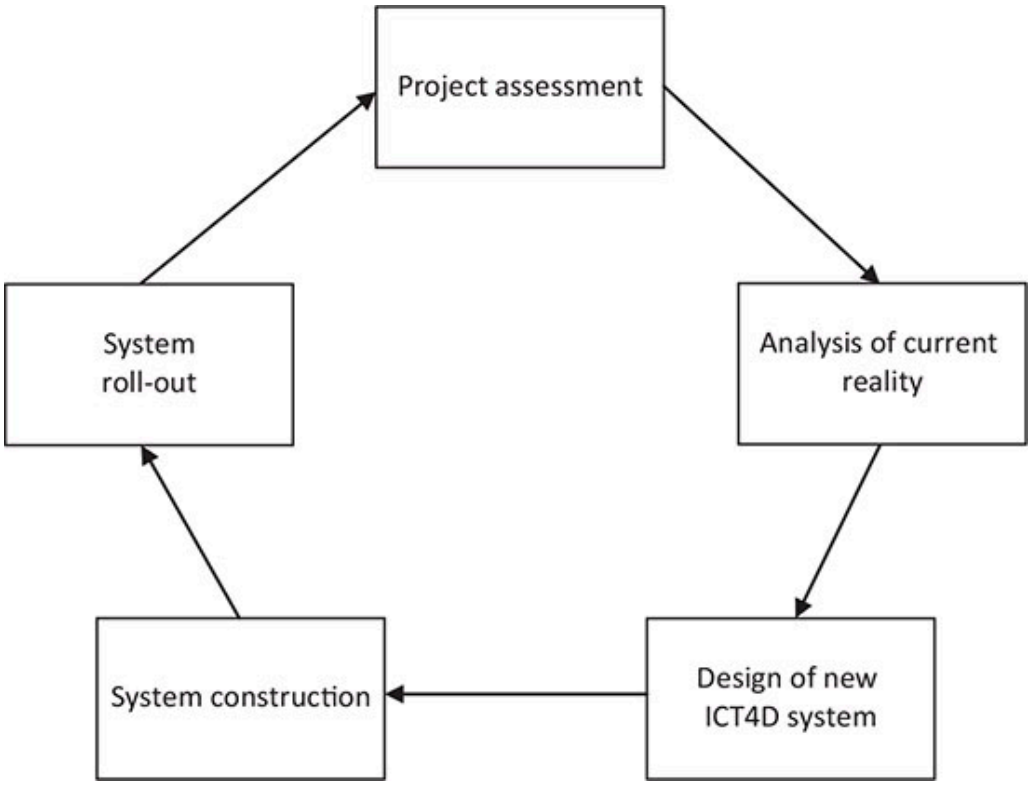


Figure 3.5 ICT4D project lifecycle



Although Figure 3.4 includes mention of design, it would be a mistake to assume ICT4D project implementation is only about design. Implementation is better understood as a lifecycle of five elements, as shown in Figure 3.5 (adapted from Heeks 2006a; see also Pade-Khene et al. 2011). Most of the ICT4D Project Implementation Principles – even those in the two design categories – apply to most of the implementation elements.

In outline, the elements are:

1. *Project assessment 1*: identifying problems and opportunities; identifying possible ICT4D projects; outlining basic project parameters; and assessing whether or not it is feasible to proceed with the project.

2. *Analysis of current reality*: describing and analysing current ICT4D realities including technology, capabilities, context, needs, issues, etc.

3. *Design of new ICT4D system*: setting objectives for the proposed new ICT4D system, and then describing in general and then specific terms the

new technical and social elements of the system needed to meet these objectives.

4. *System construction*: acquiring any new technological infrastructure; building and testing the new system.

5. *System roll-out*: training users; acquiring data in required formats; introducing the new system.

6. *Project assessment 2*: monitoring and evaluating ICT4D system performance and context; identifying any arising problems and opportunities, which might be the trigger to re-start the cycle.

Different methodologies view the cycle in different ways: traditional methodologies see it as more linear than cyclical; newer methodologies see further iterations within the main cycle.

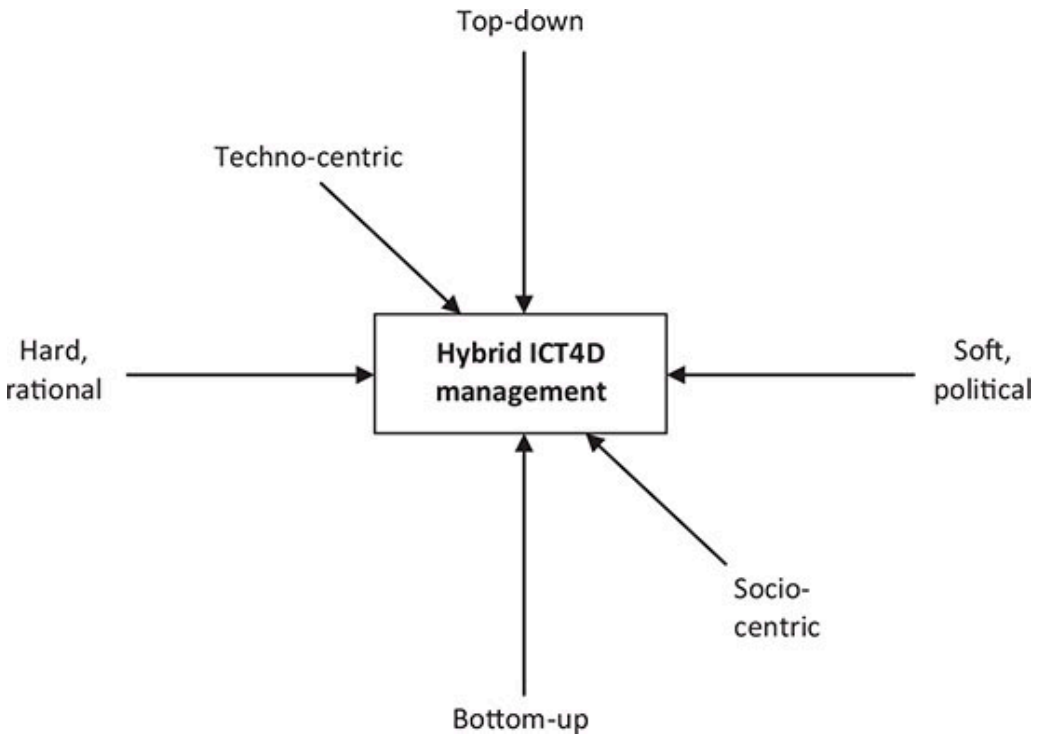
3.2.1. ICT4D project context

Build partnerships. We have already seen from Chapter 2 that ICT4D is a multi-stakeholder activity. Collaboration between stakeholders will ensure efficiency as resources are shared, and effectiveness as ideas and interests are shared (Nurdin et al. 2014). There is a rational element to this, and also a political element; ensuring key actors are not excluded. In particular, there needs to be collaboration with powerful stakeholders such as senior individuals in the funding and implementing organisations, and in the context of ICT4D deployment.

Manage hybridly. There are three tensions that ICT4D project managers must negotiate (Pade-Khene et al. 2011, Dodson et al. 2013), as summarised in Figure 3.6. The first is between the technical and the social. Technology-centred projects fail because they do not take people and social context into account. Social-centred projects will fail to make use of the opportunities new technology has to offer. ICT4D project managers must follow a hybrid socio-technical path that locates technology in its social context. Second, and very much related, is the tension between "hard" and "soft" worldviews. Hard, rational approaches focus on optimal solutions identified from logical

criteria. Soft, political approaches focus on power, bargaining and personal interests. ICT4D project managers must follow a hybrid bounded-rationality path that recognises the cognitive and political limits on rationality and that to get tasks completed, a mix of rational and political actions is required. Third is the tension between top-down and bottom-up. Top-down projects fail because they ignore on-the-ground realities. Bottom-up projects fail because they ignore the interests and knowledge and other capacities of high-level actors. ICT4D project managers must follow a hybrid federal path that mixes top-down control, efficiencies and insights with a bottom-up flexibility that understands development beneficiaries and their needs and agency.

Figure 3.6 Hybrid ICT4D project management



Use champions. As defined in Chapter 2, a champion is "the person (or group) who drives the ICT4D initiative forward and seeks to justify its implementation". They are a frequent – perhaps universal – occurrence in successful ICT4D projects, and can be characterised by 3Rs: results,

relationships and resources (Renken & Heeks 2013). ICT4D champions have a clear vision of the results they want from the ICT4D project, and they maintain or build a diverse set of relationships in order to obtain both material and intangible resources for successful completion of the project. They are typically adept hybrids who are able to span the technical and the social, the rational and the political, and the outside and inside of an ICT4D project. Where they do not emerge organically, it may be possible to identify and develop ICT4D champions.

3.2.2. ICT4D design process

Involve users. The classic ICT4D error is for designers to get all excited about the technology, and forget about the users. To avoid this, users need to be involved in ICT4D design and construction in some way. This can be understood as some type of ladder of participation building from lesser to greater degree of involvement (Maail 2011, Ongwae 2016); for example:

- Informing: the developers give updates to users as the ICT4D project progresses.
- Consulting: the developers formally discuss key design and construction decisions with users, but retain decision-making power.
- Cooperating: developers and users are jointly responsible for key design and construction decisions.
- Co-creating: users become members of the development team and assist directly with ICT4D system design and construction.
- Producing: responsibility for some or all of ICT4D system design and construction is devolved to users.
- Controlling: responsibility for the ICT4D project is devolved to users.

User participation has various benefits: it exposes the design process to user realities (skill levels, interests, norms, etc) which might derail the project; it exposes users to the design so that their expectations are managed; it allows the project to draw on an additional set of resources; and it gives users some ownership of, and motivation to adopt, the new system (Barakabitze et al. 2017).

Iterate. The principle of iteration applies in various ways. At the start of an ICT4D project, one should "use, modify, and extend existing tools, platforms, and frameworks when possible" (DP 2015). Within the project itself, iteration means you don't release just a final version of the system at the very end of the project. Prototyping is common: providing users with an initial version of the ICT4D system on which they can have a trial run and offer feedback, which is then incorporated into a revised, improved version (though this might loop back all the way to re-analysis of reality if serious problems emerge). There can be a number of cycles of release and improvement – gradually introducing the new system rather than attempting a "big bang" changeover – up to the notion of systems never being finalised and always in "perpetual beta".

Make evidence-based decisions. This seeks to push ICT4D projects from the subjective to the reflective and objective. Partly, this involves integration of learning into ICT4D projects: time at the start of projects to look for evidence from similar past experiences; time during projects for the team to reflect on the process to date and reorient if necessary; time at the end of the project to document and disseminate key lessons (Sinha & Garro-Strauss 2013). Partly, this involves a data-oriented approach: setting clear metrics for project deliverables and impact; seeking innovative ways to gather data about and from the ICT4D system; using strong communication and visualisation techniques to help maximise use of data in decision-making. These may be enhanced by aiming for higher "maturity" levels on ICT4D projects, as explained in Box 3.3.

Box 3.3

ICT4D project management maturity

Maturity models are a common and long-standing feature of the informatics field, dating back at least to the 1970s with Gibson & Nolan's (1974) four-stage model of "electronic data processing" systems that ran from Initiation through Expansion and Formalisation to Maturity. From maturity of systems, this notion spread to maturity of systems development, with the best-known being the Capability Maturity Model. This has gone through a number of versions, but one example has six levels of increasing capability to manage systems development: Incomplete, Performed, Managed, Defined, Quantitatively Managed, Optimising (SEI 2002).

It is therefore no surprise that the idea has spread to the management of ICT4D projects, with a maturity model proposed as summarised in Table 3.1 (developed from Ciaghi et al. 2014). This sees maturity operating across four areas of ICT4D project management which are similar to the four main phases of the ICT4D value chain identified in this chapter: strategy, implementation, sustainability and evaluation/impact. There are three levels of maturity:

- Ad hoc: "processes are carried out ad hoc and chaotically".
- Structured: "the organisation introduces basic and documented processes".
- Defined: "all processes have been institutionalised and standardised".

Although prescriptive – telling ICT4D project managers what they should be doing – the model also claims to be descriptive: reflecting actual practice. It represents a rather different approach to that advocated by the Principles for Digital Development, which say little about standards and structure and documentation. Further evidence would be needed to demonstrate that higher levels of maturity – particularly the move from Structured to Defined – deliver better development results.

Table 3.1 ICT4D project management maturity model

	Strategy	*Implementation*	*Sustainability*	*Evaluation and imp*
Ad hoc	No formal strategy	No formal methodology	Not properly considered	Little or no formal measurement
Structured	Basic strategy formulated	Formal methodology used	Sustainability is considered	Goal-based framew used for evaluation
Defined	Overarching strategy linked to development goals sets structure for all ICT4D activities	Formal methodology used with standards set for all implementation processes	Sustainability is integrated from start of projects	Standard evaluatio framework used across projects and across time

3.2.3. ICT4D design content

Orient to development. This is ICT*4D*. The whole project and all its component actions should be focused on delivering a development goal. That goal should head every document and start every meeting to ensure it remains the prime orientation. One implication already noted is that projects should avoid being "techno-centric": a trait associated with higher failure rates (Dodson et al. 2013).

Design for the local context. The other classic ICT4D error is for designers to get all excited about the technology and forget about the deployment context. This creates too large a gap between ICT4D design and local reality. So, along each one of the ITPOSMO dimensions, those local realities must be understood and the design must take account of them: the data that is actually available; the technology that users can access; local political imperatives; local cultural norms and values; the policy environment; the level of knowledge and skills; and so forth. One approach to this – the emerging field of HCI4D – is discussed in Box 3.4.

Box 3.4

HCI4D: designing ICT for low-income communities

During the twenty-first century, there has been growing activity in the field of human–computer interaction for development (HCI4D): "a subfield of ICT4D that focuses on understanding how people and computers interact in developing regions, and on designing systems and products specifically for these contexts" (Ho et al. 2009:2). Much of the work in HCI4D deals with the type of design principles discussed in this section. That includes designing ICT that is suitable for the context of low-income communities in developing countries. This helps minimise design–reality gaps, improves the likelihood of ICT adoption and use, and thus helps maximise the value of ICT4D investments. Some typical work areas include (ibid., Toyama 2010, Wyche 2015):

- Hardware design: cutting back hardware design to basic features only in order to save costs or energy use; ruggedisation to aid technology longevity in a challenging environment; simplification to enable local hardware maintenance.

- Software design: to enable easier shared use of costly devices such as PCs; tracking and blocking applications to help reduce incentives to ICT theft.

- Interface design: although part of software design, this deserves separate recognition because so much activity takes place here. This includes translation work to provide interfaces in local languages, and the creation of audio-visual interfaces – human intermediaries, voice recognition and synthesis, use of graphics and video – for low- and non-literate users. It also includes work to design for one of the most excluded groups in developing countries: the disabled (Vashistha et al. 2014, Barlott et al. 2016).

- Content design: going beyond just the interface to design services based around audio rather than text content; for example, "to enable many of the functionalities of the regular Internet, but entirely through [feature] phones" (Toyama 2010:42).

The typical assumption of HCI4D still tends to be that designs and technologies will be brought in from outside the low-income environment, and there has been a focus on design approaches – such as researcher immersion or storytelling techniques – that best elicit local needs. However, there is growing interest in design based on the resources and technologies already to hand within those environments: so-called "bricolage" or "*jugaad* innovation" (Gaur et al. 2014). At first, this mainly meant incremental adaptation of existing ICT4D systems rather than more radical innovation, and reworking of the social processes around the technology rather than the technology itself. But as digital technologies and skills diffuse further at the base-of-the-pyramid, options are growing.

Address potential harm. As already noted in Chapter 2, alongside development benefits, ICTs bring with them the potential for harm: cybercrime; environmental damage; ICT-enabled social ills such as pornography, gambling and bullying; ICT-induced personal stress, conflict and addiction; curtailment of rights to privacy and freedom of expression; and digital monopolies (Hechanova & Ortegao-Go 2014, Heeks 2016a, Lusinga & Kyobe 2017). A technology assessment exercise at the start of the ICT4D project can identify which of these are the most likely risks, and then seek ways in which design and implementation can mitigate those risks. This is one part of a broader principle of risk mitigation via design–reality gap closure: see Box 3.5.

Box 3.5

ICT4D risk mitigation through design–reality gap closure

ICT4D projects fail because they have too large a gap between design and reality. For example, a review of a Community Computer Centres project in Nigeria found it to be largely unsuccessful: only 6 of the 27 centres were even partially operational (Kanya & Good 2013). Analysis revealed gaps along all of the ITPOSMO dimensions such as: a design assumption of up-

to-date digital technology vs. a reality of outdated ICT; design objectives that prioritised computer literacy as a development objective vs. a reality that government officials had other development priorities; a design requirement for functioning operational budgets vs. absence of such budgets in reality; etc.

From this and other examples, one can identify archetypal design–reality gap failures which have been shown to impact ICT4D projects (Heeks 2002b, Ayoung et al. 2016):

- Hard-soft gaps: where an ICT4D system designed on the basis of a technical, rational worldview is introduced into a much more politicised reality.

- Country context gaps: where an ICT4D system designed for one country context is introduced into the different contextual reality of another country.

- Sectoral gaps: where an ICT4D system designed for the private sector is introduced into the different reality of the public or NGO sector.

The ICT4D Project Implementation Principles outlined above help improve the likely success of ICT4D by closing gaps between design and reality: involving users puts designers in touch with user realities; iteration reduces the extent of difference between design and reality in any given cycle; evidence-based decisions allow developers to reflect on current gaps; etc. But we can draw some additional prescriptions:

- Conduct a design–reality gap analysis during implementation. This can be done using the basic ITPOSMO dimensions, or more detailed sub-dimensions (Heeks 2008c), or ICT4D project-specific checklists (Kemppainen et al. 2014). Action can then be taken where large gaps are identified (see, for example, Lessa et al. 2015). This can mean changing the design: making greater use of existing data and technology, automating existing processes rather than also reengineering them, and so on. But it could also mean changing current reality: using incentives to change stakeholder motivations, training to build user skills, and so on. The assumption is that responsibility for closing gaps lies with system developers

(Diniz et al. 2014). However, in practice, users and intermediaries often do this – not changing the technology but changing the surrounding processes and system. This was seen, for example, in deployment of m-money systems when various workarounds were developed, with agents waiving identification rules for known clients, entering passcodes on behalf of clients, and wiring money between accounts to maintain a working float (ibid., Foster & Heeks 2013b).

- Risk must be balanced against reward. A zero-risk project will be one in which there is no gap between design and reality. But no gap means no change, and no change means no development. So there is a risk-reward tradeoff: the bigger the gap, the greater the risk but also (maybe) the greater the degree of development. Of course there are no guarantees here: a larger degree of change will be riskier but the change could be damaging rather than beneficial. However, ICT4D projects can often face a decision: to attempt a lower-risk incremental improvement in well-being or a higher-risk transformation that truly empowers (Oosterlaken 2015).

- Understand inscription. Inscription describes the way in which particular assumptions are written into the design of new technologies (Heeks 2002b). You can think of this as a continuum. At one end are "reality-supporting technologies" which contain relatively shallow inscriptions: they impose few assumptions or requirements. Voice calling on a mobile phone would be an example: it makes few behavioural design assumptions beyond the basic skill of pressing the odd button; otherwise it merely supports the current reality of human conversation and can be applied flexibly to all sorts of such conversational situations. At the other end are "design-imposing technologies" which contain relatively deep inscriptions: they impose a number of assumptions or requirements. A decision support system on networked PCs would be an example: it requires an objective data set, formal decision and management processes, a high level of skills, an assumed rationality of culture, and more. It is inflexible and leaves little room for local improvisation or for development of local ownership and empowerment: in other words, little room for appropriation (see Chapter 2). We can combine this with the previous implication to make a sweeping generalisation that feature phone-based ICT4D will have a greater chance of

success but make less of a development impact compared to PC-based ICT4D; a generalisation which has some evidence base (Luk et al. 2009).

We could also go deeper to understand why design–reality gaps arise in the first place, with root causes that are historical, cultural and organisational among others (Masiero 2016). The depth and institutionalisation of such causes may make gap closure difficult in practice.

3.2.4. ICT4D development context

The principles listed here mirror the three principles underlying the Sustainable Development Goals.

Be inclusive. The other principles tend to be quite generic and inductive: they are seen to apply universally (more on that in Section 3.2.5) and they derive from observed practice. This principle is more specific and deductive: it derives from a particular view of development; one that not everyone might share. It also has a number of possible implications.

- Maximise scope of inclusion. The idea of involving users would start to be unpacked to identify who exactly was represented in participative processes, and who was not. Power shapes those processes "through mechanisms of agenda control (what is discussed and who decides the themes), participants (who are invited in), scope (which solutions are possible) and resources (available time and people)" (Mukherjee 2015:502). The social dimensions of digital exclusion were already rehearsed in Section 2.6, and thus we may see, for example, women or the poorest members of a community excluded from ICT4D participative processes unless specific actions are taken to overcome traditional power structures (Steeves & Kwami 2012, Thapa & Saebo 2016).

- Maximise depth of inclusion. Including excluded groups in ICT4D means not just designing for them, but designing with them, or even design by them. These higher levels of user participation in particular require a change in mindset as described in Chapter 1 in moving from ICT4D 1.0 to ICT4D 2.0 (Heeks 2009a); from seeing excluded groups as passive recipients of ICT4D

to seeing them as active creators, producers, innovators. In other words, shifting our gaze further up the ladder of ICT4D capabilities outlined in Chapter 2 and thus further up the ladder of participation outlined earlier. Vashistha et al. (2014) give an example of this: they were a team of ICT4D designers intending to help those on low incomes in India who were visually-impaired with new digital content. They could have read the literature on assistive technologies and designed some new systems for their target group. Instead, the team saw their intended beneficiaries as having agency and started by finding out what they were already doing themselves. They found a vibrant ecosystem in which content was being generated, shared and consumed. Design could then build organically upwards from this existing activity, rather than seeking to impose some inappropriate external ideas. Taking this type of grassroots innovation approach may require a prelude in which the capabilities of beneficiaries are strengthened.

- Follow open principles. This would mean, for example, making use of open data where possible and making project data open; using and developing open source software; and/or making any published materials open access such as via Creative Common licensing (DP 2015). (For more details on openness, see Chapter 9.)

Be transformative. The international development agenda seeks to change the world, and we would thus want any ICT4D project to be more rather than less transformative in the extent of change it achieves. That could mean greater depth of change (see Box 3.6) but it could also mean greater breadth of change. In the latter case, being transformative means we want successful ICT4D projects to scale: not just because being larger means more impact but also because – due to the network effects described in Chapter 1 – benefits of some ICT4D systems may only cross a tipping point once the network reaches a critical mass size. However, scaling an ICT4D initiative doesn't just mean an increase in size because more beneficiaries are being reached. It also means an increase in complexity because each new community or organisation involved brings its own particular interests and context (Foster & Heeks 2013b).

A number of specific guidelines follow which are illustrated from one of the most successfully-scaled ICT4D initiatives, the Health Information Systems

Programme (HISP) (Braa et al. 2004, Sahay & Walsham 2006, Sahay et al. 2013):

- Design for scale: as design decisions are being made, ask if those designs could cope with being scaled up. This means asking questions about size (could the design cope with ten times, a hundred times, a thousand times more users), and about complexity (could the design cope with the differing needs and contexts of many different user groups: is it adaptable enough and can it handle that heterogeneity). Those questions will apply to both the technical architecture (the ITP of ITPOSMO) and the social architecture (the OSMO of ITPOSMO). HISP utilised a modular ICT infrastructure that could readily add additional capacity; and a core-periphery data design that allowed for local heterogeneity alongside a standardised core.

- Partner for scale: barring a miraculous start-up story, most scaled ICT4D initiatives require collaboration with a partner – generally either government or a large private sector firm – that has the resources and experience sufficient to deal with large-scale operations. HISP partnered with government to allow nationwide scaling.

- Manage for scale: as per the earlier ICT4D Project Implementation Principle, managing for scale means managing hybridly – balancing central control that (for example) allows interoperability of systems and scale economies, with local flexibility that (for example) allows local needs to be met. HISP adopted a federal management structure that gave shared central direction and focus on strategic objectives alongside an ability for local teams to address local issues.

- Innovate for scale: there is a mistaken impression that innovation occurs at the start of an initiative and then stops as scaling occurs. But innovation is a constant necessity if an ICT4D system is to scale: the adaptation to differing local needs as different contexts are incorporated but also as new systems and organisations are encountered. HISP constantly refined both data and software in order to cope with emergent issues via an improvisational approach that only incrementally modified the existing technologies.

- Learn for scale: as an ICT4D initiative scales, there must be ways to reflect and learn about the overall scaling process itself, to enable it to continue; and about specific local innovations, to see which of those could be incorporated centrally and rolled out. HISP developed local learning groups who shared experiences across the project.

Box 3.6

"Deep transformation" and the politics of ICT4D

Real transformation would require changes to the distribution of power within society; altering the patterns of control over the elements identified in Section 2.6 in Chapter 2: not just resources and practices, but control over institutions and knowledge systems, and changes to structural relations. One problem is that, consciously or unconsciously, it is existing rather than transformed patterns of power that tend to get inscribed into ICT4D project design (Heeks 2002b).

There are two trajectories of concern here. One is a reinforcement of the patterns of power within the existing locale of the beneficiaries. We might see this particularly with shallow-inscribed, reality-supporting technologies (see Box 3.5). Thus we find evidence in some mobile-based projects that powerful local actors have their position strengthened (Jagun et al. 2008).

An alternative trajectory changes the local patterns of power but by introducing (and thus potentially reinforcing) an external pattern of power; perhaps associated more with deep-inscribed, design-imposing technologies. This can happen when ICT4D designers inscribe their own cultural assumptions and norms into a project, or when sponsors such as aid donors or private firms inscribe their own interests and values (remember the golden rule: the one who has the gold makes the rules):

> While ICT4D sponsors may not consciously pursue an objective of domination, what is inscribed in the technology they provide, and the processes they define, is deeply rooted in their belief system … While ostensibly doing good, ICT4D sponsors might be presenting alien models of reality on the alleged beneficiaries … The logic of the ICT4D sponsors seems to be to take the destitute out from the

> feudal or agricultural societies they live in by providing them with computer technology, in line with a well-intentioned modernist rationality … However, the assumptions of individualization, commodification and bureaucratization entrenched in the modernist rationality are not necessarily aligned with the traditional beliefs and predominant social practices of the intended beneficiaries.
>
> (Andrade & Urquhart 2012:288–289)

This may well be transformational but transforming to a new pattern that still leaves intended beneficiaries without control of institutions, structural relations or knowledge systems.

The first step towards real transformation that brings power to beneficiaries in all its senses would begin by surfacing the issue of power, and the trajectories of concern (Poveda 2016). And next it would look at which elements of power as shown in Figure 2.27 – resources, practices, institutions, structural relations and knowledge systems – might be changed (Roberts 2016). But making changes, particularly to the broader sources of power, is a mighty challenge, and one that ICT alone will struggle to deliver.

Be sustainable. Concerns about ICT4D sustainability relate less to the wider definition encompassing needs of future generations, and more to keeping ICT4D initiatives going in order that they may have a longer impact. This turns out to be difficult with many reports of ICT4D sustainability failures including telecentres (Conger 2015) and initiatives in e-government (Kumar & Best 2006), e-health (Odit et al. 2014) and e-agriculture (De Zoysa & Letch 2013), among others. There are various ways in which to explain, and hence seek to avoid, sustainability failure. It can be understood as the ongoing existence or opening up of design–reality gaps along the ITPOSMO dimensions or related categorisations such as financial, socio-cultural, technological, politico-institutional and environmental sustainability (Kumar & Best 2006).

But these can be simplified down to three things that make an ICT4D project sustainable:

- Capacity: the project must match the available resources on an ongoing basis; these include money, skills, data and technology. This makes a project usable.

- Utility: the project must keep meeting the needs of at least some stakeholders; it must continue to be useful to someone. This makes a project used.

- Embedding: for long-term sustainability, the project must be "institutionalised" – embedded in the rules and norms, culture and values of its setting. This makes a project used as a matter of routine.

(Heeks 2005:1)

> Thus, for example, analysis of three government-run ICT4D projects found those that sustained did so because they had ongoing capacity (particularly financing streams and skilled operations staff), ongoing utility (they provided value to both users and government officials), and they embedded to become an accepted part of community life and government procedures (Madon et al. 2009). Conversely, lack of sustainability of some e-government projects in Malaysia could be put down to problems with capacity (technical incompatibility and unreliability, and insufficient numbers of competent ICT staff), with utility (user requirements not being met), and with embedding (no long-term strategy for e-government, changes in government leadership, and failure to develop an e-services culture) (Nawi et al. 2013).

The other ICT4D Project Implementation Principles are relevant here because they help close gaps between design and reality, but the difference with sustainability is that it requires thinking ahead about those gaps. In terms of capacity, it means keeping ICT designs simple so they will require low ongoing financial and skill inputs; building in sources for revenue generation so ICT4D projects become self-financing; training not just to develop short-term skills but also for the longer term to build knowledge and to change attitudes including the ability to "learn how to learn". In terms of utility, it means ensuring the real interests of stakeholders will continue to be met which "isn't necessarily about the information or services [ICT4D] provides. Utility could come from income generated, or political goodwill created, or modern image sustained, and so on" (Heeks 2005:1). And in terms of embedding, it means working out how the

project can be institutionalised by integrating it into policies, strategies, rules, procedures and values.

Choosing flexible rather than deeply-inscripted technology designs will help here, allowing ICTs to be adapted to changing capacities and utilities. So also will appropriation (discussed in Section 2.3) – allowing local stakeholders to take ownership of ICT4D systems and undertake their own adaptations.

3.2.5. Reflecting on the ICT4D Project Implementation Principles

In an ideal world, there would have been one ICT4D failure some time back in the 1950s; it would have been written up with a set of clear lessons and guidelines like those listed above, subsequently everyone would have followed them, and there would have been no more failures. Why has that not happened?

Just as with ICT4D projects overall, any failure of particular ICT4D principles can be understood in terms of design–reality gaps: too large a gap between the requirements or assumptions of the principle, and ICT4D project realities. Examples of this mismatch include:

- Knowledge: some developers are unaware of ICT4D good practices. This happens particularly because a fast-growing area like ICT4D induces the entry of new actors, many drawn from technical backgrounds. The literature is littered with dozens of analyses which basically reflect what happens when techie geeks encounter the social realities of development for the first time, and find their beautiful technical designs fouled up by culture, politics, resource constraints, weather, etc (Knoche et al. 2010, Chen 2015).

- Skills: many elements described above are specific techniques that require particular skills to implement. But those skills are not universal – so, for example, the use of agile methodologies in ICT projects in Nigeria is held back by lack of agile-relevant skills (and knowledge) (Omosola 2014).

- Motivation: there is an implicit assumption that all stakeholders are motivated to produce an ICT4D system that is as successful as possible. But that may not be the case. The ICT4D developers may just be paid to produce a system,

without financial incentives to make it effective. The ICT4D users may have other priorities in their lives and have no motivation to participate in the development process. The ICT4D managers may see the new system as a threat to their power structures, and be actively resistant.

- Cultural norms and values: the origins of the principles above lie in the global North – this is where they were first identified from project failures, and you can note how few of them would be unique to developing countries. As a result, they often contain within them cultural norms fit for some parts of the global North but mismatched to cultural realities elsewhere. This is often observed with the issue of user participation; as an idea freighted with different meanings in different contexts as a multi-national e-health project found: participation was a collective cultural activity in South Africa, a hierarchical activity in India and an indirectly mediated activity in Mozambique (Puri et al. 2004). In none of these locations did it either match or achieve what had been assumed from a Northern perspective.

- Resources: most of the principles require extra time and money – to build partnerships, to involve users, to consider potential harm, etc. But both those resources are constrained in ICT4D projects (Ghosh 2012, Vaish et al. 2013). Time especially is in short supply and there will be constant pressure for ICT4D teams to do a quick job rather than a good job.

These are just examples of design–reality contingency when considering the ICT4D Project Implementation Principles, and there are others which are more specific. For instance, different types of projects suit different approaches: management strategies of top-down control can work better for focused projects with a single main actor; more federal and collaborative strategies can work better for more complex, multi-actor projects (Kromidha 2015). In all, we cannot assume the ICT4D Project Implementation Principles can readily be actualised: sometimes they may, sometimes they may not; there may be differential feasibilities of different principles; and it may require groundwork and hard work to put them into practice.

3.3. ICT4D adoption and use

Implicit within a number of ICT4D initiatives – particularly during the ICT4D 1.0 era – has been a "build it and they will come" assumption that has not materialised (Valk et al. 2013). Developers built it. Users did not come. As a result, there has been growing concern with ICT4D adoption and use (see Section 2.1 and the changing value chain interests over time). We will explore this first through relatively simple models, and then look at some more complex, multi-factoral models.

3.3.1. Foundational models of ICT4D adoption and use

The very simplest way to understand adoption and use of ICT4D – indeed any involvement with an ICT4D project – is to assume that each stakeholder asks themselves the "prime question": "Why should I do this?" To just focus only on this would be a horrible over-simplification: we can see from the other parts of this chapter all the other factors that matter. However, it can be very powerful to think through the likely answer that each key stakeholder of an ICT4D initiative will give to this question. The answers give us insight into the core force in human behaviour, whether we call it "utility", "incentives" or "motivations".

The point from Section 2.3 is worth repeating: while most other factors we consider here are enablers or constraints, the answer to the prime question tells us about the drivers for ICT4D; most important because "motivation appears to trump social, technical, and environmental obstacles to adoption of a new technology" (Smyth et al. 2010:761). If key stakeholders see some personal benefit in an ICT4D initiative, they will push to overcome all sorts of constraints and make it succeed. But if an ICT4D initiative has nothing to offer key stakeholders, it will not succeed even if there are no other constraints to its adoption and use.

The idea of designing an ICT4D application so that it motivates users is one implication of the prime question. But it can be turned around to propose identifying those users – who may be called "change agents" or "lead users" – who are already motivated for change. As Patel (2010) describes in relation to m-farming applications in India, it means a mindset change among ICT4D developers: from designing for those who *need* the application, to designing for

those who *want* the application, and then using them to act as role models for others.

The simplicity of the prime question can be enhanced a little by reference to the Technology Acceptance Model (TAM). TAM boils down adoption of ICT4D and other technologies into two user perceptions: perceived usefulness and perceived ease of use (Davis et al. 1989). Perceived usefulness – utility – is synonymous with the prime question, but TAM adds a further element: whether or not it will be easy for the user to achieve that potential benefit. In a way, this could be seen as a simple form of cost-benefit analysis on the user's behalf. As already demonstrated in Section 2.3, TAM has been applied to ICT4D – as another example, adoption of electronic donations ("online *waqf*") by Muslims in Malaysia was shown to be positively correlated to perceptions that an online channel would be a useful mechanism for *waqf* and that it would be easy to use (Amin et al. 2014).

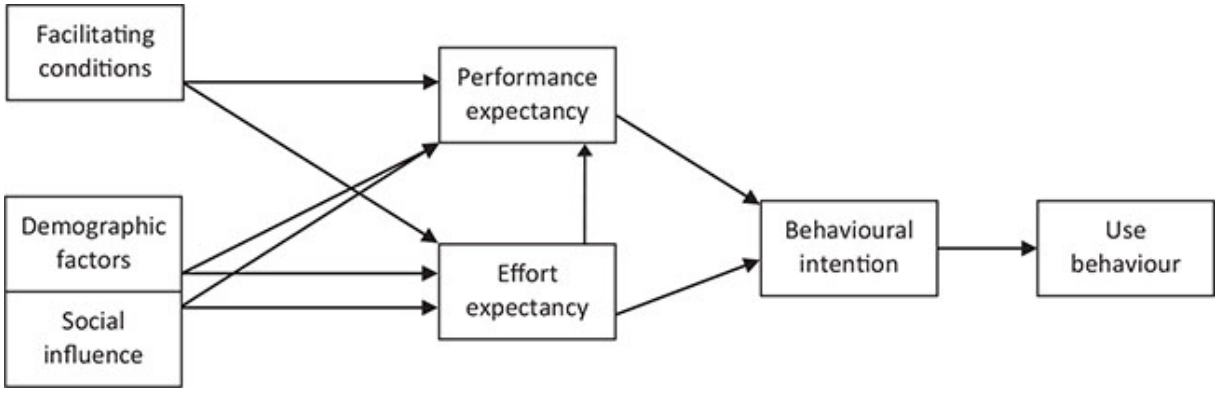
This basic two-factor model of ICT4D adoption and use was expanded in Section 2.3.1 in Section 2 (see Figure 2.8), with examples given of the multiple factors such as values, norms, beliefs, incentives that will affect the likelihood that individuals will decide to adopt and then use a particular ICT4D application. This model is valuable in giving significant emphasis to internal and external motivations; ensuring they do not become lost. But it gives limited detail on the factors that impact these motivations either directly or indirectly. We will investigate these next.

3.3.2. Expanded models of ICT4D adoption and use

TAM has been expanded over time to encompass broader factors. Examples include the Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003) and Rural Technology Acceptance Model (Islam & Gronlund 2011). Figure 3.7 shows a version combining elements of both of these that offers a richer understanding of ICT4D adoption and use than that provided by TAM. Each of the "upstream" factors contains within it many sub-factors but in simple terms, performance expectancy is the perceived benefit of adopting/using ICT4D; effort expectancy is the perceived ease of use of ICT4D; social influence is "the degree to which an individual perceives that important others believe he or she should use the new [ICT4D]" (Venkatesh et al. 2003:451); demographic factors include gender, age and experience with the particular ICT4D application; and

facilitating conditions relate to perceptions about the broader institutional and technical infrastructure of the type described in Chapter 2.

Figure 3.7 Expanded Technology Acceptance Model



A variant of this approach was used to help understand adoption and non-adoption of mobile banking in Nigeria (Olasina 2015). It showed, for example, that gender was not a particularly important determinant but that performance expectancy (such as increased speed and safety of payment), effort expectancy (ease of use), and facilitating conditions (such as external assistance with m-banking) were all linked to greater likelihood of adoption.

Integrated into the Unified Theory of Acceptance and Use of Technology and similar models – alongside dozens of other variables – are considerations about particular features of the technology involved. But these are buried so deep they are hard to recognise. We therefore turn to examine how the particular nature of the ICT4D application affects its adoption and use, by investigating Diffusion of Innovations theory.

3.3.3. Diffusion of Innovations theory

At its heart, Diffusion of Innovations theory is about communication – how details of a new technology spread through a society – because its originator,

Everett M Rogers, was a professor of communication studies (Rogers 2003). He sees diffusion as influenced by four main elements: the innovation itself, the communication channels through which details of the innovation flow, the passage of time, and the social system within which this takes place including the individual adopters within that social system.

Diffusion of Innovations theory can be used in two main ways to offer insights into ICT4D. From an "upstream" perspective, we can disaggregate the attributes of technology (i.e. the innovation) from the other parts of the overall theoretical model. Rogers (ibid.:15–16) identifies five attributes which determine the rate of adoption of an innovation. Perceptions of these have been shown to explain much of variation in adoption decisions for various ICT4D including PCs in Saudi Arabia (Al-Gahtani 2003), telecentres in South Africa (Chigona & Licker 2008), and mobile money in Kenya (Wamuyu 2014). It will therefore help to understand what each attribute means in ICT4D terms, and also to reflect on its implications for ICT4D design and implementation:

- Relative advantage: the degree to which an ICT4D innovation is perceived as better than what came before. This implies that the views of users should be built into the design process about what advantage the ICT4D innovation provides; communication about the innovation should emphasise the relative advantages it will bring to users – indeed, more generally, Diffusion of Innovations makes clear that publicity and marketing should be important parts of ICT4D implementation.

- Compatibility: the degree to which an ICT4D innovation is perceived as consistent with the existing values, experiences and needs of potential adopters. This reinforces the ICT4D Project Implementation Principles of designing for the local context and involving users. Part of this will be ensuring affordability: compatibility with the incomes of local users.

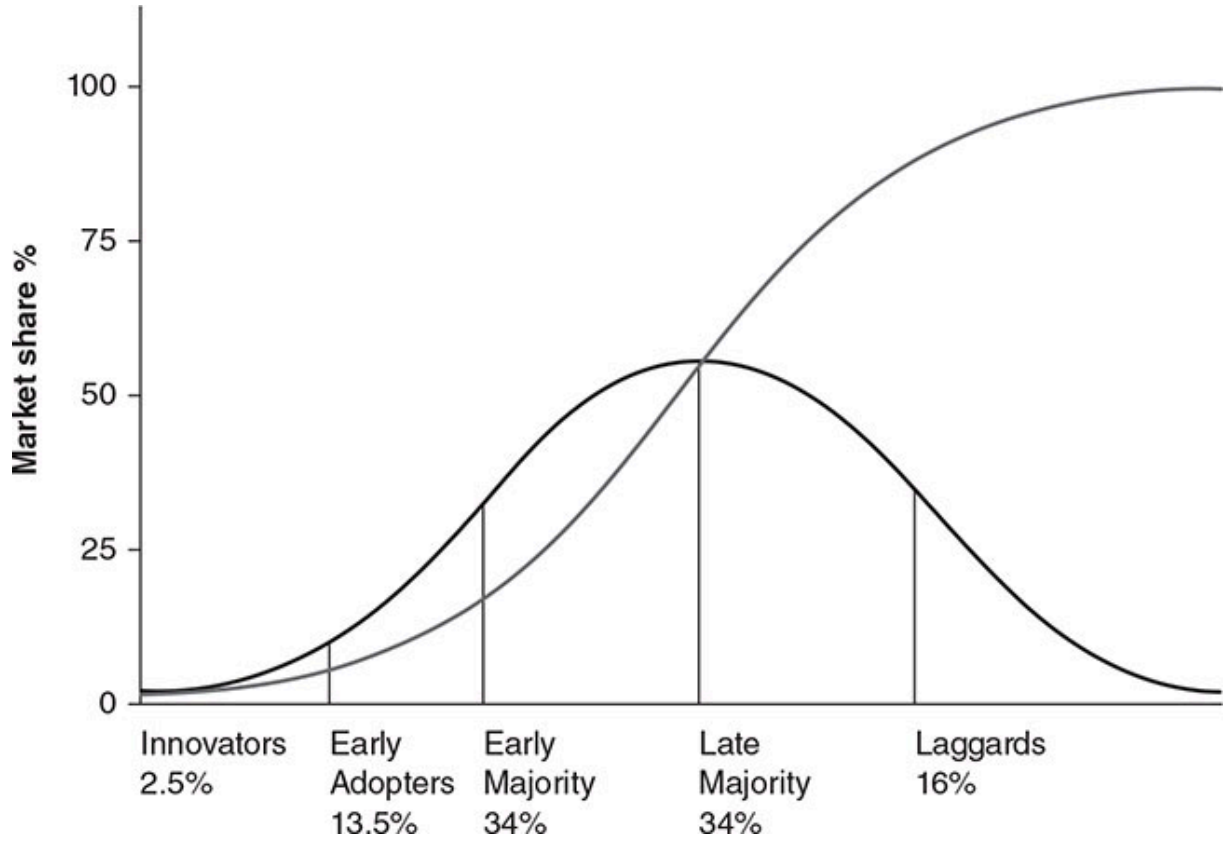
- Complexity: the degree to which an ICT4D innovation is perceived as difficult to understand and use. This highlights a design principle implicit in some of the ICT4D Project Implementation Principles – KISS: keep it simple, stupid.

- Trialability: the degree to which an ICT4D innovation may be tried out on a limited basis. In rolling out the technology, situations should be designed which allow users to "try before you buy": sampling the technology before

they commit to it via free or low-cost routes. Training and awareness programmes may incorporate this as well as lessons from relative advantage and observability.

- Observability: the degree to which the results of an ICT4D innovation are visible to others. This may relate to the design of the roll-out programme for the ICT4D innovation, allowing opportunities for potential users to see or be told of the benefits that have accrued to adopters.

Figure 3.8 Technology adoption curves



From a "downstream" perspective, Rogers gives an insight into the nature of technology adoption through two curves (see Figure 3.8; source: WP 2017a). The bell curve shows the staggered nature of adoption over time due to different types of adopters: from innovators who will adopt new technology very early in its life, through to "laggards" who are the last to adopt. The S-curve shows the

cumulative shape of adoption over time and indicates that successful new technologies tend to be adopted only slowly at first; then reach a take-off point where adoption is rapid and reaches a major part of the population; then a plateau as adoption approaches saturation point.

These adoption curves have been shown to apply to ICT4D; from patterns of mobile phone adoption by individuals in rural areas (Michailidis et al. 2012) to patterns of broadband diffusion across nations (Gulati & Yates 2012). There are a number of user- and technology-focused implications for practice:

- It will help to know, down to the level of the individual, which category users fall into. Different categories require different adoption messages, and they will also give different feedback – if, say, prototyping has only been undertaken with innovators, that may be of limited use in designing a system that the majority will wish to adopt.

- Early on in an ICT4D project, one needs to identify those most likely to adopt – innovators, early adopters – who can take a lead and provide a demonstration effect (echoing the point made above about change agents/lead users). Next, the early majority will be targeted in order to create a critical mass of use: it may require significant time and investment to reach this group. Then messages will need to change in order to get the more sceptical users on board. (One criticism of Diffusion of Innovations is that it assumes all innovations are positive, not allowing for the possibility that scepticism and resistance might be an appropriate reaction.)

- It will help ICT4D projects using an existing technology to understand where on the diffusion curve that technology lies. Working with a technology in the early adoption stages will be harder work than one already majority-adopted.

3.4. ICT4D monitoring and evaluation

It is not always clear what the difference is between monitoring and evaluation: sometimes monitoring is seen as occurring during an ICT4D project, evaluation at the end; sometimes monitoring is seen to relate to formal project goals, evaluation

to encompass all impacts. Here, and to avoid repetition, we will just subsume all assessment of project impact under the single term, “evaluation”.

In line with the changing pattern of ICT4D priorities over time outlined in Section 2.1 (Box 2.2), the focus for evaluation has also changed. In the 1990s, evaluation considered whether or not countries were ready for ICTs. Around the turn of the century, this changed to availability – evaluating the extent of the ICT applications available. Then in the 2000s there was more interest in uptake: the adoption and use of ICTs within developing countries. Only from the 2010s was there sufficient depth and length of experience to start evaluating the actual development impact that ICT is having. The latter – evaluation of development impact – will be the principal content here, though we start with a generic overview, with text drawn and adapted slightly from a key source on ICT4D evaluation: Heeks and Molla (2009).

3.4.1. An overview of ICT4D evaluation

As with any investigative process, two questions drive ICT4D evaluation:

- What do we not know, that we need to know?
- How are we going to find that out?

Specifically, evaluation of ICT4D projects can be based around six questions (see Figure 3.9):

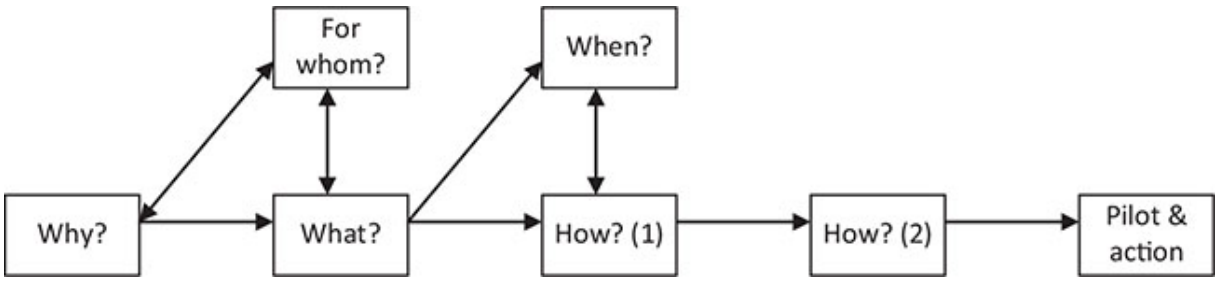
- Why: What is the rationale for evaluation? This will cover both the externally stated rationale, and the internal purpose for the stakeholders driving the evaluation. In most cases, external rationale will be one or more of: a) retrospective achievement – post hoc assessment of what has been achieved from investments to date; b) prospective priorities – pre hoc or durante hoc assessment of future development project investments; c) accountability – enabling agencies to be held to account for their ICT4D spending.

- For whom: Who is the intended audience for the evaluation? Typical audiences are a) ICT4D investment decision-makers; b) ICT4D policy decision-makers; c) ICT4D project decision-makers; d) ICT4D project users/beneficiaries; e) other ICT4D stakeholders.

- What: What is to be measured? This will be a mixture of the indicators the key audience will best consume, the indicators it is most feasible to measure and the indicators the evaluation team is most familiar with. This may also include identifying the conceptual framework guiding the evaluation.

- How 1: How are the selected indicators to be measured? Alongside the specific measurement issues, a key element here will be the extent of participation of project users in measurement (and in more upstream processes such as selection of indicators).

Figure 3.9 ICT4D project evaluation: planning overview



- When: At what point in the ICT4D project lifecycle are indicators to be measured? The classic evaluation failure has been to assess ICT4D pilots rather than fully-scaled-up projects; and to evaluate too early in the project's history.

- How 2: How are evaluation results to be reported, disseminated and used? Probably the most important and the most overlooked element in the whole process, with some evaluations being conducted but having little impact. Includes questions on whether indicators are reported "as is" or are communicated via causal models, case sketches, stories, etc.

3.4.2. Different approaches to ICT4D evaluation

Inevitably, there are many different approaches that can be taken in order to evaluate an ICT4D project, as summarised below (text developed from Heeks & Molla 2009):

- Generic: general frameworks usable in evaluation of any project. Cost-benefit analysis would be an obvious example, though – as with many quantitative techniques – there has been far too little undertaken in the ICT4D field. One instance is work showing that computerisation saved blood-testing costs only in larger hospitals in Pakistan (Sinha & Garro-Strauss 2013). An even more generic framework is discussed in Box 3.7.

- Discipline-specific: evaluation drawing from a particular academic discipline. A number of these frameworks are discussed in later chapters such as information economics in Chapter 4, which comes from economics, and the livelihoods framework in Chapter 5 and the capabilities approach in Chapter 6, both of which come from development studies.

- Issue-specific: evaluation focused on a particular development goal or issue. For example, interests in gender equality have led the Gender Evaluation Methodology (GEM) to be used with ICT4D initiatives. GEM analysis of the Bangladesh "mobile ladies" initiative showed female involvement did not deter men from using the service overall, but did restrict the topics they were willing to communicate (Earl et al. 2013).

- Application-specific: evaluation focused on one particular ICT4D technology. For example, there are specific frameworks used to evaluate telecentre performance (Whyte 2000, Cheang 2015), though these tend to be broader frameworks just modified somewhat to take account of particular features of telecentres.

- Method-specific: evaluation centred on a particular approach to data-gathering. Within ICT4D, some of these are qualitative methods involving engagement with the beneficiary community. Examples include ethnographic work (e.g. a longitudinal study involving many hours of classroom

observation to understand how ICTs were impacting the learning of pre-school children in Fiji (Lee & Sparks 2015)) and participatory evaluations (e.g. an evaluation of community ICT4D in South Africa in which community members helped guide the evaluation design and undertook key aspects of data capture (Pade-Khene & Sewry 2012)). Others are quantitative methods such as randomised control trials, which are increasingly used in ICT4D evaluation to try to deliver "objective" data on impact. As an example, a randomised design was used to demonstrate that weekly text messaging was effective in promoting exercise in older adults in Malaysia (Muller et al. 2016).

- Sector-specific: evaluation centred on an individual development sector. There are, as illustrations, ICT4D evaluation frameworks specific to e-health (Sinha & Garro-Strauss 2013), e-learning (Rashid et al. 2013) and e-government (Fischer et al. 2013). As with application-specific frameworks, though, these are typically just general frameworks with some modifications.

Box 3.7

A generic framework for ICT4D evaluation

A simple generic approach to evaluation of ICT4D projects would identify the goals of the project, identify indicators of achievement of those goals, and then measure those indicators (Heeks & Molla 2009). For example, an evaluation of e-government services in the Middle East assessed goals including cost saving (measured by citizen time saved per service use) and improved accessibility to services (measured in terms of number of languages offered) (Alshawi & Alalwany 2009).

However, there are a couple of problems with this approach. It assumes that everyone shares the project goals. But that may not be true. In the e-government example, "openness" was removed as a project goal due to political resistance from government officials. However, government openness is something that civil society groups often seek. So an evaluation should look not just at the official project goals but at the goals of all key stakeholders involved.

A second shortcoming of the project goal approach is that it just focuses on what was meant to happen. But sometimes the unexpected happens. A 2003 pilot project using mobile phones to improve management of Kenyan micro-finance institutions was largely unsuccessful in terms of project goals (Foster & Heeks 2013b). But an unexpected outcome – users began converting cash into m-cash for security when travelling, and then sent this to others as a form of payment – created the foundation for the very successful M-Pesa mobile money system (discussed further in Chapter 5). So an evaluation should incorporate the unanticipated.

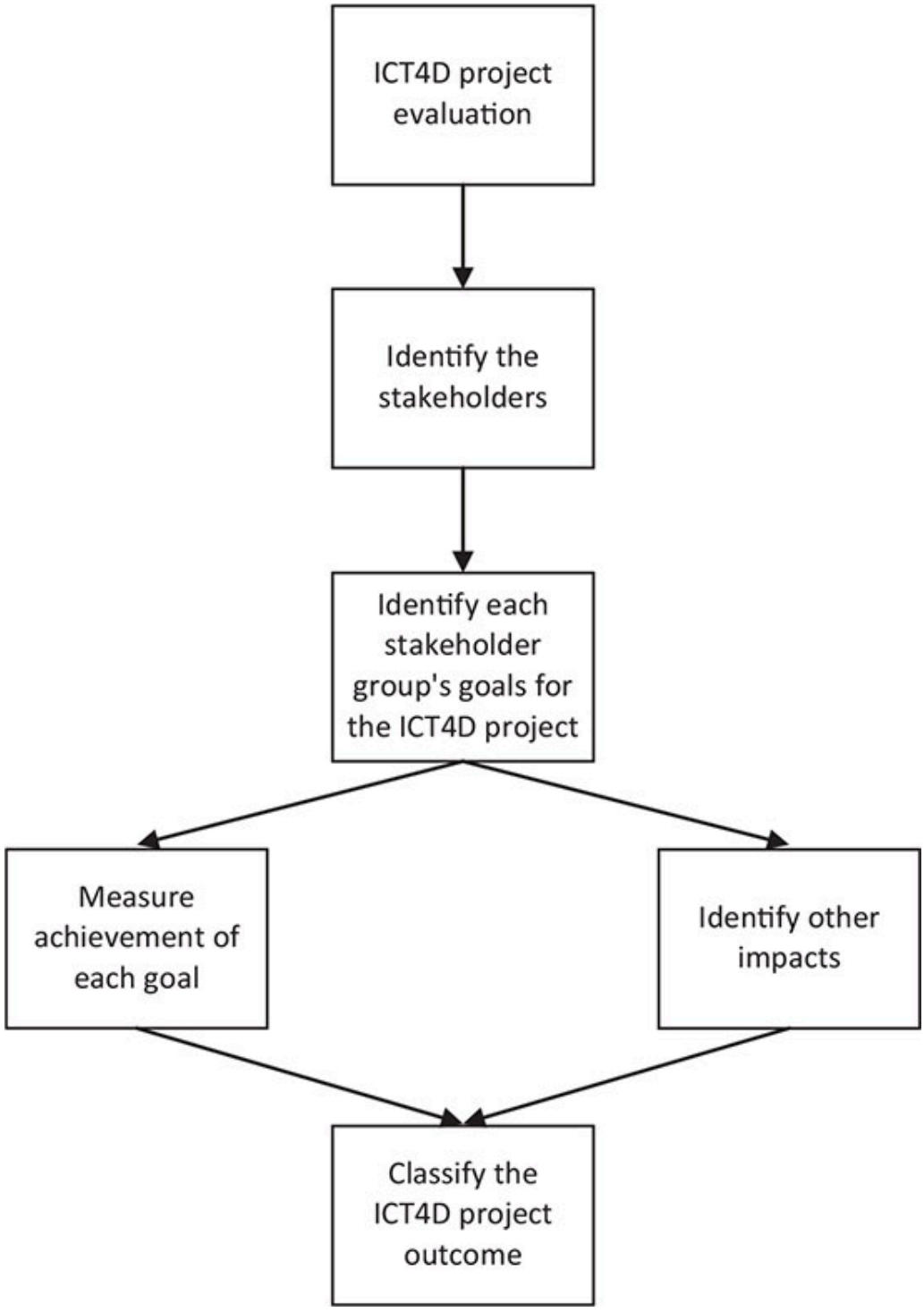
A revised approach would therefore look like that shown in Figure 3.10 (adapted from Heeks 2017).

The final step tries to provide a single overall summary, for which we can expand the failure categorisation discussed earlier in the chapter:

- Total failure: the ICT4D initiative was never implemented or was implemented but immediately abandoned.

- Mainly unsuccessful: some goals were attained but most stakeholder groups did not attain their major goals and/or experienced significant undesirable outcomes.

Figure 3.10 Multi-stakeholder approach to ICT4D evaluation



- Partial success/partial failure: some major goals for the ICT4D initiative were attained but some were not and/or there were some significant undesirable outcomes.

- Mainly successful: most stakeholder groups attained their major goals and did not experience significant undesirable outcomes.

- Total success: all stakeholder groups attained their major goals and did not experience significant undesirable outcomes.

The frameworks such as those shown in Figures 3.9 and 3.10 can give a very clinical and straightforward appearance to evaluation but "no plan survives first contact with the enemy", and in reality there are multiple challenges to ICT4D evaluation.

Central to evaluation of impact is an understanding of the difference between before and after the ICT4D intervention, but baseline data on the before situation may be absent and, unless primed to do so, those involved may not have monitored the intervention as it is implemented (Pather & Uys 2010). Where ICT4D evaluation data is gathered, it often relies on reports from those involved. But those reports may not be accurate – respondents' perceptions may differ from reality (perception bias); and they may tell evaluators what they think the latter want to hear (reporting bias). For example, farmers in Kenya were very enthusiastic in their reports about an m-agriculture application, with the great majority claiming it had led to changes in type of crops planted, increased market prices and greater income (Baumuller 2015). Yet cross-checks did not substantiate any of these claims.

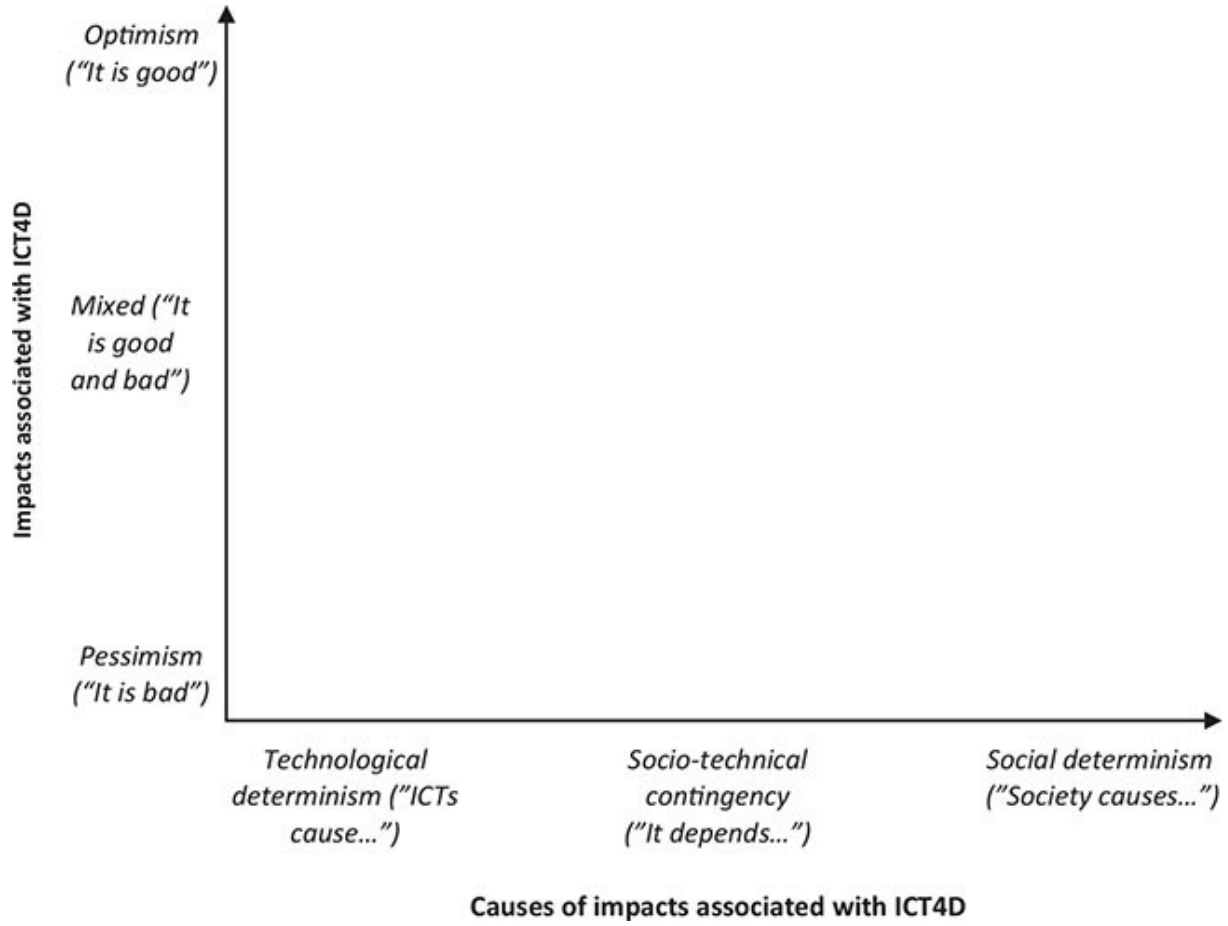
And there is the problem of attribution: when impacts are seen, what is the cause? Was it the technology, or was it some parallel intervention, or some combination of the two? For instance, an m-health project in India provided community health workers with a mobile phone application that guided them through the support stages for pregnancy and neo-natal care (Murless et al. 2015). The performance of the health workers significantly improved. But it was unclear to what extent the mobile app was the cause, and to what extent the impact derived from the improved training and supervision of the health workers that was also part of the project. We will explore different views on this in the following section.

3.4.3. Perspectives on ICT4D evaluation results

Whatever the results of ICT4D evaluation, people tend to try to fit those results into their own personal ICT4D worldview. We can understand those worldviews as a two-dimensional space (see Figure 3.11; diagram and following text adapted from Heeks (1999)). The first dimension is a continuum of *technology impacts*, from optimism to pessimism. Some people – optimists – associate ICTs with largely positive impacts like wealth creation and improvements in service quality. Others – pessimists – associate ICTs with largely negative impacts like unemployment, cyber-addiction and the other digital harms identified earlier in Section 3.2.3.

The other dimension is a continuum of *impact causes*, from technological determinism to social determinism. Some people – technological determinists – believe that it is mainly inherent features of the technology which determine impacts of introducing digital technologies; for example, that ICTs cause job losses. Others – social determinists – believe that it is mainly human choices within social structures which determine impacts of introducing ICTs; for example, that any job losses from automation arise from explicit managerial decisions.

Figure 3.11 Worldviews on ICT4D impacts and causes



Each continuum has a midpoint of, respectively, mixed neutrality about impacts and contingency about the causes of those impacts.

This map of worldviews can help understand some of the disagreements that arise within ICT4D: optimists arguing with pessimists, technological determinists arguing with social determinists. It can therefore be useful to apply the map not only to oneself but also to the expressed views of other ICT4D actors including development informatics researchers or those involved with evaluation of an ICT4D project. This can offer an understanding of these views and also of alternate views and critiques.

Additional material

Discussion questions

3.1. Which of the steps in the ICT4D strategy do you think is most important; to which greatest attention should be paid? And why?

3.2. Do most ICT4D projects fail? Can you find evidence for or counter-evidence against this claim?

3.2. What are the main differences between the Principles for Digital Development, and the ICT4D Project Implementation Principles? Are these differences important, or not?

3.2. Which of the ICT4D Project Implementation Principles do you think is most important? And why?

3.2.3. What challenges do you foresee if you were to try to put the design–reality gap model into practice in order to reduce risks on an ICT4D project?

3.3. Compare the following: the prime question, the Technology Acceptance Model, the motivation-centred model of ICT4D adoption and use, the Unified Theory of Acceptance and Use of Technology, and Diffusion of Innovations theory. Which of these do you think would be most helpful in practice when managing an ICT4D project?

3.4. Identify an example ICT4D project. Which of the six types of evaluation framework would you recommend using to assess this project? And why?

3.4.3. Where do your views lie in the Figure 3.11 diagram? Can you justify your worldview?

Assignment question

What are the key good practices for an ICT4D initiative?

Further reading

If you would like to know more about . . .	3.1. ICT4D strategy	. . . then take a look at . . .	3.1. NetHope (2014) *Organizational Guide to ICT4D*, NetHope, Fairfax, VA >Overview guide to formation of ICT4D strategy CRS (2010) *Information and Communications Technology for Development (ICT4D)*, Catholic Relief Services, Baltimore, MD >Example ICT4D strategy from an international NGO

	3.2. ICT4D design and implementation		3.2. the Principles for Digital Development Web site: http://digitalprinciples.org/ >Explains the Principles in detail, and provides supporting resources Pade-Khene, C., Mallinson, B. & Sewry, D. (2011) Sustainable rural ICT project management practice for developing countries, *Information Technology for Development*, 17(3), 187–212 >A set of critical success factors for ICT4D project implementation
	3.2.3. HCI4D		3.2.3. Toyama, K. (2010) Human-computer interaction and global development, *Foundations and Trends in Human-Computer Interaction*, 4(1), 1–79 >An overview of the relation between HCI and international development including mutual benefits, issues and future directions Anokwa, Y. et al. (2009) Stories from the field: reflections on HCI4D experiences, *Information Technologies & International Development*, 5(4), 101–115 >A group of HCI4D researchers reflect on experiences, lessons and wider issues
	3.2.3. design–reality gaps		3.2.3. Heeks, R. (2002) *Failure, Success and Improvisation of Information Systems Projects in Developing Countries*, Development Informatics Working Paper 11, IDPM, University of Manchester, UK >Foundational paper introducing the design–reality gap idea http://www.egov4dev.org/success/techniques/idfailure_drg.shtml >Along with related Web pages, gives more explanation and examples of applying the design–reality gap model
	3.3. ICT4D adoption and use		3.3. Smyth, T.N., Kumar, S., Medhi, I. & Toyama, K. (2010) Where there's a will there's a way: mobile media sharing in urban India, in: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, G. Fitzgerald, S. Hudson, K. Edwards & T. Rodden (eds), ACM, New York, NY, 753–762 >Shows the importance of motivation in driving ICT4D adoption and use
	3.3.1. to 3.3.3. ICT4D adoption and use models		3.3.1. Davis, F.D., Bagozzi, R.P. & Warshaw, P.R. (1989) User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, 35(8), 982–1003 >Technology Acceptance Model 3.3.2. Venkatesh, V., Morris, M.G., Davis, G.B. & Davis, F.D. (2003) User acceptance of information technology: toward a unified view, *MIS Quarterly*, 27(3), 425–478 >Unified Theory of Acceptance and Use of Technology 3.3.3. Rogers, E.M. (2003) *Diffusion of Innovations*, 5th edn, Free Press, New York, NY >Diffusion of Innovations theory

(continued)

	3.4. ICT4D evaluation		3.4. Heeks, R. & Molla, A. (2009) *Impact Assessment of ICT-for-Development Projects: A Compendium of Approaches*, Development Informatics Working Paper 36, IDPM, University of Manchester, UK >Overview of ICT4D evaluation, and details and examples of many different evaluation methods Bachelor, S. & Norrish, P. (2007) *Framework for the Assessment of ICT Pilot Projects*, infoDev, World Bank, Washington, DC >Comprehensive guide to a structured approach to ICT4D evaluation

4 ICTs and economic growth

In reading this chapter, you will learn to:

- explain key strategies and key foundations for economic growth in developing countries;
- explain the informational context of growth in developing countries;
- apply a model of ICT4D-enabled change to explain evidence on ICTs and economic growth;
- analyse evidence on ICTs and micro-economic growth and draw conclusions;
- analyse evidence on ICTs and supply chains and draw conclusions;
- analyse evidence on ICTs and macro-economic growth and draw conclusions.

The previous three chapters have explored foundational and cross-cutting ideas and evidence about ICT4D. From this point onwards, until Chapter 9, we turn to look at the role ICTs play in the delivery of specific international development goals. In this chapter we start with arguably the most fundamental development goal: economic growth.

4.1. Economic growth as a development goal

The original understanding of development was that it meant economic growth. As a development goal, economic growth has often been criticised. It is seen as empty because wealth of itself has no inherent development value – it's what you do with it that matters. It is seen as unsustainable because the world cannot grow economically forever on a base of finite resources. It is seen as covering up or ignoring the "*cui bono*?" problems of who gets what in society, with overall growth potentially having little impact for those on lowest incomes.

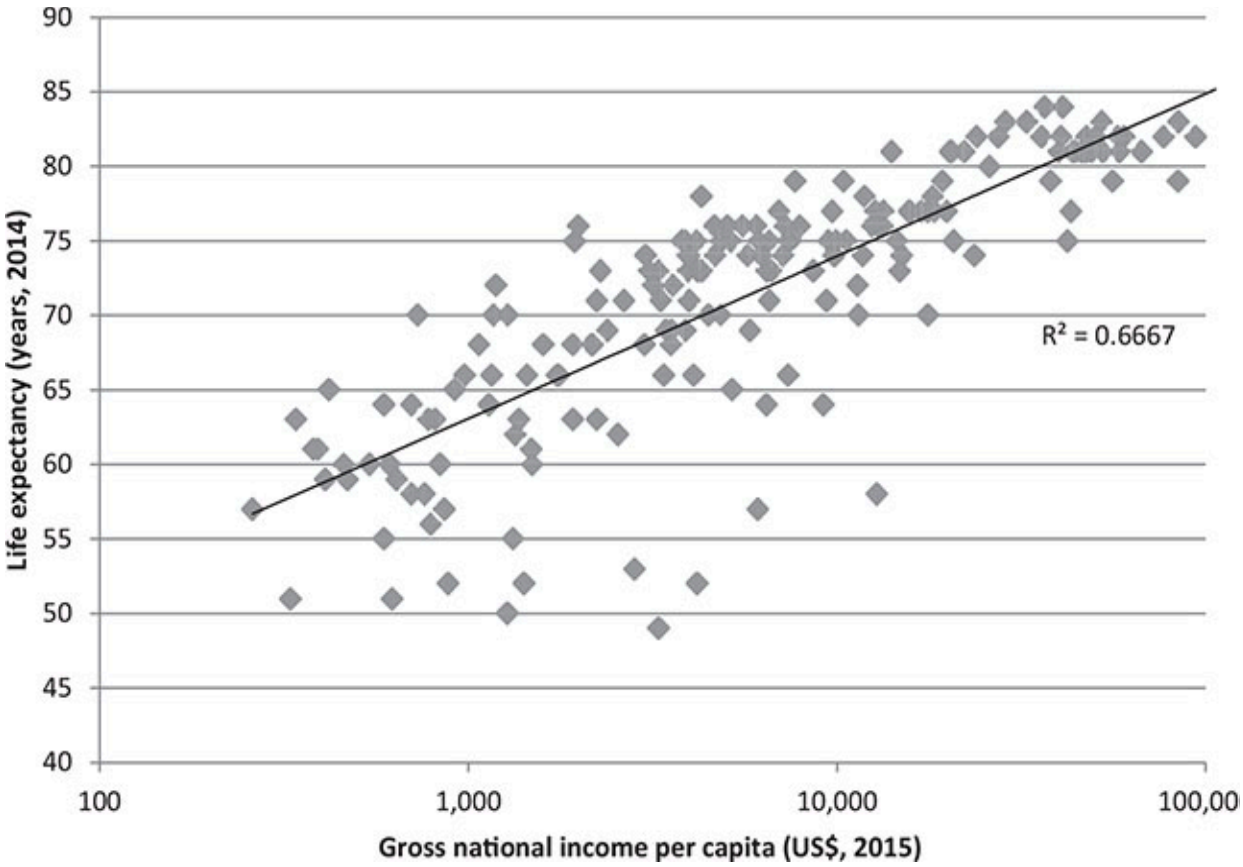
Partly as a result of these criticisms, it has often been supplemented by other development goals: the modernisation paradigm saw economic growth would require socio-cultural change; the dependency paradigm saw change in political structures as necessary for economic growth; the human development paradigm sets growth alongside health and education goals. And during the twenty-first century it has often been reshaped to focus on economic growth for the poorest in society: a topic picked up in Chapter 5.

Despite all this, economic growth remains foundational to our understanding of international development, and is a core Sustainable Development Goal:

> SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

It is simple to understand and relatively straightforward to measure. It fits with the core aspirations of most citizens in developing countries. And it correlates relatively well with other aspects of development: see for example Figure 4.1 (data source: WB 2017b) showing the correlation between life expectancy and national wealth.

Figure 4.1 Income and life expectancy across countries



Economic growth can be measured at different levels and in different ways, but a typical measure is the change in overall wealth of a country. For example, change in gross domestic product (GDP) per capita. This takes the GDP of a country – which "measures the value of all goods and services produced within a particular country" (Willis 2011:5) – and divides it by the number of citizens living in the country at that time. The alternative is gross national product or income (as used in Figure 4.1) which "measures the value of all goods and services claimed by residents of a particular country regardless of where the production took place" (ibid.:5) and thus includes income from abroad.[1]

Whichever the definition, the core strategy for economic growth is clear – to increase the value of goods and services produced including the value-added: the difference in value between inputs and outputs. It is possible to

increase value and achieve growth without increasing value-added (Stanley et al. 2015), but the main goal is to increase productivity: the ratio of value of outputs:inputs produced via production processes. There are various mechanisms by which countries can increase productivity (summarised in Figure 4.2 and a re-working of the cheaper, more, quicker, etc list of process benefits provided in Section 1.1) such as:

a) Economy: reducing the amount or cost of inputs; for example, when data or raw materials can be obtained more cheaply.

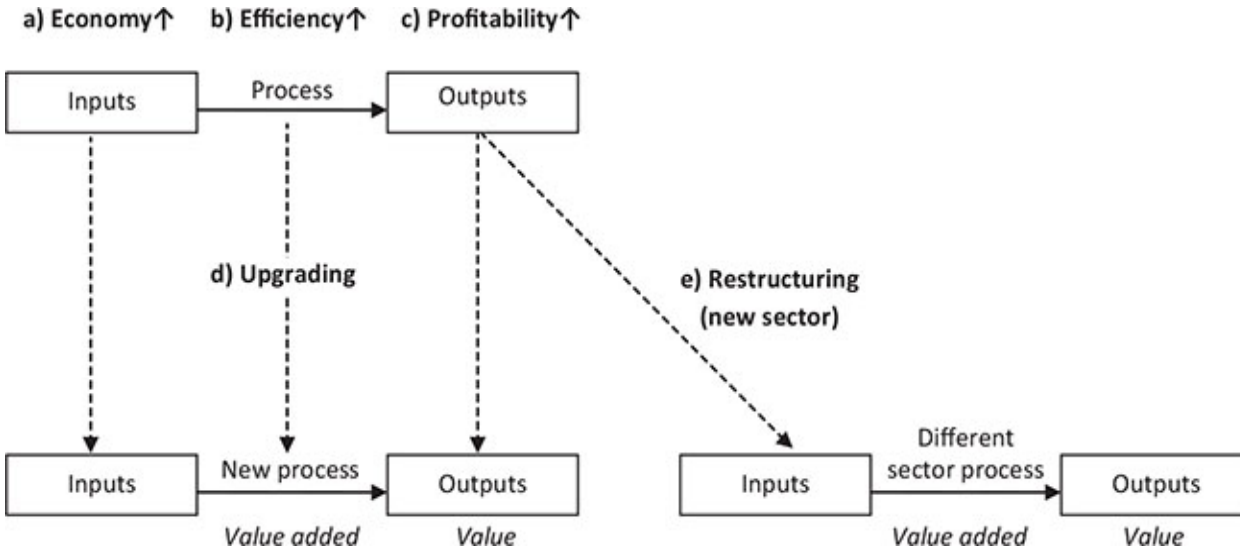
b) Efficiency: improving a production process so greater value of outputs can be produced per unit of input; for example, improving productivity by investing in new technology.

c) Profitability: improving the value of outputs; for example, by obtaining a higher price for those outputs.

d) Upgrading: changing a production process from a lower- to higher-value one; for example, upgrading from software programming to software analysis and design.

e) Restructuring: shifting resources in the economy from less-productive to more-productive sectors; for example, moving workers out of low-productivity agriculture into high productivity industry and services.

Figure 4.2 Mechanisms for economic growth



In all cases, there is a central role for technology given – recalling Chapter 1 – its definition as converting inputs into outputs. Thus investment in new technology, innovation via research and development, and learning by doing have all been seen as routes to better technology and productivity improvements (Klenow & Rodriguez-Clare 1997).

While there is general agreement on the need to improve productivity, there is less agreement on how to bring this about, with variation between development paradigms. The neo-liberal paradigm, for example, argues productivity increases are best driven by competitive pressures, and those pressures are best transmitted by the widespread presence of market forces. At the other end of the political spectrum, Marxists would argue that market capitalism encourages profits for the few rather than the benefits of productivity being spread to the many; and that any productivity increases are best achieved by allowing workers to own and control their production processes. In between, Keynesians would argue state intervention and investment to be underpinnings for productivity growth.

These disagreements are problematic for ICT4D because they lead to differing recommendations about how best to use ICTs to achieve economic growth: through private sector actors or through public sector actors, through incremental redesign or radical restructuring.

Whatever the particular mechanisms for ICT application, it can broadly follow the ways of improving productivity listed above, and be understood in three different ways:

- Micro-level: applying ICT to improve the productivity of individual enterprises; linked particularly to mechanisms a) to c) above but also to mechanism d) to some extent.
- Meso-level: applying ICT to improve the productivity of chains of enterprises; applying mechanisms a) to d) at a broader level.
- Macro-level: applying ICT to a national economy, which can mean aggregate effects of mechanisms a) to d) but also mechanism e).

Each of these will now be investigating in further detail.

In what follows – and remembering discussion in Chapter 1 about the scope of ICT4D – the focus will be less on medium and large enterprises, and mostly on small and micro-enterprises. Farms will be included in this, thus bringing some relation to SDG 2:

> SDG 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

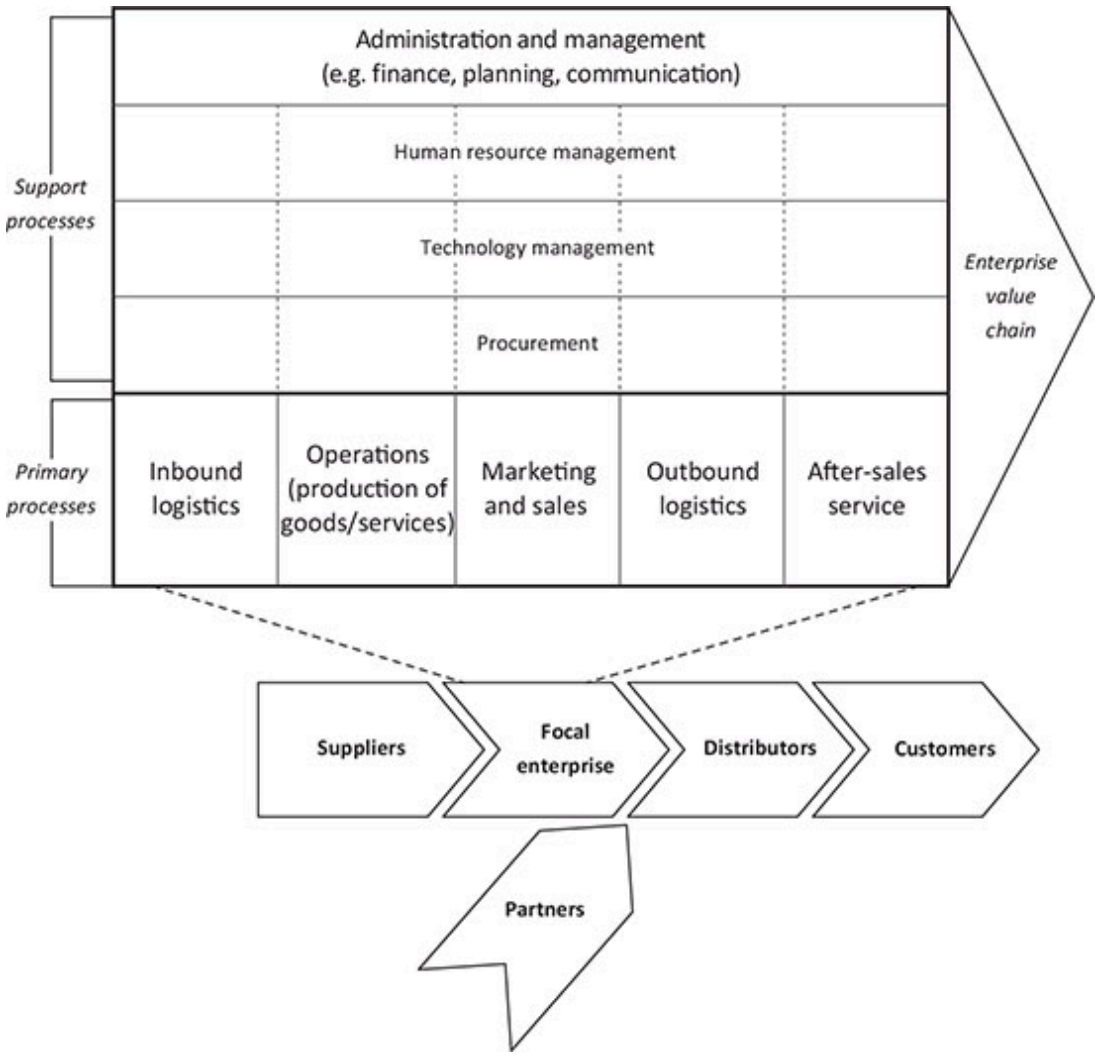
4.2. ICTs and micro-economic growth

Micro-economic growth deals primarily with improvement to the productivity of processes within individual enterprises – in agriculture, other primary production, manufacturing or services. So our starting point will be a value chain model of enterprise,[2] as shown in Figure 4.3 (adapted from Laudon & Laudon 2016; itself developed from Porter 1985). It shows the primary processes that directly add value in the enterprise, and the support

processes that enable the primary processes to take place. It also shows the wider supply chain within which the enterprise sits: a focus for Section 4.3.

For a medium or large company in a developing country, the enterprise value chain model would be a useful basis for understanding ICTs: one could examine the role of digital technology in each one of the nine processes outlined. However, this is too detailed for the great majority of enterprises in developing countries – small-scale farming, micro-enterprises – for which the model is too complex. We can therefore reduce it down to four key processes that will be recognisable in all enterprises (see Figure 4.4):

Figure 4.3 Enterprise value chain and wider supply chain



- Purchasing: buying the inputs necessary for the enterprise – seeds and fertiliser for a farm; flour and yeast for a bakery; and so on. Key challenges are finding suppliers, judging quality and getting a good price.

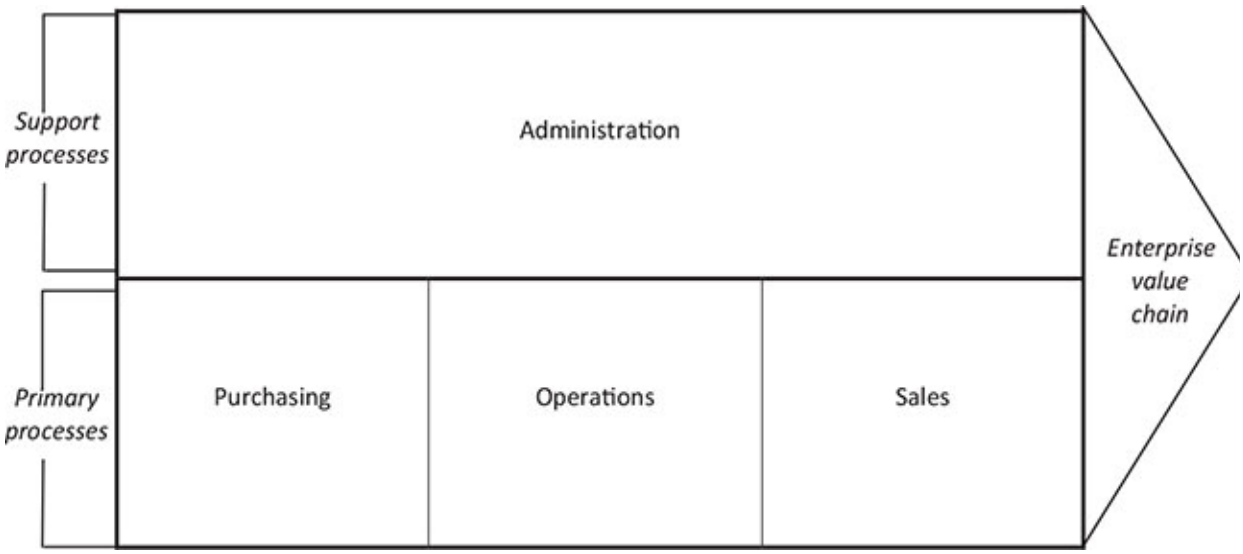
- Operations: the core process that turns inputs into outputs – growing crops, making bread, etc. Key challenges are maximising outputs and dealing with unexpected problems.

- Sales: selling the enterprise's outputs to customers. Key challenges are finding customers, delivering on time and getting a good price.

- Administration: managing the enterprise's resources – its money, staff, technology, etc. Key challenges are sourcing and controlling these resources.

All of these processes involve actions of some kind but, prior to that, they also involve information-based decisions: deciding who to buy from or sell to; deciding when and how to plant crops or bake bread; deciding how to manage a badly behaved staff member. We can thus apply the CIPSODAR information value chain model from earlier chapters to each one of these processes as shown in Figure 4.5. We therefore have a link from information to value processes to the result of economic growth.

Figure 4.4 Simplified enterprise value chain

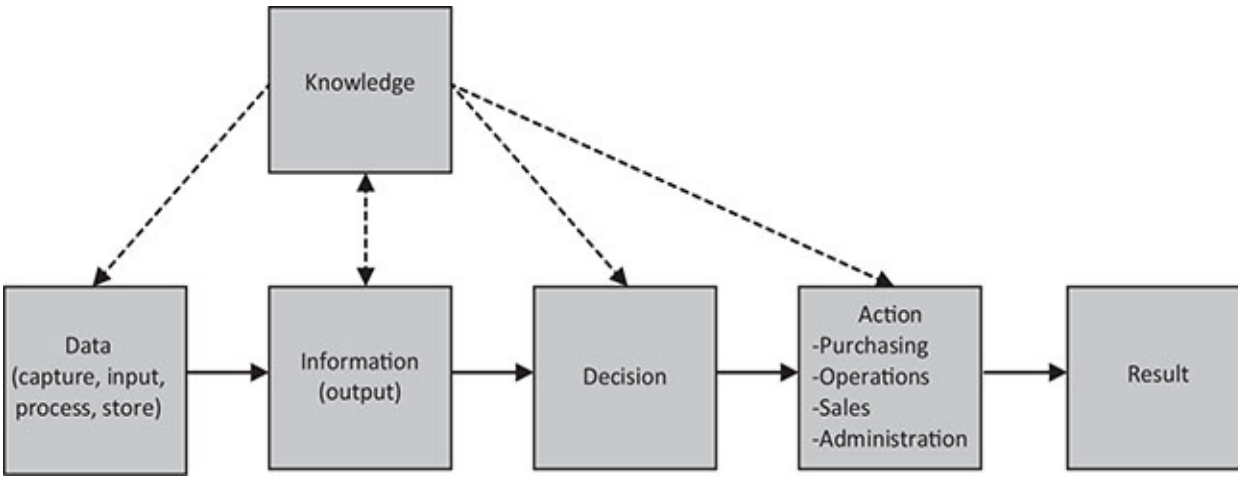


Where this information will feed into a purchase or sale – a transaction with another party – then there are three types of information required (Heeks & Molla 2009:49):

- Search: “information acquired prior to trading (on the existence of the other party, on their reputation and trustworthiness, on typical prices)”;
- Bargaining: “information communicated during trading (on items offered and money/other items sought, on quality of items offered, as part of negotiation)”;
- Enforcement: “information acquired after trading (on whether or not the terms of the agreed trade contract have been fulfilled)”.

Getting this information creates costs for any transaction – for example, one study estimated that information search costs alone account for 11 per cent of the total cost of smallholder farming in Asia (Diga 2013b). The informational costs of search, bargaining and enforcement form “unobservable” transaction costs. Total costs of a transaction include these plus “observable” transaction costs: those which are visible when exchange occurs and are proportional to the size of the exchange; they include “transport, handling, packaging, storage, spoilage” (De Silva & Ratnadiwakara 2008).

Figure 4.5 CIPSODAR/information value chain model of key enterprise processes



Unfortunately, it is not straightforward to obtain information for transactions and other decisions. A central problem for enterprises in developing countries is "information failures": shortcomings around information which hamper productivity and, hence, wider economic growth. Five main categories of information failure can be identified:

> a) *Information absence*: key information that development actors need is not available.
>
> b) *Information quality*: key information that development actors need is available but of poor quality.
>
> c) *Information uncertainty*: key information that development actors need is available but its quality is uncertain.
>
> d) *Information asymmetry*: some development actors have access to key information that others lack.
>
> e) *Information cost*: key information can only be obtained at high cost (often a physical journey).
>
> (Heeks & Molla 2009:48)

Because these failures typically impact some groups more than others, they are sometimes bundled together to talk of "information poverty" for those for whom information is absent or of poor quality, uncertain and costly (Gebremichael & Jackson 2006).

In a general sense, these transaction costs plus other information failures are problematic because they stifle economic growth in developing countries. They also impose certain characteristics on commerce in developing countries: they make it costly, they make it slow, and they make it risky (Jagun et al. 2008). These characteristics in turn shape the nature of commerce in developing countries. For example, they explain why most commerce is highly localised. And they explain why intermediaries are so often involved:

> They hold both quantitative and qualitative information on buyers, sellers, products and prices. They can thus reduce the informational costs and increase the communication speed of all three stages of trading for buyers and sellers. Their broader spread of contacts allows trade to become less localized. They can make trade less risky, or at least make it perceived to be less risky, because of their informational resources and reputation.
>
> (ibid.:50)

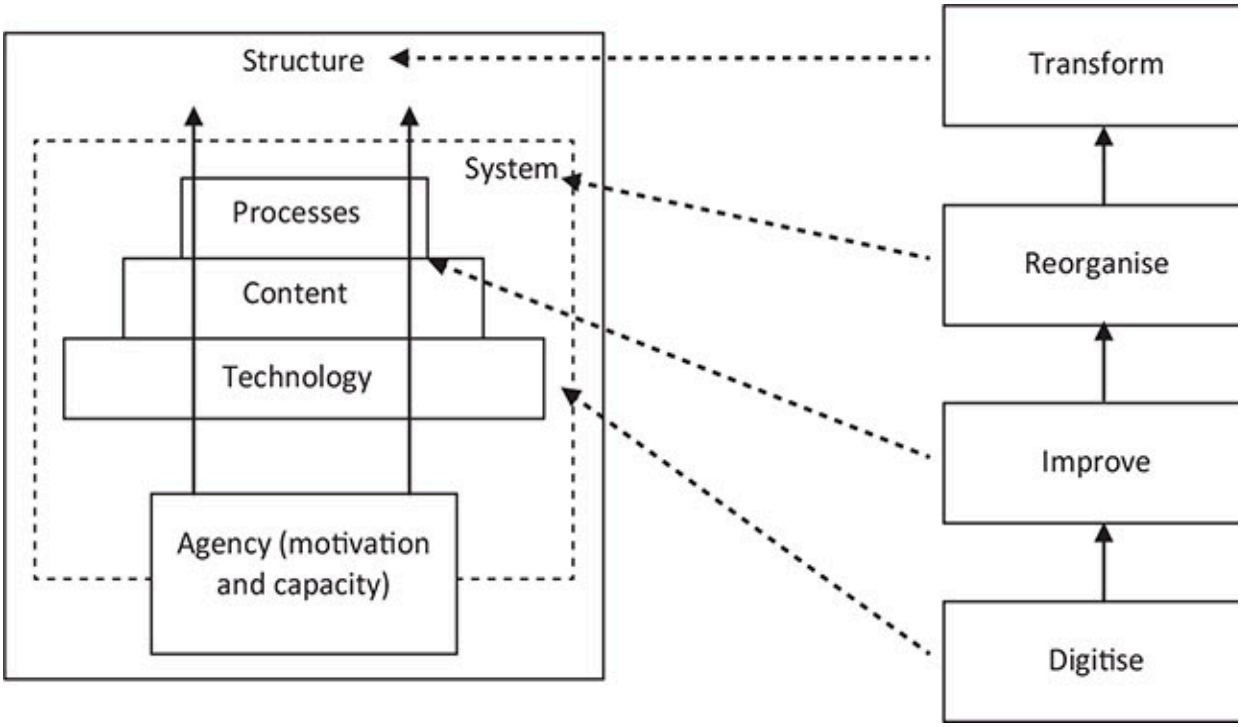
However, these middlemen (and they typically are men) are sources of information asymmetries: they are able to capture much of the profit in a supply chain as a result of what and who they know, and what others do not know. As one example, middlemen in farming chains in India captured profits worth at least 30 per cent of the wholesale price and two-thirds of the farm-gate price (Mitra et al. 2016).

Hence, the significant interest in ICTs given their potential to address these information failures, leading to better decisions/actions by enterprises, leading to more value addition, leading to greater economic growth. In Figures 4.2 and 4.4 terms, if ICTs can improve purchasing they will increase economy; if they can improve operations and administration they will increase efficiency; and if they can improve sales they will increase profitability. The fundamental role of ICTs in all these situations is to handle the data and information relating to the enterprise's four key processes: the CIPSO of Figure 4.5. However, ICTs are increasingly also the platform for transactions – the enactment of a decision such as purchase or sale of goods and services: the A of Figure 4.5. And, more slowly, ICTs are making enterprise decisions: the D of Figure 4.5.

To understand, we can use a simplified version of the onion-ring model presented in Chapter 1 and of the ICT4D foundations presented in Chapter 2, as shown in Figure 4.6. This shows activity being driven by the agency (motivations and capacities) of actors, with digital systems formed of these actors plus ICTs, data content and CIPSODAR/information value chain processes. All of this sits within a wider social structure of organisations and

a societal environment of institutional forces, structural relations and knowledge systems.

Figure 4.6 Four levels of ICT4D-enabled change



There are various ladder-type models to understand the extent of ICT-enabled change (e.g. Venkatraman 1994, Heeks & Davies 2001, Layne & Lee 2001). The one here identifies four "DIRT" levels of change:

- Digitise: changes the technology of the process (initially from human to digital) without otherwise changing the process.
- Improve: makes incremental changes to the process or inputs such as data content.

- Reorganise: makes changes to the overall system, for example adopting a different type of process.
- Transform: makes changes to the broader social structures that encompass the digital system.

We will now look at each of these in turn as they affect enterprises in developing countries, though noting the actual progression in such enterprises may not follow DIRT in a simple manner, as Box 4.1 describes.

Box 4.1

Enterprise digital stage model

The ladder of ICT-enabled change shown in Figure 4.6 seems to apply at different speeds to the four different core enterprise processes: typically being applied first to support purchasing and sales, then administration and operations (Donner & Escobari 2010, Adeniran & Johnston 2014). However, the actual interaction is rather more complex than that because ICTs combine data communication and data processing functions, and their amalgamation in transaction-handling functions. A typical enterprise stage model (adapted from ibid.) might therefore be:

- Step 1: use of phone and then email to digitise and improve basic communications
- Step 2: use of mobile apps to improve business transactions
- Step 3: use of office automation to digitise and improve basic data processing

- Step 4: use of Internet platforms to improve business transactions
- Step 5: use of higher-level applications to reorganise and integrate business processes

Even this will vary from enterprise to enterprise, and benefits will only accrue when there is alignment between ICTs, processes and business strategy (Muhanguzi & Kyobe 2014) – choosing the right steps for each particular enterprise that apply the right technology to the right processes for the right purposes at the right time.

4.2.1. Digitisation

Purchasing, sales and – to a lesser degree – operations and administration of any enterprise require communication: the movement of data. Where that data movement is physical – moving a person or moving a document that holds the data – there are substantial opportunities for cost savings from digitisation, since that will dematerialise the data and allow it to flow virtually cost-free across ICT networks. There have been particularly large opportunities for savings in developing countries because, often for want of alternatives, so much communication until recently has been physical.

In particular, a significant amount of commerce in developing countries has required journeys; for example, from a village to a nearby town to buy supplies or to sell produce/goods. But entrepreneurs show a strong preference for journeys and physical gathering of information even where there are potential analogue alternatives such as radio, newspapers or television (Aker & Mbiti 2010). Journeys in developing countries are problematic for three reasons. First, the direct cost of the journey: for example, the minibus fare. Second, the opportunity cost of the journey: the earnings foregone because the farmer or entrepreneur is away from their business. Third, the risk cost of the journey such as dangers of accidents and robbery.

If the journey is only required for informational purposes i.e. as part of the unobservable transaction costs noted above, then the "journey substitution" impact of ICTs can be a valuable benefit (though, as Box 4.2 explains, there can be other benefits of digitisation). Some examples of direct cost savings include:

- Farmers and rural entrepreneurs in Niger would, on average, require a three-hour round trip to the nearest main market. Substituting that with a phone call in order to gather information would save around 300 CFA (US$0.50) (ibid.).

- Micro-entrepreneurs in Nigeria typically spent up to N250 (US$1.25) on a phone call but saved N1,000 (US$5) on the typical cost of a taxi journey; a net saving of US$3.75 (Jagun et al. 2008).

Some work has tried to measure both direct and opportunity cost savings. For example, smallholder farmers in Malawi were estimated to save an average of US$1 per purchase/sales transaction as a result of using ICTs (in this case, an online trading platform) with savings calculated in terms of both time and transport (Katengeza et al. 2014). In all cases, one would add risk cost savings as well.

There are limits here because face-to-face transactions may still be necessary or valuable in some circumstances (see Box 4.7 later in the chapter). This will occur when there is physical exchange of goods (where the journey is thus also part of observable transaction costs). Thus, for instance, fishermen in Ghana reported three-quarters of input purchases being undertaken directly prior to ownership of a mobile phone (the rest conducted via intermediaries), but still 44 per cent conducted the same way after mobile acquisition (Salia et al. 2011). By its nature, digitisation also tends to be a one-step dividend: upgrading to other digital means of communication, such as from phone call to email, will not produce equivalent benefits.

Box 4.2

A mobile phone's other digitisation functions

Mobile phones are very strongly associated in ICT4D initiatives with phone calls and, to a lesser extent because of its literacy requirements, with text messaging. But there are many other digital functionalities of potential value including (Martin & Abbott 2011):

- Calculator: e.g. to calculate total prices of goods to be bought or sold;
- Speakerphone: e.g. to share among group members at a meeting the discussions with buyers, extension officers, loan providers to avoid internal information asymmetries;
- Data storage: e.g. to store planting and harvesting dates in the calendar;
- Voice recording: e.g. to record training or advice messages;
- Camera: e.g. to take and share examples of agricultural good practice.

4.2.2. Digital improvement

As with the well-known case in Box 4.3, digital improvement in ICT4D is most often associated with use of ICTs to access market prices; the foundation for purchasing and, especially, sales. The assumed logic of productivity gains is straightforward: market price information in developing countries is subject to the information failures identified earlier. ICTs eradicate those failures. At its simplest, the problem is information absence and asymmetry. Sellers – a farmer wanting to sell her maize crop; an

entrepreneur wanting to sell her baskets – do not know the prices of their goods in different markets, and so sell at a lower than optimum price. If they could know that prices in the next-door town are 20 per cent higher, or that their middleman is then selling-on their goods at twice the price in the state capital, then they could significantly increase their profits. And ICTs could provide that information.

Box 4.3

Mobiles and fishermen in Kerala, India

Before the arrival of mobile phones, fishermen in Kerala would land their catch at a particular market (there were several different markets along the coast), and try to get the best price (Jensen 2007). But if other fishermen had chosen the same market or there were few buyers at the market, they might get a poor price and also have to throw away unsold fish. Their main problem was information absence: they did not know prices and demand at other markets.

With mobile phones, the fishermen would call ahead to different fish markets along the coast and, as a result, they saw their earnings increase by an average Rs.205 (c.US$4.5) per day. Most people assume this was because the fishermen were getting a higher price for their fish but that was not so: the average price per kg of fish actually fell. The increased revenue arose because the fishermen identified markets with higher demand and so they sold more, and wasted less, of their catch. Less waste meant a higher supply of fish and, as per the laws of supply and demand, the price fell.

This digging-behind-the-headline is one reason why Jensen's work is an exemplary illustration of development informatics research, and he provides a number of other valuable insights:

- A classic ICT4D mistake is to just look at the benefits and forget the costs. Jensen calculates that fishermen were spending an average Rs.72 per day on mobile costs. So while *gross* revenue was up by Rs.205, *net* income was Rs.133 (c.US3) per day. Even this is faulty because it does not take into account the cost of the mobile phone – around Rs.5,000 (c.US$110) at the time – which would consume around two months of additional income (given roughly 24 days per month of fishing).

p.148

- Alongside benefits for the phone owners, there was also a digital provide to others. "Those fishermen without mobile phones also saw their profit rise by an average Rs.97 (c.US$2) per day as a result of the general improvements in market efficiency which phones introduced. This was about half the profit increase seen by phone owners and meant, even allowing for the additional costs, that returns to phone ownership were greater than those for non-ownership" (Heeks 2014d:14). And, because lower wastage and higher supply reduced the price of fish, consumers also benefited.

- Fishermen also benefited from use of mobiles by others; for example, they lost less fishing time due to equipment failures when repair companies adopted mobiles, and thus sped up their transaction times (Jensen 2010).

This is therefore a very positive ICT4D story – a win-win for all those involved – which may be one reason it has been so widely circulated and widely used.

However, this isn't the whole story. A re-investigation some years later found that – while the overall results of Jensen's study held – there were additional issues (Srinivasan & Burrell 2015). All fishermen could now afford phones so the digital provide to non-phone-owners had disappeared. The design assumption that fishermen choose between different markets to land their catch was true for larger boats, but was rarely true in reality for small boats, which typically used the same

market every day. So the impact of phones was uneven across different fishermen. And phones were valued as much for other tasks such as rescue at sea and fish-finding (in conjunction with GPS (global positioning system) location capabilities) as they were for help with pricing.

Given the clear assumed logic, we would expect to find plenty of evidence that ICTs are helping producers in developing countries get better prices. But digging down delivers relatively little such evidence. One positive example is that compared to a control group, users in Ghana of an SMS (short message service/text message) market price alert system called "Esoko" reported a 7 to 10 per cent increase in the price paid for their farm produce (maize and groundnuts) (Courtois & Subervie 2015).

Conversely, there is at least an equal amount of counter-evidence:

- An experimental evaluation of an SMS service that distributed price (and other) information to farmers in India found no difference in average price paid comparing matched user and non-user farmers (Fafchamps & Minten 2012).

- An experimental evaluation of a mobile phone-based service that distributed price information to potato farmers in West Bengal, India found "The average impact of provision of daily retail and wholesale market prices to farmers on annual averages of farmer sales and revenues were statistically indistinguishable from zero" (Mitra et al. 2016:2). This was even true in one part of the experiment, where the farmer was asked to write up the prices on a public board so others could see them.

Why would this be?

Methodology. We noted in Chapter 3 some methodological problems with this type of ICT4D evaluation. Accuracy is one concern – studies often rely on asking producers what price they receive for their outputs, and it can be shown that their recall is inaccurate (Baumuller 2015). Then there is the problem of attribution. In a number of the positive cases of increased revenues, introduction of ICT-based price information was not the only change: new sales centres, new contracts, other information to support better operations, additional support mechanisms may all go alongside (ibid., Courtois & Subervie 2015). There is also the problem of timing. Impacts early on in ICT adoption – when some users don't know how to use the information, or when some actors in a market have ICTs and others do not – may be different from those when almost everyone is a confident ICT user. Finally, there is the problem of comparison. The studies want to compare a situation in which the experimental group has price information, and the control group does not. But that is rarely the case. Friends, traders, extension officers, the radio, etc often share price information with everyone including a digital provide of ICT users sharing that information with non-users (Baumuller 2015, Burrell & Oreglia 2015).

Design–reality gaps. There may be basic design–reality problems with market price information systems that mean users don't or can't access the information e.g. the system is not accessed because in reality phones are too basic, old or broken, or farmers don't have the necessary capabilities (Wyche & Steinfeld 2016). Beyond this, the logic above is based on an abstract model of impersonal data disembedded from its context and operating within a perfect market (Burrell & Oreglia 2015). But that is not the reality in developing countries. For example, price information is useful to a producer only if they have choice about when and to whom to sell, and if there is competition between buyers. In North Kerala's fish markets, these conditions held quite well for larger boats and ICTs made the market work better. But in many situations, these conditions do not hold:

Perishable goods have to be sold quickly and cannot wait for a good price; the same is true for goods owned by producers who must repay debts (Djane & Ling 2015).

There may just be one viable channel for sales – in the Indian SMS service case as for the small boats in Kerala, most farmers sold to a single, local wholesale market and they had few other options that were either trusted or reachable (Fafchamps & Minten 2012). By contrast, those who sold to itinerant traders at the farm gate and thus had a choice of buyers, did see gains – a price improvement of 8 to 9 per cent.

Many producers sell to middlemen – there is evidence this is a dominant model in much farming rather than travelling around to different local markets (Courtois & Subervie 2015, Mitra et al. 2016). These middlemen may act as a cartel, preventing price competition. And relationships with middlemen are often hard to change: producers may take credit or loans from middlemen that need repaying; they may have family or other allegiances to particular middlemen (Porter 2012, Burrell & Oreglia 2015).

Trust and risk matter in exchange relationships: producers trust information from a known source more than an impersonal one (Molony 2006, Zanello & Srinivasan 2014), and producers may prefer selling at a lower price to someone they trust than at a higher price to someone they do not (Porter 2012, Burrell & Oreglia 2015).

As a result, there are gaps between design and reality, and the intended benefits of ICT do not emerge. Addressing "*cui bono*?", where there are beneficiaries, then they may be the more powerful actors: middlemen rather than farmers (Aker & Fafchamps 2011); commercial rather than subsistence farmers (Labonne & Chase 2009); groups of farmers rather than individuals (Ferris et al. 2014); and larger-boat rather than small-boat fishermen in Kerala. As well as other sources of power, the former actors in each set have access to information value chain resources (see Figure 2.26 model in Section 2.6), so another way to explain the differential effect of digital improvement is in terms of absence or presence of those other resources – see also Box 4.4.

Box 4.4

Digital improvement of enterprise operational information

As with market price information, evidence about digital improvement of operational information is contradictory. For example, Fafchamps and Minten (2012:30) compared users and non-users of a system supplying agricultural advice and weather forecasts via SMS. They found "no statistically significant average treatment effect on . . . crop losses resulting from rainstorms, or the likelihood of changing crop varieties and cultivation practices". And evidence from Cambodia found farmers did not use information that was provided about new techniques such as ways to use fertiliser (Grunfeld 2011).

On the other hand, in Colombia, provision of weather information via mobile phone reduced crop losses by 4 to 7 per cent comparing treatment vs. non-treatment groups (Camacho & Conover 2011), and a new phone-based advisory service providing information on crop and animal management and disease control led to a 37 per cent increase in income for the experimental vs. control group of farmers in India (Rizvi 2011).

As with the price information evidence, methodology issues will play a role here, but it may best be understood via the wider perspective of the resource-based information value chain, presented in Section 2.6.2's Figure 2.26. Most of the ICT systems only provide data. Whether that turns into information and whether the producers can then turn that into decisions, actions and results will depend on a whole set of broader factors. For example, telling a farmer they'll get higher yields if they apply a new fertiliser is of little use if that fertiliser is not available locally, or if they can't afford the fertiliser, or if they don't trust the information given, etc.

We can see this at work in a study of the impact on profitability of a mobile application in Indonesia – Usaha Wanita – which gave

operational tips to women entrepreneurs via mobile text message (Cai et al. 2015). There was a "small but statistically significant" correlation between uptake of the system and profits, but level of education and length of business experience were key mediators: better-educated, more-experienced entrepreneurs were better able to turn the text message data into business actions and results.

An important implication, then, for design of ICT4D systems which provide information for producers is to think through the information value chain. How will the producers turn the data provided into information, decisions, actions and results? How can inequalities be addressed – per se, provision of ICT-based information will benefit those richer producers who have the resources to turn it into results, and give no benefit to poorer producers who do not. So can the information provided be low resource-demanding – a best-fit solution that matches what most producers have to hand rather than a best-possible solution that requires resources many will not have?

Broader impacts. The underlying model is that shown earlier: better information on prices will lead prices to rise. But the impact of price information may be quite different. As seen in Box 4.3, prices might fall as a result of general efficiency. Or – as discussed in Section 4.3 – the main impacts may be on price variation and/or on producers' production decisions.

4.2.3. Digital reorganisation

We can identify four enterprise-related reorganisations that can address key shortcomings of small enterprise and that can impact economic growth (see Figure 4.7).

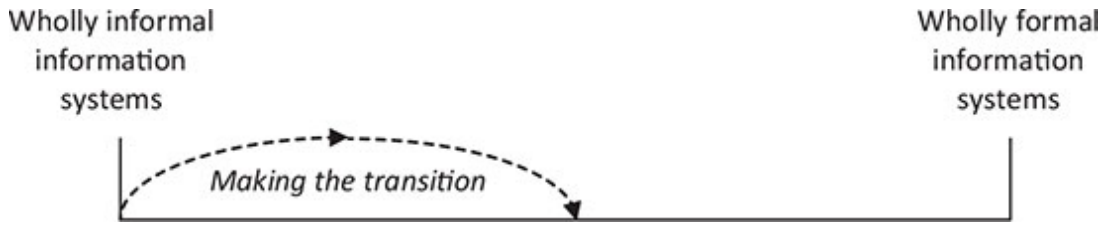
Two of the ICT-enabled changes are significant reorganisations:

- Participating in enterprise: moving from not being an entrepreneur to being one. In Section 4.4 below, we will discuss ICT-based enterprise but can find some evidence that ICTs are involved in non-ICT business start-ups: "In South Africa, 29 percent of respondents from non-mobile phone related firms were influenced to some extent by the availability of mobile phones in starting up their business, while 26 percent in Egypt were influenced by mobile phones. This was particularly true for small businesses operating in the service sector" (Samuel et al. 2005:51). Though Donner and Escobari (2010:651) note other work which shows no ICT impact on entrepreneurial start-up. We will return to this in Box 4.6.

- Participating in commerce: moving from not selling your outputs, to selling them. All typical enterprises sell their outputs, so this only applies to the move beyond subsistence farming. Given that information failures are – alongside transport – key transaction costs that discourage participation in commerce, ICTs should have significant potential to impact subsistence farming. Unfortunately, there seems to be little data on this; merely findings that subsistence farmers derive fewer economic benefits from ICTs than other groups (Labonne & Chase 2009, Sey 2011).

We might also include here upgrading the processes of an enterprise to make these more formal; as Box 4.5 explores.

Figure 4.7 Reorganisational enterprise participations



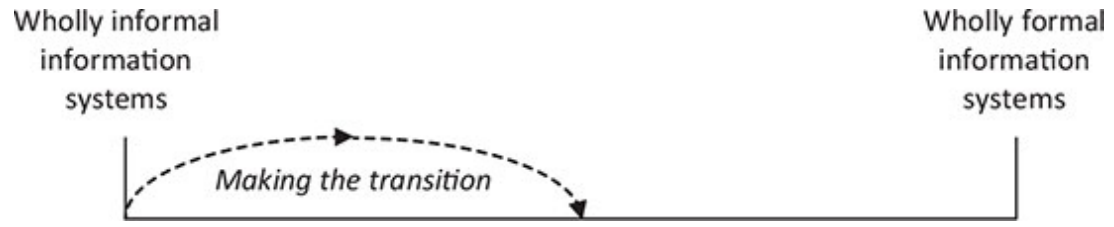
Box 4.5

ICTs and enterprise formalisation

Involvement with ICT4D like the digital trading systems described earlier is part of broader process upgrading, and can be described as formalisation of informal enterprises. Wholly informal enterprises keep no records and are unregistered with government authorities (Diga 2013b). Informality brings benefits of low cost and flexibility and many informal enterprises want to stay that way. But others are held back by their informality (Duncombe & Molla 2009). Their decisions are poorer because informal information is – in OCARA terms (see Chapter 2) – more appropriately presented but less open, less complete and less accurate than formal information. And informality prohibits access to other resources such as formal credit and assistance. As a result there is some – though as yet rather weak – evidence that formalisation is beneficial for enterprise productivity and growth (Gelb et al. 2009, Rand & Torm 2012).

As ICTs are introduced, some enterprises are pushed towards a process of transition (see Figure 4.8) away from sole reliance on informal information systems and towards "more balanced formal/informal information systems" (Duncombe & Heeks 2001:11). Research on micro-enterprises in Botswana showed the transition to be associated with changing demands for more and better information, formal recording of data and use of formal data processing technologies, and a move away from primarily social external linkages to more business linkages (Duncombe & Molla 2009).

Figure 4.8 The information transition



Two of the ICT-enabled changes are rather more incremental:

- Participating in a market: moving from selling outputs to one person, to selling them in a market. There is some evidence of an ICT effect with, for example, banana farmers in remote rural areas in Uganda more likely to sell in a market than at the farm gate once they had access to mobile phones (Muto & Yamano 2009). And there is also evidence of a differentiated effect by type of ICT with a study of Peruvian smallholder farmer participation in markets showing "Increasing internet usage by 1% leads to 2.5% increase in the share of farmers who sell in the national market and 0.24% increase in the share of farmers who sell in the international market" whereas a 1 per cent increase in mobile usage had no impact on national market participation and only a 0.05 per cent increase in international market participation (Garcia & Fan 2015).

- Participating in a supply chain: moving from selling direct to customers, to selling into a longer supply chain. An example is the creation of the e-Choupal system in Madhya Pradesh, India, which allowed farmers to sell their soybeans direct to a large corporation rather than relying on local wholesale markets (Goyal 2010). Those who did so saw a 33 per cent increase in profits.

We might also include here participating in a different kind of market. Some farmers use ICTs to facilitate a move from open to contract-based farming. For example, in Kenya, farmer involvement in a contract for sale of passion fruit was facilitated by the M-Farm app organisation (Baumuller 2015). Other farmers changed from a physical to a virtual market. One example is

the TradeNet platform which allowed farmers in Sri Lanka to post buy or sell orders for agricultural produce via mobile phone (Lokanathan et al. 2011). Those in the experimental group that used the system saw a 23 per cent increase in the average price paid compared to a 4 per cent increase for parallel non-users of the system during the same time.

In these and other cases (Ferris et al. 2014, Baumuller 2015, Alam & Wagner 2016), ICTs have enabled wider changes which bring greater certainty and higher quality of information (addressing two key information failures) and greater certainty and fairness of sales. These have induced farmers to plant more of the produce covered by the digital systems and even to switch from one crop to another; quite a significant reorganisation of their livelihoods.

4.2.4. Reflection

If we look overall at the evidence provided on ICT4D and micro-economic growth, then there are five main messages about ICTs and changes in economic growth.

a) *Limited nature of change*. Digging behind the hype and assumptions, there is both a paucity of (high-quality) evidence and a paucity of effect. The direction of evidence is generally positive – ICTs help more than hinder economic growth – but the extent of impact is small: "profit and productivity changes through use of ICTs over time have been modest" (Diga 2013b:156). Chew et al. (2011:11) likewise conclude that there is a "small, albeit statistically significant, relationship between total ICT access and [micro-enterprise] growth": in their study ICTs explained only 2 per cent of the variance in growth between enterprises. This might not be such a surprise if we think about typical small enterprises. Application of ICTs to the core processes – planting and harvesting crops; making basic goods; providing basic services – is not feasible at present, so ICTs can only be applied to the more peripheral parts of the value chain.

b) *Lack of transformation*. As well as looking at what changes, we might also reflect on what does not change very much, and can take a lead on this from Figure 4.6. You will note that there was no digital transformation category discussed here. That's partly because micro-economics does not readily encompass structural transformations, but also because ICTs can be seen here to have unequal economic impacts. Not necessarily in terms of winners and losers but in terms of winners vs. non-winners: those who gain vs. those who do not. Those divisions look to be along lines of information value chain resources we discussed in Section 2.6.2, such as money and other sources of power, and they mean that ICTs were seen here to tend to reproduce existing societal structures rather than transform them. We can draw two conclusions for practice. First, that economic growth will only occur when ICTs are accompanied by complementary information value chain resources. Second, that ICTs may have more impact where they support structural change than where they just try to improve or reorganise existing processes and systems: a point taken up in Section 4.3 and in the next message.

c) *Risk/reward of change*. The more we try to change with ICTs – the further we go up the "DIRT road" – the greater the impacts, and there are some signs in the evidence above that the developmental benefits may increase. As we know from Chapter 3 and design–reality gaps, though, the risks increase also, so there may be some type of risk/reward trade-off. There is some connection here to type of ICT, with feature phones being relatively easy to implement and use but being associated with relatively limited process changes and relatively limited benefits. By contrast, PC- and Internet-based applications are harder to implement and use, requiring more complementary inputs, but potentially bringing greater changes and benefits. For example, a study of farmers in Ghana found far higher barriers to Internet than to mobile usage, but Internet users had much better access to complex agricultural knowledge (such as new farming techniques) and much greater access to export channels for their sales (Krone et al. 2016). There is similar evidence in comparing barriers and rewards to dial-up vs. broadband Internet access (Sambasivan et al. 2016).

d) *Drivers to change*. Figure 4.6 does not directly include agency and motivation in its DIRT ladder of change but does incorporate these issues as a reminder that motivation is a critical information value change resource. ICTs were shown above to either partly provide or enable opportunities, but do they change the fundamental motivations and incentives to enterprise? Box 4.6 explains more and is a reminder that any attempt to link ICTs to economic growth must incorporate or build incentives to economic growth.

Box 4.6

ICTs and the drive to enterprise

Entrepreneurs in developing countries are typically divided into one of three groups (Heeks 2008e:10):

- "*Survivalists* are those who have no choice but to take up the income-generating activity because they have no other source of livelihood. Income provided may be poverty-line or even sub-poverty-line. Most 'entrepreneurs' in developing countries are of this type, and Mead [1994] describes them as 'supply-driven': forced into enterprise by push factors related to their poverty and lack of opportunity . . .

- *Flyers* are true entrepreneurs who have taken up enterprise because they see opportunities for growth. Income levels may meet more than basic needs, and enterprises may graduate to the medium-scale category. Only a very small proportion of developing country small entrepreneurs fall into this category . . . Mead describes them as 'demand-driven': pulled into enterprise by factors such as the opportunity for profit.

- *Trundlers* fall in between the two other groupings and represent those whose enterprise turnover is roughly static and who show no

great desire or no great capacity to expand. Income provided will be enough to meet basic needs. These form the second-largest group of small entrepreneurs in developing countries, and their stasis reflects the relative lack of strong external push/pull factors."

From this we can say that the entrepreneurial driving forces are respectively necessity or ambition or – more a shaper than a driver – habit. ICTs are unlikely to change the motivation of necessity that affects survivalists; but they may provide better opportunities for them to survive. Flyers are also already well-motivated and, again, ICTs may provide better opportunities for them to make profits but may not alter their underlying motivation. The motivation of trundlers may be affected most. If ICTs provide awareness of opportunities, or of the achievements of others, then they might stir ambitions. And if ICTs help induct trundlers into new or stronger markets, then the force of competition may also impel them.

e) *Other types of change*. The impact of ICTs on economic growth may misdirect our attention if we focus on it too much – there are plenty of non-growth-related developmental impacts that should be attended to: the topic of future chapters.

4.3. ICTs and meso-economic growth

Discussion of meso-economic growth shifts our focus from the internal value chain shown in Figure 4.3 to the external supply chain – the structure of connections between a focal enterprise and its suppliers and customers and, where relevant, distributors and partners. In discussing purchasing and sales, we have already touched on these issues but will now pick out some additional aspects.

The main notion here is that supply chains in developing countries are inefficient and costly; that some of those problems are information-based; and that ICTs can help solve some of those problems, increasing productivity through various of the means summarised in Figure 4.2, and so driving growth. We will again consider this according to the DIRT model.

4.3.1. Digitisation

Basic digitisation of supply chains can be understood as digitisation of communication with actors able to save money, particularly by journey substitution, and thus increase economy. We already discussed this above (see Box 4.7), though there can be a wider impact on competitive advantage – and thus an increase in profitability – for those who can communicate digitally vs. those who have to communicate still via journeys. Alongside improvements in economy and profitability, digitisation can also improve the efficiency of supply chains.

4.3.2. Digital improvement

Digital communication permits better coordination of the supply chain. This can begin in a very simple way with coordination of sales to ensure that goods are only delivered or a trader is only requested to visit when a sale is certain. This reduces wasted transportation costs but it also reduces waste of perishable goods, improving both efficiency and profitability. This is a particularly important issue within agriculture with estimates that up to 50 per cent of fresh fruit and vegetables and 30 per cent of cereals rot before reaching the consumer: a waste of over US$300bn annually (FAO 2013). The Keralan fishing case above centred around less waste, and later research found waste reduced as phones were used to coordinate auctioneers, buyers, ice and trucks to all arrive at a beach market as fish was being landed (Srinivasan & Burrell 2015). Dairy farmers in central Uganda used mobiles to coordinate with traders in Kampala and saved regular wastage of thousands of litres of unsold milk (Karamagi & Nalumansi 2009), and mobile calls between farmers and traders in Ghana similarly reduced spoilage in agricultural produce along the supply chain (Overa 2006).

Within the supply chain, traders are often key actors. They have always been communication nodes – linked to producers, transporters and retailers – and ICTs have had a direct impact in improving their ability to coordinate across these different actors. This has helped to improve the functioning of markets as traders more effectively balance supply and demand between areas of surplus and shortage; directing goods and produce from oversupplied to undersupplied markets (Djane & Ling 2015). As well as reducing waste, this also helps reduce price variation between different markets. In Jensen's (2007) Kerala study, the use of mobile phones across all fish markets along the North Kerala coast reduced price variations from 65 per cent to 15 per cent. Aker's (2010) study of grain markets in Niger showed price variation on first introduction of mobiles reduced by 10 per cent, with that variation decreasing further over time. Parker et al.'s (2016) study of the Reuters Market Light service found it reduced price dispersion of crops in rural markets in India by 12 per cent above any impact mobiles alone would have. This reduction in price variation may not impact average prices but it will reduce opportunities for arbitrage – which allows traders to capture profits because of knowledge of price differences – because ICTs are here reducing information absences and asymmetries. It will also reduce risk and uncertainty for both producers and consumers.

4.3.3. Digital reorganisation

Alongside better coordination of actors within existing supply chains, ICTs can also change the shape of supply chains: a form of process upgrading (Donner & Escobari 2010). Two examples are given in Box 4.7. This change can be geographic, breaking supply chains away from the localisation which, as we noted above, occurs partly due to high transaction costs and other information failures. Thus, for example, the larger-scale Keralan fishermen landed their catches at a wider geographic range of markets once they started using mobiles (Jensen 2007).

There can also be a growth in complexity, with a greater number of actors brought into supply chains; for example, Aker's (2008:4–5) finding that traders with mobile coverage "have more contacts and trade in more markets", or Donner and Escobari's (2010) wider review which found a number of studies showing micro- and small enterprises linking to new customers as a result of using a mobile. However, at least with mobile phones, this is nothing like a globalisation of supply chains – the extension of range and complexity still has distinct limits, for example, imposed by either a need or a preference to conduct certain transactions face-to-face, or by continuing high transportation costs (Porter 2012).

Box 4.7

Limits to the impact of mobiles on cloth-weaving supply chains in Nigeria

The weaving of cloth for ceremonial occasion clothing in Nigeria involves buyers, producers (both master-weavers and "sub-weavers"), and intermediaries who sit between the two. As mobile phones began to be used, changes were seen in the supply chain; but changes within limits. Four particular effects were noted:

Journey substitution (digitisation): mobiles phones substituted for some journeys and so saved time and money, increasing the efficiency of the supply chain. However, there were limits to this. Partly because physical materials had to be moved around. Partly due to the nature of decisions. Structured decisions – simple, standardised, objective – such as "Do you have an order for me?" or "Is the design sample ready for me to collect?" were readily digitisable. Unstructured decisions – complex, non-routine, subjective – such as "Can you produce a design that looks like this?" or "How far have you got in weaving the next part of the order?" were not readily digitisable.

Competitive advantage (digitisation): there was a growing competitive divide within the supply chain: "At one end, those without mobile phones were losing orders and income. At the other, one of those who had managed to obtain his own mobile phone was developing into an intermediary through his role as a coordinator-weaver".

Geographic location (digital reorganisation): a few weavers in the supply chain used a wider geographic spread of suppliers or sub-weavers once they obtained mobiles. But these were the exception more than the rule.

Intermediation (digital reorganisation): mobiles did not help buyers know of, trust, manage or transact direct with weavers. Instead, they made it easier for the intermediaries to contact and control the weavers, and led to a new type of intermediary emerging – the "coordinator-weaver" – who was able to take on larger numbers of orders and sub-contract them to a wider set of sub-weavers. Mobiles helped entrench the informational and financial power of intermediaries.

Source: Jagun et al. (2008)

A more substantial change is the removal of some actors from the supply chain. As noted in Chapter 1, ICTs have long been understood to promise "disintermediation": at its most extreme, putting producers and consumers in direct transactional contact and removing the need for other intermediaries.

The ability of mobile phones on their own to do this has been limited. For example, only 12 per cent of Ghanaian fishermen – having obtained a mobile phone – used it to "bypass middlemen and sell straight to their customers" (Salia et al. 2011:14). Further, there is evidence of structural reinforcement; especially that middlemen gain most from the advent of ICTs: the traders mentioned by Aker (2008) became better aware of price differences and better able to take advantage of arbitrage opportunities, increasing their profits by 29 per cent. This will have done little to improve

the efficiency of the supply chain; the only other benefit is reduced price variation for consumers. See also Box 4.7.

Some of the reasons have been noted above including lack of trust, and financial and social dependencies on particular middlemen (Porter 2012). However, broader interventions have been able to support more substantial changes in the supply chain. For example, the Esoko mobile system in Ghana included a module to match bids and offers for agricultural produce (Arinloye et al. 2015). Where this could be used – and there were a number of constraints limiting its scope – farmers could sell direct to wholesale traders, middlemen were removed, and savings estimated between US$2 and US$150 per transaction were recorded.

An alternative reorganisation is the restructuring of enterprises from individual to group structures. Farmers, for example, report that working as a group significantly improves their ability to bargain, such as for better prices (Ferris et al. 2014, Krone et al. 2016). Though this is a social rather than technological change, ICTs make the change possible by helping farmers to coordinate group activities such as meetings, crop storage, purchase of inputs and sales of outputs. Conversely, where this does not happen – where entrepreneurs remain atomised, competitive entities – the gains from ICTs are reported to be more limited (Caceres et al. 2012).

4.3.4. Reflection

Returning to Figure 4.2, the evidence in this section shows ICTs improving the efficiency of supply chains, but it is less clear that ICTs are upgrading through supply chain reorganisation unless there is some related change in supply chain structures. As with the evidence in Section 4.2, we can therefore find little affirmation for the idea of ICT-enabled transformation; the highest level of DIRT. Indeed, as Box 4.8 shows, there is more evidence for reproduction rather than transformation of economic structures.

Box 4.8

ICTs and structural (non-)transformation of supply chains

If disintermediation occurs then it can help producers capture more of the value in a supply chain: a form of upgrading. But that word "if" is critical, and disintermediation and other forms of supply chain restructuring seem relatively rare at present.

Studies of the role of ICTs in three African globalised supply chains – tea, tourism and wood products – found examples of benefits (Foster & Graham 2015, Murphy & Carmody 2015). Some firms had been able to disintermediate and have more direct access to customers. But in other cases, new intermediaries had emerged in the global North to take advantage of digitisation: firms like Expedia or Hotels.com in tourism. And the majority picture was one in which those who gained most from digitisation of the supply chain were "established firms who had the skills, knowledge, finance and power" (Foster & Graham 2015:112) – in other words those with information value chain capabilities and those controlling other sources of power as per the models in Section 2.6.2 – who were typically either based in the global North, or were local subsidiaries of Northern multinationals.

The African goods/services producers report benefits in terms of efficiencies and sometimes sales resulting from ICT implementation; thus boosting economic growth. But upgrading is absent for most and there can be a sense of "running to stand still": that ICTs have simply become a minimum requirement for participation in global supply chains. Thus far in these cases (and others in other parts of the global South: Caceres et al. 2012, Wresch & Fraser 2012), the conclusion is that ICTs may be good at delivering incremental development, but much less good at delivering transformational development.

There should be an "as yet" added to that last sentence since it is clear – as with the micro-economic discussion – that timing matters. For instance,

impacts when mobiles are new and owned by a few supply chain actors are different from impacts when mobiles are owned and embedded in the lives of all actors. And time will also see more powerful ICTs start to have an effect. Basic mobile phone applications of calls and SMS seem to struggle to make changes to existing supply chain structures; indeed, they may reinforce them. More sophisticated ICTs – mobile phone apps, Internet-based systems – may be more disruptive.

Nonetheless, one clear conclusion for design of ICT4D economic interventions is that parallel change is required. Hoping that ICTs alone will change supply chains may be less effective than implementing parallel changes alongside the technology. Building on what we know from Sections 4.2 and 4.3 and the models in Section 2.6.2, those parallel changes must include (see also Diga 2013b, WB 2016):

- Motivation: to build a drive for growth unless it already exists.
- Resources: to provide the resources necessary for information value chains to operate (data, skills, knowledge, money, materials, etc).
- Institutions: to create a supportive behaviour-shaping context through appropriate regulations, quality controls, risk protections, etc.

But it can now be seen that this alone may not be enough for transformative development; that may require more dramatic change that disrupts the structural relations of power within supply chains.

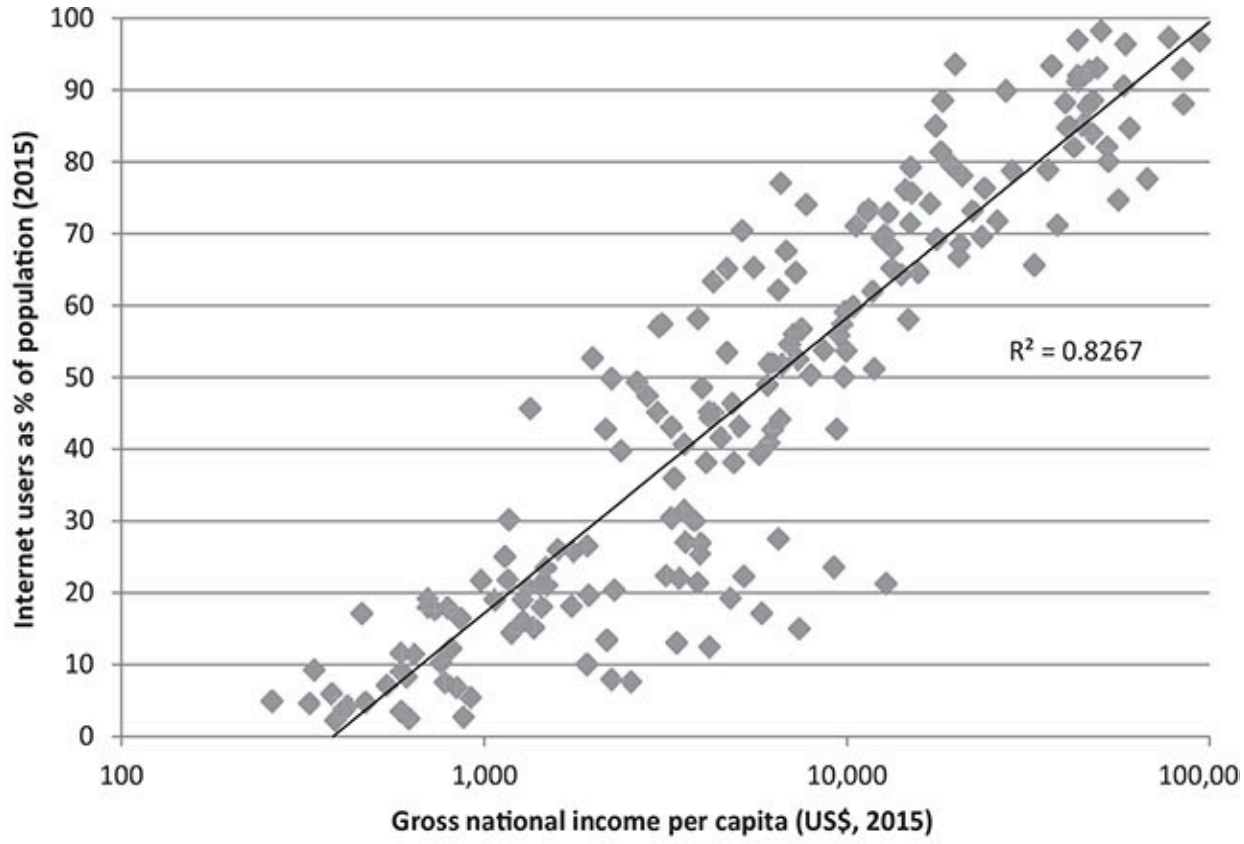
4.4. ICTs and macro-economic growth

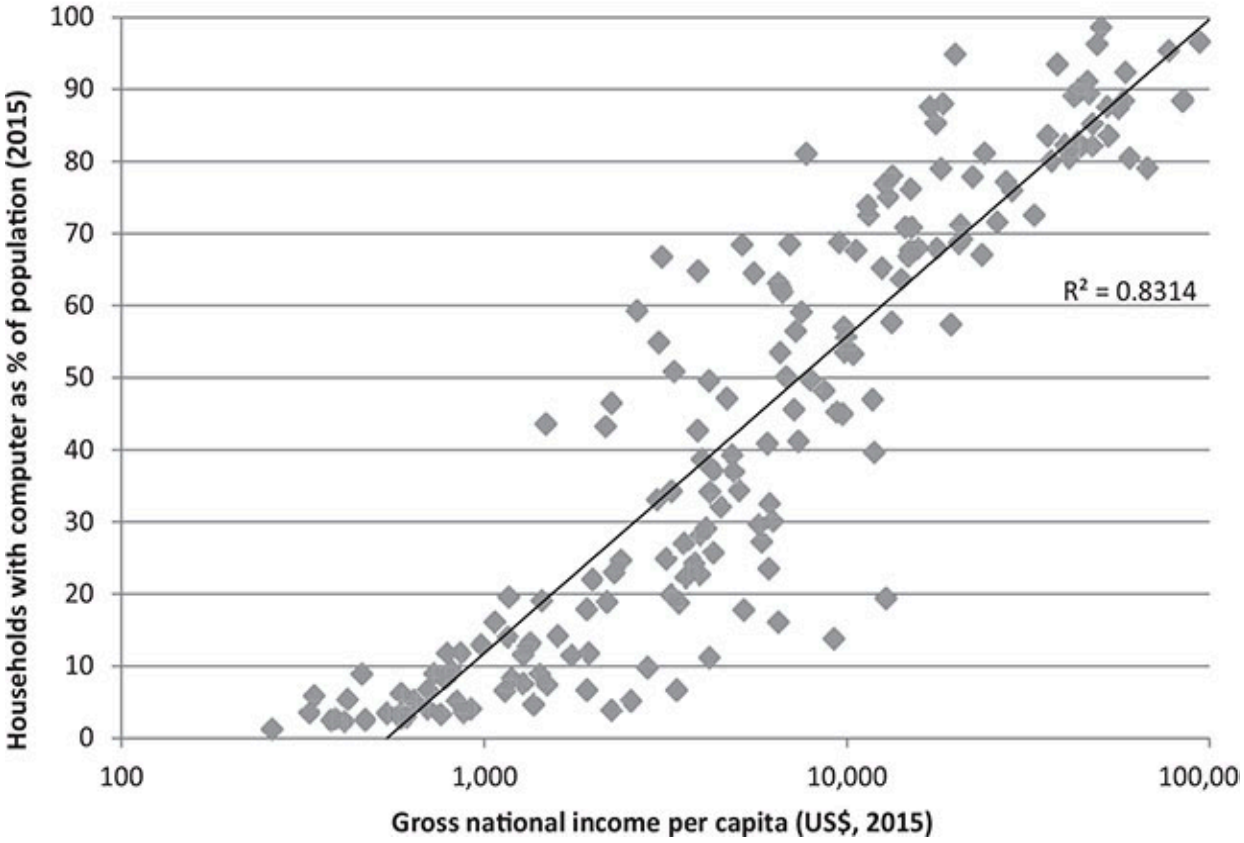
All of the evidence presented so far in this chapter can be described as "bottom-up": it draws from field studies of individual farmers or enterprises or markets or supply chains. But there is also ICT4D evidence that comes at

things “top-down”: looking for patterns and connections in overall economic data.

One pattern is generally agreed: that there is a correlation between access to ICTs and national wealth. Figure 4.9 gives a couple of examples (data source: WB 2017b).

Figure 4.9 ICTs and national income


Internet users as % of population (2015)
100
90
80
70
60
50
40
30
20
10
0
R² = 0.8267
100
1,000
10,000
100,00
Gross national income per capita (US$, 2015)


Households with computer as % of population (2015)
100
90
80
70
60
50
40
30
20
10
0
R² = 0.8314
100
1,000
10,000
100,00
Gross national income per capita (US$, 2015)

So, does this mean that ICTs cause countries to get richer? It does not, because all the graph demonstrates is correlation and – a phrase seared onto the heart of every statistician – correlation does not imply causation. It could be that ICTs cause countries to get richer. Or it could be the reverse: as countries get richer they spend more on ICTs. Or there could be some other factor: perhaps populations in richer countries tend to be much more mobile and it is that mobility which causes people to buy more ICTs. Or the link could be just coincidental. Or some full or partial combination of the four. This is a real problem. As an example, the *Global Information Technology Report 2015* (Pepper & Garrity 2015) cites two studies it says show ICT causes economic growth (Qiang et al. 2009, Scott 2012). Read both studies, though, and neither is able to reject the reverse causality hypothesis: the possibility that their results arise because economic growth drives ICT consumption.

However, there are statistical techniques to get around this problem such as studying time lag effects between introduction of ICTs and later outcomes on growth. These have demonstrated a two-way causal effect between ICTs and economic growth, but have then been able to tease out the strength of the ICT-to-growth relation:

- "10 more mobile phones per 100 people would increase GDP per capita growth by up to 0.6 percentage points" (Deloitte 2012:4);
- "[a]n increase in the broadband penetration rate by 10 percentage points raised annual growth in per capita GDP by 0.9–1.5 percentage points" (Czernich et al. 2011:530).

Many of the studies done to date are on developed countries, or on a combined basket of developed and developing countries. But might we expect the macro-economic impacts of ICTs to be different between developing and developed countries?

There are a few reasons we might anticipate an exclusionary effect, increasing inequalities between the two sets of countries:

- Complementary inputs: we know in general terms from Chapter 2 and from specific cases throughout the book that effective use of ICTs requires various complementary inputs: data, skills, knowledge, institutions, money, etc. And we know those are in shorter supply in developing countries, which will likely lead to less effective conversion of ICTs into economic growth.

- Critical mass: we know from Chapters 1 and 3 that network effects mean there is a critical mass or threshold of 20 to 25 per cent of the population connected to the network, and that below this, significant economic growth impacts will not be achieved. All developed countries have reached this level for mobile phone and Internet and broadband usage (ITU 2016). Most developing countries have reached this level for the mobile phone network (the only exceptions – other than those with no data – are Eritrea and North Korea). But only some developing countries have for the Internet or broadband: for instance, least-developed countries average 19.4 and 15.2 users per 100 population respectively.

- Different cost equation: ICTs originate in the global North and those digital technologies involved with automation are based on a fundamental cost equation – they save money because cheap technology replaces expensive human labour, thus saving input costs which we earlier saw (by increasing "economy" in Figure 4.2) as one foundation for economic growth. But in the global South, that equation could be reversed since it is quite likely that ICTs may be more expensive and human labour much cheaper.

However, there is also a reason we might anticipate an inclusionary effect, reducing inequalities between the two:

- Information failures: these have been much more severe in developing countries than in the global North. As one example of this, mobile phones should have less overall impact in the global North – where a reasonable fixed-line infrastructure already existed – than in the global South – where for most people mobiles are not a supplement or replacement for fixed lines but a first reasonable access to telecommunications.

We can find evidence about all the ideas above:

- Countries with a "larger stock of human capital, more openness to trade and foreign activities, and stronger institutions" benefit more economically from ICTs (Seck 2012:437; see also Dedrick et al. 2013).

- A key work finding critical mass effects looked only at OECD countries (Roller & Waverman 2001), but others have extended to developing countries and found threshold effects (Sassi & Goaied 2013). Some then claim developing countries benefit less than developed countries from ICTs as a result (Gruber & Koutroumpis 2011).

- Because of higher infrastructural costs and higher taxes, the cost of ICTs in developing countries does tend to be somewhat greater than the cost in developed countries (WB 2016). And labour costs are significantly lower: at least three times lower on average (ILO 2016). However, there is relatively little evidence as yet for automation effects of ICTs in developing countries (Vivarelli 2014). As described in this chapter, applications to date have been much more communications-oriented than replacing human labour in operational processes, with the scope of automation held back by the altered technology/labour cost equation, and the effectiveness of automation held back by the lack of complementary inputs.

- Others find evidence for greater ICT benefits in developing countries due to greater information failures with, for example, gains from mobiles "greater wherever land line phones are rare" (Lee et al. 2012:461), and

find that developing countries benefit more than developed countries in terms of ICTs' impact on economic growth (Deloitte 2012). Such inclusive effects have been found at other levels also: "the highest productivity gains from broadband in Brazil appear to be found in the country's less-developed regions" (Jung 2015:107).

Unravelling why these differences occur would need us to differentiate between the statistical methodologies used, the independent variable (the particular type of ICTs investigated), the timing of the study, and the geographical coverage – with evidence that improvements in complementary inputs and critical mass over time spread down to ever-poorer groups of countries (Dedrick et al. 2013). This may explain why some earlier studies (e.g. Heeks & Kenny 2002) found that ICTs increase inequality – the relative economic gap between rich and poor countries – whereas some later studies have shown evidence of ICTs reducing inequality by increasing productivity and growth more in poorer than richer countries (e.g. Forero 2013, Dell'Anno & Solomon 2014).

Whatever the impact of ICTs on relative economic growth and inequality between nations, this should not obscure the largely accepted fundamental of absolute impact: ICTs cause some economic growth in developing countries. There is increasing evidence of this – alongside Czernich et al. (2011) and Deloitte (2012) cited earlier, Cleeve and Yiheyis (2014:556) report slightly more modest figures for African countries: "roughly 0.3 percent increase in the growth rate of real GDP for every 10 percent growth in the rate of mobile penetration"; Katz and Callorda (2013:15) report from Ecuador "for every 1% increase in [broadband] penetration, the average annual contribution to GDP growth was estimated at 0.052%". Though figures vary considerably, an overall conclusion could be that while GDP payoffs for ICT investments are "usually among the highest" when compared to investments in energy, water and transport (Estache & Garsous 2012), their overall economic growth impact is still "modest" at present (Stanley et al. 2015).

But how do ICTs provide this growth impact? We will now investigate.

Intensive and extensive application of ICTs

One main way that ICTs cause economic growth is through the increases in productivity outlined in Sections 4.2 and 4.3: the improvements in economy, efficiency, profitability and upgrading caused by ICT-enabled digitisation, improvement, reorganisation and – potentially – transformation. These all typically represent what has been called "intensive" applications of ICTs, meaning application that intensifies – that is improves in some way – an existing economic activity (Narasimhan 1983). All of these help explain some part of the macro-economic causal link from ICTs to economic growth.

But at the start of the chapter, we noted a fifth channel for economic growth: through restructuring that shifts resources from less-productive to more-productive sectors. An important way in which ICTs do this is through their "extensive" application, meaning application that extends the boundaries of economic activity. (A simple way to understand extensive economic activity is to ask: "has this activity only arisen due to ICTs?" If the answer is no – the activity already existed before ICTs – then any use of ICTs is intensive. If the answer is yes – the activity only exists because of ICTs – then this is extensive.)

We can label extensive economic activity overall as the ICT sector, broken down into six sub-sectors which are summarised in Figure 4.10 (Heeks 2008e):

- *Goods*: production of ICT consumer goods such as computer hardware and digital telecommunications, plus ICT producer goods: both capital goods (e.g. automated machinery for manufacturing PCs) and intermediate goods (chips, motherboards, hard disk drives, DVD drives, etc used in computer manufacture).

- *Software*: design, production, marketing, etc. of packaged and customised software.

- *Infrastructure*: "development and operation of enabling network infrastructure" (Wong 1998:325); both foundational telecommunications plus value-added networking services.

- *Services*: professional services not covered in other categories such as consulting, training and technical services.

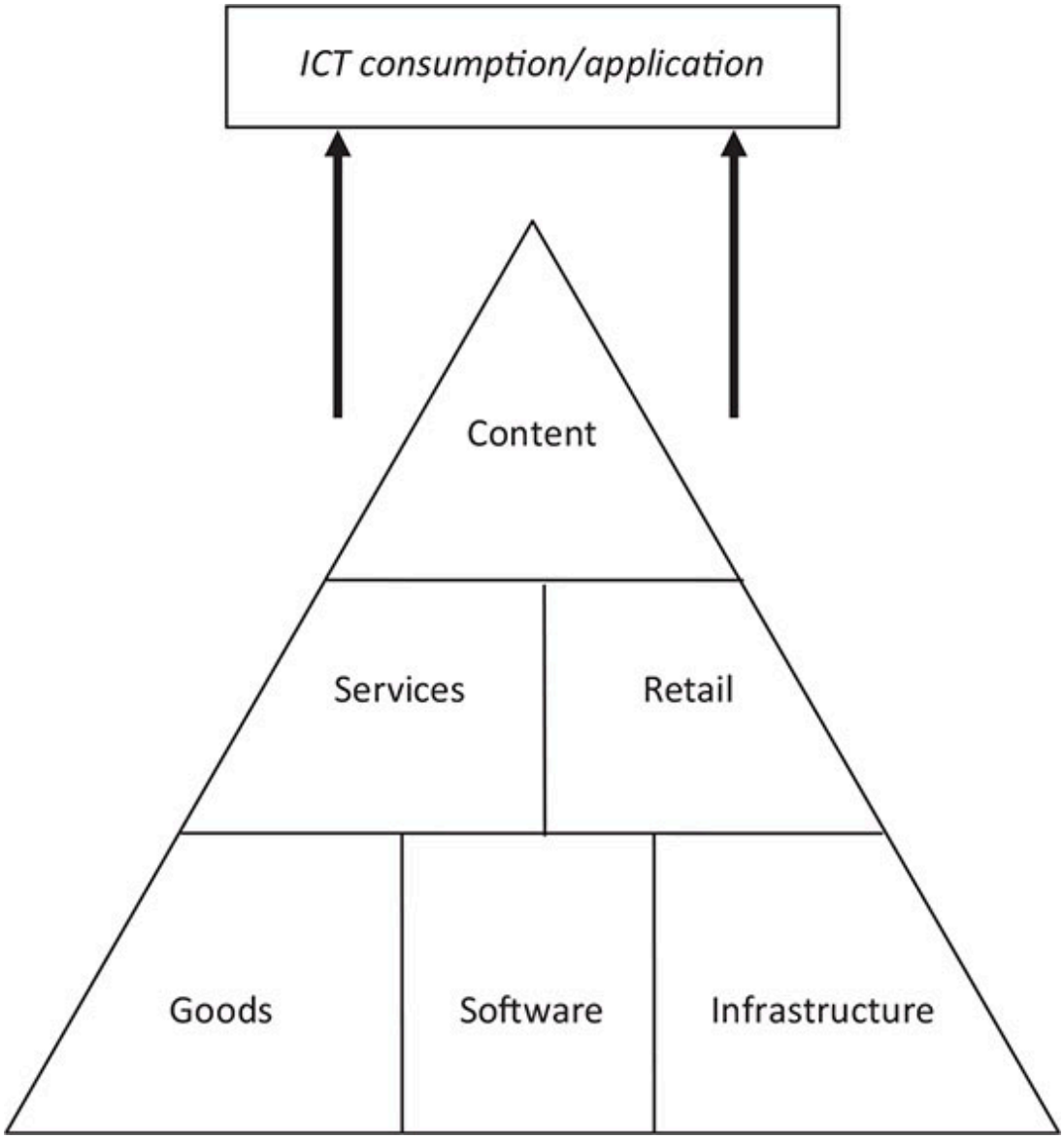
- *Retail*: sale, re-sale and distribution of ICT goods, software and infrastructure and related services.

- *Content*: production and distribution of data content, including back-office processing and digitisation.

(ibid.:5)

The ICT sector overall contributes directly to GDP through its value addition: the difference between the economic value of its outputs as compared to its inputs. And it contributes indirectly through its employment effects: for example, the uses that ICT sector workers make of their wages (Pepper & Garrity 2015). But it also contributes to economic growth through restructuring. ICT sector activity adds more value (has higher productivity) than other types of economic activity: typically, around 1.5 times higher than average but up to three times higher in some countries (OECD 2014). Therefore, as resources are drawn into the ICT sector and in relative terms away from other economic sectors, a country will experience growth. This is the extensive link between ICTs and economic growth to set alongside the intensive links discussed earlier.

Figure 4.10 Typology of ICT sub-sectors



In absolute terms, the overall size of the ICT sector can seem quite impressive. Looking just at telecommunications-related activity, we can include both direct employment, which means formal jobs with telecom operators; and indirect employment, which means those working in telecommunications but outside the main operators such as in distribution, repair and retail including SIM and airtime and top-up card retail (Heeks 2014d). (This excludes induced employment which means the broader employment impact of a) efficiencies from intensive application of digital technology and b) GDP growth including those who work for people in direct and indirect employment.)

Figures include:

- The telecommunications sector in Pakistan is responsible for the creation of nearly 1 million direct and indirect jobs (UNCTAD 2010).
- The mobile sector alone in India is estimated to employ 2.8 million people directly and indirectly (WB 2012).
- The mobile sector in Africa is estimated to have created 3.3 million direct and indirect jobs (GSMA 2013).

These large numbers are still quite small given population sizes in the global South, even in countries like India which are well-known for their ICT sectors. For instance, if we take the 3.5 million formally employed in India's ICT services sub-sector (Nasscom 2014), and multiply by three to account for the much greater number employed in the informal sector (Nandi 2014), and add all those argued above to be employed in the mobile sector, then the total – around 13 million – is still only about 2.5 per cent of India's overall workforce (WB 2016). Such percentages will be much smaller in most developing countries.

Because of its relatively high productivity levels, the ICT sector's contribution to GDP is higher than the workforce percentages. Again, taking India, just the ICT services and mobile sub-sectors combined were estimated to contribute more than 15 per cent of GDP in 2014 (Nasscom 2014, GSMA 2015c). Of course, India is exceptional. Global averages (dominated by the global North) see the ICT sector contributing 4 per cent of the workforce and 6 per cent of GDP (OECD 2014). And figures for most developing countries are smaller still – only very rough estimates are possible but taking the ICT sector as just hardware, software and telecommunications, the contribution is typically around 3 per cent of GDP in middle-income developing countries and around 1.5 per cent of GDP in low-income developing countries (Nottebohm et al. 2012, Enriquez et al. 2015, Huawei 2016).

The current evidence base makes it hard to know whether the intensive or extensive effects of ICTs are making a bigger difference to macro-economic growth. But we do know the extensive component is likely to be growing given annual ICT sector growth in developing countries is often double-digit (Nottebohm et al. 2012, OECD 2015a, Huawei 2016).

Additional material

Discussion questions

4.1. Is economic growth the most important of the development goals?

4.1. Of the five mechanisms identified for productivity improvement – economy, efficiency, profitability, upgrading and restructuring – which do you think offers the best means to help developing countries grow through ICTs?

4.2. What is the connection between information and economic growth? How is this connection challenged in developing countries?

4.2. The costs of farming can be divided into three (De Silva & Ratnadiwakara 2008):

a) Direct costs (85 per cent of total): labour, fertiliser, seeds, irrigation, etc;

b) Unobservable/information transaction costs (11 per cent of total): information search, bargaining and enforcement;

c) Observable transaction costs (4 per cent of total): transportation, storage, etc.

What effects could ICTs have on each of these? Where would ICT be likely to have its greatest effect?

4.2. How is the Figure 4.6 model similar to, and different from, other overview models of ICT4D in this book?

4.2.1. Given the near-ubiquity of mobile phones in developing countries, are the main micro-economic gains from digitisation already in the past?

4.2.2. What information value chain resources would a farmer need in order to turn market price information into economic growth results?

4.2.4/4.3.3. Why is digital transformation so rare?

4.2.4. Can ICTs alter the fundamental motivations of individuals to pursue economic growth?

4.3.2. Why is it so difficult for ICTs to eliminate middlemen from supply chains?

4.3.2. Is it better to use ICTs to support the work of farmers as individuals or as groups?

4.4. Do ICTs cause economic inequalities between the global North and the global South to increase, decrease or remain the same?

4.4. To which should we give higher priority in the global South: intensive or extensive applications of ICTs?

Assignment question

How and to what extent do ICTs help deliver economic growth in developing countries?

Further reading

If you would like to know more about . . .	4.1. economic growth in developing countries	. . . then take a look at . . .	4.1. Chapter 5 of Thirlwall, A.P. (2011) *Economics of Development*, 8th edn, Palgrave Macmillan, Basingstoke, UK >Discusses different theories of economic growth Tribe, M., Nixson, F. & Sumner, A. (2011) *Economics and Development Studies*, Routledge, London >A complete overview of economic development
	4.2. information and economic development		4.2. Jagun, A., Heeks, R. & Whalley, J. (2008) The impact of mobile telephony on developing country micro-enterprise: a Nigerian case study, *Information Technologies & International Development*, 4(4), 47–65 >Provides an overview of information issues, and pointers to other relevant sources
	4.2. ICTs and micro-economic growth		4.2. Jensen, R. (2007) The digital provide: information (technology), market performance, and welfare in the South Indian fisheries sector, *The Quarterly Journal of Economics*, 122(3), 879–924 >Important to read because it is a seminal paper in the field Diga, K. (2013) Local economic opportunities and ICTs: how ICTs affect livelihoods (part II), in: *Connecting ICTs to Development*, L. Elder, H. Emdon, R. Fuchs & B. Petrazinni (eds), Anthem Press, London, 137–160 >One of few overview pieces Burrell, J. & Oreglia, E. (2015) The myth of market price information: mobile phones and the application of economic knowledge in ICTD, *Economy and Society*, 44(2), 271–292 >Valuable in questioning simple assumptions about ICTs and market price access in developing countries
	4.3. ICTs and meso-economic growth		4.3. Porter, G. (2012) Mobile phones, livelihoods and the poor in Sub-Saharan Africa, *Geography Compass*, 6(5), 241–259 >One of few overview pieces

(continued)

			Jagun, A., Heeks, R. & Whalley, J. (2008) The impact of mobile telephony on developing country micro-enterprise: a Nigerian case study, *Information Technologies & International Development*, 4(4), 47–65 >Summarises a number of supply chain-related issues Murphy, J.T. & Carmody, P. (2015) *Africa's Information Revolution*, John Wiley, Chichester, UK >Critical reflections on ICTs and export-oriented supply chains in Africa
	4.4. ICTs and macro-economic growth		4.4. Dedrick, J., Kraemer, K.L. & Shih, E. (2013) Information technology and productivity in developed and developing countries, *Journal of Management Information Systems*, 30(1), 97–122 >Typical paper that both reviews past work and provides its own input on the relation between ICTs and macro-economics

Notes

1. One important variation in measuring economic growth is the sometime use of purchasing power parity. The core issue runs along the following lines: if it costs US$1 to buy a kilogram of potatoes in the USA but only US$0.25 to buy them in India, then the purchasing power of US$1 in India is four times that in the USA, and adjustments should be made to GDP or gross national income to take account of this. Of course the calculations are more complex than that because consumers buy more than just potatoes, but the main principle is that we should account for different prices when measuring economic growth.

2. This is therefore the third value chain we have seen, sitting alongside the ICT4D value chain that explains the overall role of ICTs in development, and the information value chain (CIPSODAR) that explains how information links to development.

5 ICTs, poverty and livelihoods

In reading this chapter, you will learn to:

- explain the intention of poverty eradication as a development goal;
- categorise the relationship between ICTs and financial poverty eradication;
- summarise evidence on the relationship between ICTs and financial poverty eradication;
- outline the sustainable livelihoods framework;
- overview evidence on the relation between ICTs and sustainable livelihoods;
- explain the impact of ICTs on gender equality.

Like Chapter 4, this chapter also relates to economic development but, instead of focusing on economic growth generally, it looks more specifically at the role of ICTs vis-à-vis poverty and the livelihoods of those on lowest incomes.

5.1. Poverty eradication as a development goal

We noted in Chapter 4 that one criticism of economic growth as a development goal was that it ignores problems of who gets what, in particular those on lowest incomes. To understand this, we need first to understand what poverty means.

In commonplace terms, poverty means a lack of money as measured in absolute terms, with a key definition being an income of less than US$1.90 per day measured in purchasing power parity terms (WB 2017a). Using these measures,

around 800 million people live in the extreme poverty of less than US$1.90 per day, and 2.1 billion live in the poverty of less than US$3.10 per day. While the figures declined during the twenty-first century – particularly due to changes in China – these are still vast numbers, and show why poverty eradication is such a development priority: the first of the Sustainable Development Goals. One only has to think of the impossibility of living one's own life on such incomes to understand why change is needed.

SDG 1. End poverty in all its forms everywhere

But poverty can also be defined in relative terms. A typical measure of relative poverty is earning less than 60 per cent of median income (Ravallion & Chen 2011). Another common notion linked to relative poverty is measurement of inequality in society, for example by the Gini coefficient or index. If income if perfectly distributed – everyone in society gets the same – then the Gini coefficient is 0. If income is perfectly unequally distributed – one person gets everything and everyone else gets nothing – then the Gini coefficient is 100. Levels of inequality in developing countries are high: the Gini coefficient for low-income countries is 41.8 compared to 34.3 for high-income countries (WB 2017b). Such inequality is a problem of itself since equality and fairness have inherent moral value. But it is also a developmental problem: high levels of inequality create social tensions and they also slow overall economic growth (Dabla-Norris et al. 2015). Thus there is a specific SDG on inequality.

SDG 10. Reduce inequality within and among countries

There is general agreement that overall economic growth helps address absolute poverty – the numbers below a certain income level – but that the size of this effect varies considerably depending on initial conditions such as the way assets are distributed in society and the type of economic growth policies (Dohlman & Soderback 2007). There is no agreement that growth per se addresses relative poverty such as the gap between the richest and poorest in a society; what matters more is the type of growth – hence the interest in "pro-poor growth" or "inclusive growth" aimed at reducing inequalities (DFID 2009, De Haan 2015).

Thus, alongside Chapter 4's general investigation of the way ICTs can support economic growth, we have a specific interest in the way ICTs can directly address poverty in both absolute and relative terms. We respond to that interest in this chapter by first looking at the various different processes by which the poor interact with money, and the role ICTs have to play in those processes. And then we will expand the perspective to look at how ICTs relate to overall livelihoods of the poor.

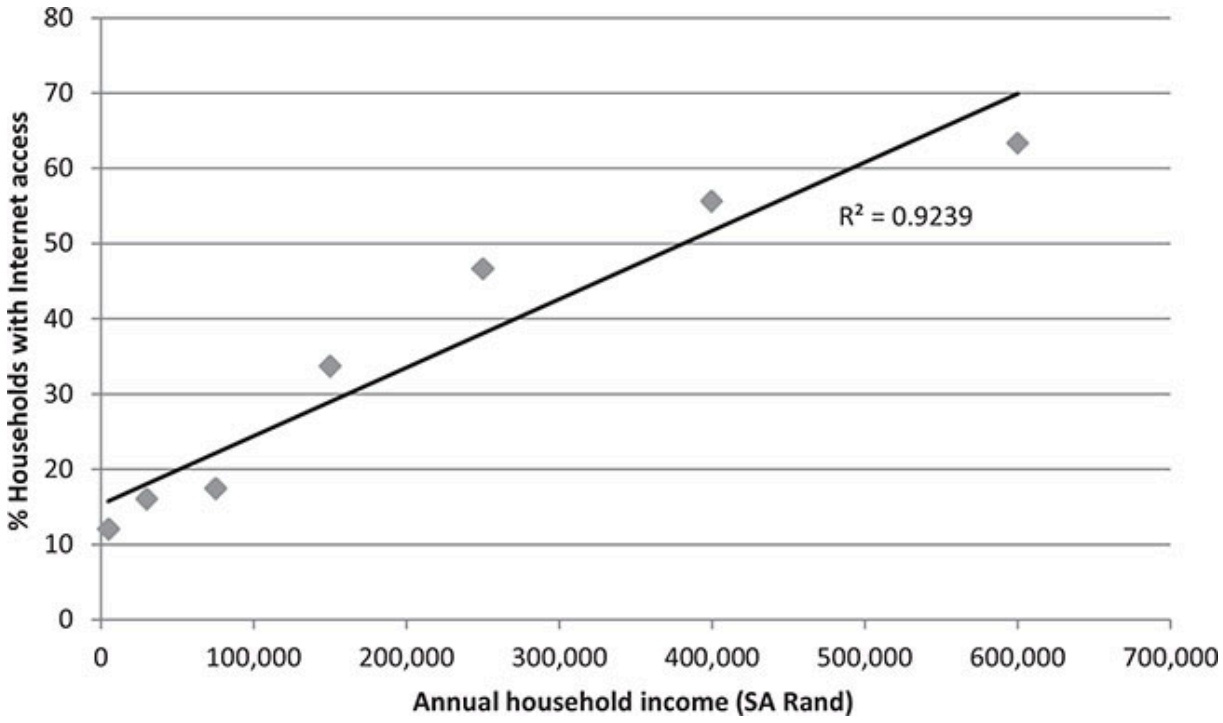
5.2. ICTs and financial poverty

Just as there is a strong correlation between ICTs and national economic wealth, so there is also at the level of individuals, and Figure 5.1 (data source: Oyedemi 2012) gives an example from South Africa. Just as with economic growth, the causal relationship runs two ways: as reflected in Chapter 2, higher income means it is easier to own and access ICTs. But what of the opposite direction: can ICTs cause an increase in personal wealth, especially for the poor?

We have already seen examples in Chapter 4 of ICTs helping boost the incomes of farmers and other micro-entrepreneurs. We can supplement that with other evidence. There is general evidence:

- A two-year longitudinal panel survey in Peru found those households that started using the Internet during this period earned on average 19 per cent more and spent on average 14 per cent more than similar households that did not use the Internet (De los Rios 2010).
- A quasi-experiment comparing cantons in Ecuador which introduced broadband during a two-year period with a control group that already had access found deployment increased annual income among broadband users by 5 per cent (Katz & Callorda 2013).

Figure 5.1 Household income and Internet access in South Africa



- A different longitudinal study in rural Peru (Fernandez-Ardevol et al. 2013 summarised by Aguero et al. 2014:79) found that "if a household member has been using a mobile phone for more than two years, welfare, measured by household expenditure, increases by 37.7 per cent".

And there is evidence specifically related to poverty:

- A quasi-experiment took two urban locations in Tanzania and measured their baseline poverty levels (Mascarenhas 2014a). In one, micro/small business owners were given business skills training, ICT training, a mobile phone, free airtime and paid Internet/email access at a local cybercafé. In the other, they were not. In the former area, poverty levels (set at US$1 per day) dropped from 54 per cent of households to 16 per cent of households: a decrease of 38 percentage points. In the latter area, poverty levels dropped from 57 per cent of households to 39 per cent of households: a decrease of 18 percentage

points. Comparing those who had and had not changed from poor to non-poor, ownership and use of ICTs were significantly correlated.

- A longitudinal household panel study was undertaken in East Africa. "The survey findings showed that the ICT index statistically causes change in per capita expenditure. Furthermore, that with every one unit increase of ICT access, one sees a 3.7% improvement in one's poverty status from 2007 to 2008 and 2010 in the four Eastern African countries" (May & Diga 2015:98).

But how exactly do ICTs cause this reduction in poverty? Digging deeper, we can divide the relationship between ICTs and money into several different activities, as discussed next.

5.2.1. Getting money

ICTs have been used by the poor to get money in many different ways. The most basic use has been messaging family and other social contacts to ask for money; often connected to life events (births, deaths, marriages), education or emergencies. Building on this interactional model to a transactional one, transfers of airtime/credit via mobile phone have been used as a means of remittance. For example, figures from Africa from the late 2000s show an unweighted average across 17 countries of 46 per cent of mobile phone owners had received airtime as a financial transfer from a friend or family member (Comninos et al. 2009). However, airtime has its limitations with only a small minority of recipients using it as a pseudo-currency to purchase other items (Walia & Goodman 2007). Hence, as they emerged, the growing popularity of mobile money systems increased, with a typical average value of transfer being c.US$35 (Duncombe 2012).

It is easy to demonstrate that ICTs are being used by the poor to mine their social contacts for financial gain. But this was always the case, with well-established and pre-existing informal and formal systems for transmitting funds, for example from urban to rural areas or from abroad such as the *hawala* system. The difficult question is whether the money being obtained with or through ICTs is "new" money that would not otherwise have been sent. In small part it will be with use of airtime and m-money because the transport costs, risk costs and other

transaction costs of traditional remittance systems are avoided, so a greater proportion of the remitted amount arrives: as an example it is estimated that mobile money reduces the cost of sending US$100 internationally from US$8 to US$2 (GSMA 2015b, 2016), and saves around US$1 on a typical domestic remittance (Jack & Suri 2014). It would also be likely that the reduced barriers to remittance would make it more likely.

We can therefore find evidence of the positive effect of m-money systems on increasing the amount of money sent to the poor. Research on the M-Pesa mobile money system in East Africa provides an example (see also Box 5.1). One study reports a 20 to 40 per cent increase in the size of in-country remittances thanks to advent of ICTs (Morawczynski 2009), and another reports a 36 per cent increase partly through greater frequency of remittance (Munyegera & Matsumoto 2016). Another research project in Kenya reports on households experiencing a shock (illness, loss of crops, loss of job, etc) (Jack & Suri 2014). It found that households without access to mobile money suffered a 7 per cent drop in consumption, whereas household consumption of mobile money users was not affected.

Mobile money systems have also been beneficial through their application to organisational payments to the poor: either wages for employment or welfare-oriented cash transfers. The latter are increasingly popular given their proven link to improved health, education and consumption for poor households in both the short and longer term (Hanlon et al. 2010, Woolard & Leibbrandt 2013). The sending organisation certainly benefits by changing from physical to electronic payments: two studies both report per recipient per monthly payment costs fall by about US$7, amounting to anywhere from 20 to 50 per cent of total costs (Aker et al. 2013, Blumenstock et al. 2015). By making cash transfer initiatives easier and cheaper, this may encourage more of them.

However, recipients also benefit. In an experiment in Niger, comparing physical vs. mobile cash transfers, those getting money via mobile bought a wider diversity of food goods and thus had a more diverse diet, spent more on clothing and retained more of their assets (anything from bicycles to torches) (Aker et al. 2013). These changes are thought to come partly from the lower (journey) costs of receiving money but also from greater discussion within households about how money was to be spent.

Box 5.1

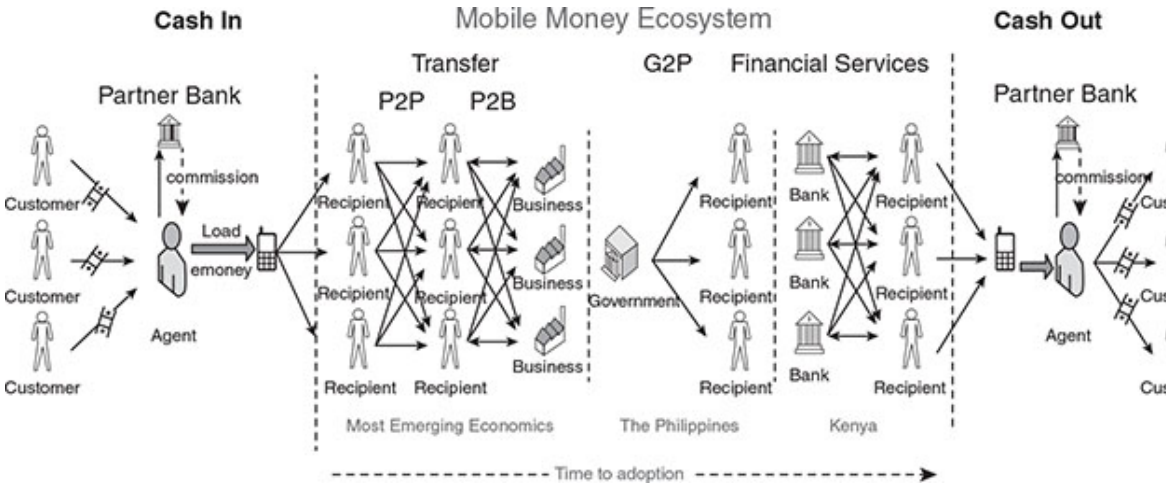
The M-Pesa mobile money system

M-Pesa ("pesa" is Swahili for money) began in 2003 with a grant of nearly £1m from the UK's Department for International Development to mobile phone company, Vodafone; part-owner of Kenyan operator, Safaricom. The initial intention was to use mobile phones to support the work of a large micro-finance institution, Faulu Kenya. As explained in Chapter 3, this was largely unsuccessful, but it was noted that phone users were sending credit to each other. The direction of the pilot changed, and focused on enabling financial transfers between phones (Foster & Heeks 2013b).

M-Pesa is based on "two core functionalities: conversion and transfer. Customers register to set up an M-Pesa account. They can then *convert* between e-cash and real cash: depositing real cash to load their M-Pesa account, or withdrawing cash from their account. Registration and conversion services are typically provided by mobile money 'agents': independently-owned but officially-sanctioned kiosks or stores. Agents charge small commissions on all transactions undertaken with them, and their work is facilitated by specialised SIM cards which are loaded into their phones . . . M-Pesa customers can also *transfer* e-cash from their account to another by sending an SMS containing the recipient's mobile number (which is also their M-Pesa account ID) and the amount; again, with a small charge levied. They might use this to send money to family members or friends, or to pay a provider – anyone from a taxi driver to a local school – for goods and services" (Foster & Heeks 2013b:300). A broader representation is shown in Figure 5.2 (Clifford 2013).

Since its formation, M-Pesa has grown in size: as of 2016, M-Pesa had over 100,000 agents in Kenya and around 16m active customers (with many more registered accounts) and nearly two-thirds of the adult population using mobile money (Safaricom 2016). It has also grown in functionality: for example, launching m-savings, m-credit and m-insurance products from 2010 onwards. In Kenya, users undertook 340m financial transactions per month, worth US$4.4bn.

Figure 5.2 Mobile money payment process



Of course, users are not the only beneficiaries from mobile money systems. Safaricom, the operator of the M-Pesa system, reported revenues of c.US$1.9bn, of which M-Pesa contributed 21 per cent, and net income of roughly US$300m (ibid.). As more users access more financial products digitally, operators are also building up increasingly valuable sources of big data that they can utilise to increase revenue (Chen & Faz 2015).

The overall roll-out of m-money is extensive: by 2016 there were more than 270 mobile money services live across nearly 100 countries, and more than 400 million registered mobile money accounts (GSMA 2016). However, M-Pesa in Kenya has been by far the most successful mobile money system and overall adoption rates in other countries are often much lower (Finau et al. 2016, Kalba 2016). For example, M-Pesa has rolled out across ten other countries but these share c.8m customers and 150,000 agents (Vodafone 2016). There are many reasons for M-Pesa's particular success in Kenya, including: light-touch government policy that allowed some level of competition but also helped Safaricom build and retain a large market share; high consumer demand partly driven by historical patterns of money transfers and partly driven by societal instabilities; and presence of a large agent network that reached down into most low-income communities (Heeks 2012).

These are ways in which the poor are given money, but they can also be lent money either by informal moneylenders or by formal institutions. The latter can

be tied up with saving money and so is discussed in the next section, but other ICT-enabled routes are opening up including "Development 2.0" routes discussed in Chapter 9 such as crowdfunding and peer-to-peer micro-lending.

5.2.2. Saving money

In Chapter 4, we already discussed the way in which the advent of ICTs can help substitute for some journeys and thus save direct, opportunity and risk costs for poor farmers and micro-entrepreneurs. We can extend this saving more generally to the lives of the poor with examples of migrants saving money because they feel less necessity to travel to their home villages (Mehta 2013), and citizens seeking services needing to travel less often to government offices (Bhatnagar & Singh 2010). Typical proportions of household expenditure committed to transportation vary widely – a quarter or more for those commuting in urban areas down to less than 5 per cent for those who travel rarely, with typical figures around 10 per cent and poorer households spending a greater proportion than those on higher incomes (Booth et al. 2000, Carruthers et al. 2005, Hammond et al. 2007). With only some journeys substitutable – telecommuting, for example, is not yet an option for most jobs undertaken by the poor – this provides moderate opportunities for ICTs to save money.

But there is another sense of the term "saving money": not reducing expenditure or loss of income but accumulating a pot of money that can be used to buy physical assets, to pay for education or healthcare, or to tide over an emergency. Savings are therefore demonstrably of significant benefit to the poor, but they are hindered by "transaction costs, lack of trust and regulatory barriers, information and knowledge gaps, social constraints, and behavioral biases" (Karlan et al. 2014). Digital technology cannot impact all of these, but it can impact several.

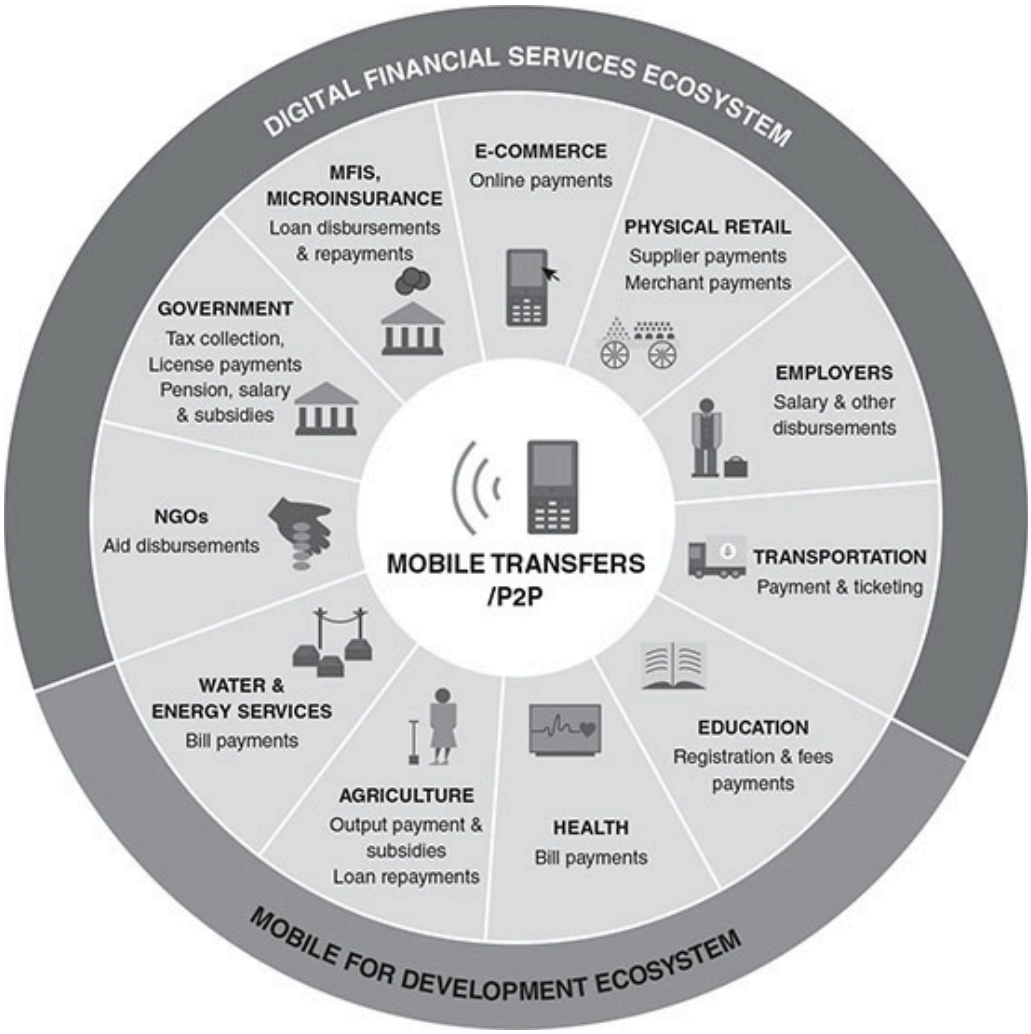
At a simple level, mobile communications can facilitate the work of group-based savings and credit schemes: helping coordinate group meetings, sending reminders about repayments (Mersland 2007). Given the proven benefit of group schemes in encouraging savings, any reduction in barriers to creation and operation of such schemes from ICTs will be welcome (Dupas & Robinson 2012). And mobile money systems have a small impact on saving: ICT-based cash transfer initiatives sometimes find a little additional saving by recipients

(Blumenstock et al. 2015), and controlling for other factors like income, education and wider community use of mobile money, use of the M-Pesa system was found to make it 20 per cent more likely for individuals to report savings (Demombynes & Thegeya 2012). Even if people don't save more, they save differently, holding their savings on the mobile money system rather than in the riskier form of physical cash: women in Kenya described this as a way to keep their "secret savings" safe from their husbands (Morawczynski 2009). In total, this is seen as a primary explanation for M-Pesa having lifted 2 per cent – nearly 200,000 – of Kenya's households out of extreme poverty during the 2010s (Suri & Jack 2016).

But these fall into the incremental category of digital improvements. ICTs have a deeper effect higher up the DIRT ladder (see Section 4.2) where they enable financial inclusion: a key problem for the poor is their exclusion from formal financial services which increases costs and risks for them, and reduces the likelihood of saving. Globally, 77 per cent of poor households living on less than US$2 per day lack access to a savings account, and in sub-Saharan Africa, the figure is 85 per cent (Kendall & Voorhies 2014). Mobile money services can help here as they are developing from individual applications to become a financial infrastructure, as Figure 5.3 summarises (©GSMA in Muthiora 2015).

Providing access to formal financial institutions increases savings and results in "strongly increased household investments in health and education" (Prina 2015:16). This is what the M-Pesa system has done by linking up with a bank to offer "M-Shwari", a mobile savings application (Hinz 2014, Cook & McKay 2015). Though – like M-Pesa before it – M-Shwari was initially adopted by wealthier urban users, it soon expanded to millions of rural and poor users. They earn interest on their savings but by far the main attraction of M-Shwari is that it enables users – circling us back to getting money – to build up a credit rating that allows them to take out loans. The amounts here are small – the average savings are around US$5, the average loan around US$12 – but even these small amounts can be very important to poor households which face monthly volatility of income of 50 per cent and more; which often have their wealth tied up in "illiquid" assets (livestock, machinery, jewellery) that can be hard to sell; and which face high interest rates if they borrow from informal moneylenders.

Figure 5.3 Mobile money as a platform for financial services



This covers regular small-scale volatilities but increasingly products are available that enable m-savings for specific events: pregnancy, retirement (via m-pensions), house purchase, etc (Kendall et al. 2011).

As indicated in Figure 5.3, an additional financial product that combines saving and getting money is m-insurance. The information failures and transaction costs outlined in Chapter 4 are a key reason why insurance services have traditionally not reached out to the poor in developing countries. The result is that the poor either have no insurance – remaining ill when they need treatment, or falling further into poverty – or they seek informal insurance from neighbours and

relatives via loans which may be of limited size (Banerjee & Duflo 2007). M-insurance helps address a number of these problems and is growing rapidly, albeit from a small base. Driven by competition in the mobile market, nearly half of all insurance services are "free" in the next month for those who top up a certain amount (typically around US$2–3) per month, but paid products are available at less than US$1 per month, with the payment typically being made as airtime (GSMA 2015b). Worldwide, hundreds of thousands of these micro-insurance schemes have already paid out.

The poor live financial lives of high relative transaction costs, risk and uncertainty. Access to mobile and other digital financial services is helping to reduce those costs, increase the security of their financial transactions, and smooth out some of the financial volatilities they face. The main challenge in expanding this further may not be technological but human: limited financial literacy among poor households means the poor are increasingly being offered financial products about which they have limited understanding (Cook & McKay 2015).

5.2.3. Making money

As explained in Chapter 4, there are two different ways in which ICTs can be applied in development (Narasimhan 1983):

- Intensive applications improve existing livelihoods. Examples include use of mobiles to bring market information to farmers; a micro-entrepreneur substituting a journey to a local supplier; use of a website helping handicraft producers sell their goods; or use of email by a retailer in a low-income community. The users here undertake digital consumer roles as outlined in Section 2.3.

- Extensive applications create new ICT-based livelihoods. Examples include the "umbrella people" selling mobile phone calls by the street; a worker from a poor community undertaking data entry work; or a mobile money service agent. The users here undertake digital producer roles as outlined in Section 2.3.

Then, there are two ways in which the poor can earn a living; either working for themselves (what we can call an "entrepreneur" role, though this would also include subsistence farmers and survivalist micro-entrepreneurs) or working for someone else, as an employee. Combining these two categorisations – as shown in Table 5.1 – we can summarise the different ways in which ICTs can help the poor make money through a livelihood. We next move on to investigate these in more detail.

Improving a traditional enterprise

We have already discussed this in some detail in Chapter 4, looking at the various ways in which ICTs can help traditional economic activity including farms and other micro- and small enterprises. We can also include here the growing use of m-money to receive payments: 64 per cent of micro-entrepreneurs in one study in Tanzania indicated they did this (Mawona & Mpogole 2013).

Table 5.1 Ways of making money from ICTs

***Role**/Application*	*Intensive*	*Extensive*
Entrepreneur	a) Improving income for a traditional enterprise	c) Creating or improving an ICT sector enterprise
Employee	b) Getting a new or better traditional job	d) Getting a new or better ICT sector job

Getting a traditional job

A key source of poverty is unemployment or underemployment, and thus exclusion from job markets is a key cause of poverty (Wiggins & Higgins 2008). The most transformative effect ICTs can have on an individual is employment: to take them from a situation of having no job to having a job. Klonner and Nolen

(2010) track the before-and-after impact on employment as mobile phone coverage rolled out across South Africa. They find "employment increases by 15 percentage points when a locality receives complete network coverage" (ibid.:17), with the majority of employment gains being among women taking up paid employment, but also with a shift of men out of agriculture and into wage labour.

ICTs can help individuals find new or better employment in two different ways. First, through ICTs providing information about jobs. Much of this will happen informally. It is a well-known feature of job-seeking that the best information comes from weak not strong social ties: strong ties such as close family and friends are of limited use because they know the same as the seeker; weak ties such as acquaintances who move in different social circles help more because they know different things from the seeker (Granovetter 1995). And ICT4D has been associated with facilitating weak ties (Baron & Gomez 2013); so tools like mobile phone calls and social media help job seekers find employment.

ICTs have also been used to try to create formal job markets through digital employment exchanges: employers submit job details to a database that can be viewed by those looking for work; would-be workers submit their details for employers to view; contact between the two is facilitated by mobile (SMS/call) or email. Faster filling of vacancies, better employee-job match, and improved wages are reported benefits, all of which will correlate with poverty eradication (Lundstrom & Ronnas 2007, Balasuriya & De Silva 2011, Andjeklovic & Imaizumi 2012). However, these formal ICT4D applications have faced important challenges:

- Ongoing information failures (see Section 4.2): online exchanges can readily address information failures of absence, asymmetry and cost but not those of quality and uncertainty: alongside wanting better access to information, employment stakeholders also want access to better information. A key problem with employment information is trust – job seekers don't trust job information; employers don't trust job-seeker information – and this can worsen as digital systems disembed information from the social relations through which it normally travels, reducing opportunities to check its authenticity (Mann 2014). Babajob – one of the most successful online exchanges – seeks to address this by incorporating human referrer and mentor roles (Van Sandt et al. 2009).

- Information value chain problems (see Section 2.6.2): providing a job-seeker with job information is not enough; they must also have the resources to turn that information into action and results. But they may lack the money to travel to where the job is; they may lack the required skills to do the job well; they may be excluded from certain jobs by cultural barriers such as India's caste identities (Jain & Sarda 2014).

Second, as ICT skills become an increasingly important part of all jobs, having access to ICTs and then developing ICT skills has an employment effect of helping people be suitable for better jobs. An example comes from a study in Uruguay (Dodel 2015b). Controlling for all other variables that are shown to matter – gender, class, education – having office automation skills at age 15 makes it 60 per cent more likely that you will have a white-collar job at age 20 compared to those who lack those ICT skills.

Working in the ICT sector

Items c) and d) in Table 5.1 are more of a continuum within the – broadly defined – ICT sector. As Chapter 4 showed, a very large number of new jobs has been created as a result of ICTs. Our standard view of an ICT job might be a formal, middle-class, professional role but much, perhaps even a majority of ICT-based employment is found lower down the economic pyramid as Heeks (2014d:13) explains:

> [s]ome 70% of the telecommunications-related jobs created in Pakistan – around 900,000 in total – were payphone operators and airtime retailers of the type found in poor communities (UNCTAD 2010). Other studies report significant numbers of livelihoods, especially related to mobile, being created in low-income communities. 41% of a convenience sample in rural areas of Nigeria made money from offering public mobile phone call services, selling recharge cards sent from urban relatives, or charging mobile phone batteries (Baro & Endouware 2013). There are similar reports of the density of ICT-related livelihoods in low-income urban areas (e.g. Rangaswamy & Nair 2012; Foster 2013).

Many of these occupy space c) in Table 5.1, such as the mobile money agents described in Box 5.1 or the many other ICT-related micro-enterprises that are

emerging within these communities. These often occupy a hybrid space that bridges between the informality of poor communities and the formality of the ICT-related value chains into which they connect (Rangaswamy & Nair 2012). However, as ICT infrastructure and skills diffuse ever-more into low-income communities, the opportunities for the poor to be hired into formal ICT-based jobs – space d) in Table 5.1 – increase. Box 5.2 provides an example.

Box 5.2

Impact sourcing and the potential of low-income ICT jobs

IT "impact sourcing" (also called "social outsourcing"), means the targeting of IT outsourcing contracts to marginalised groups (Heeks 2013). Impact sourcing combines market and welfare logics and explicitly seeks a win-win outcome of cost savings and other benefits (such as lower worker attrition rates) for clients, and improved livelihoods for those who are economically or socially disadvantaged (Ismail et al. 2016).

One of the earliest and largest examples was the decision of the Kerala State Government in India to use impact sourcing as the model for its data entry and other digitisation work, rather than either undertaking that work in-house or outsourcing to conventional private sector firms (Heeks & Arun 2010). The work was channelled via the State Poverty Eradication Mission (known as "Kudumbashree") to dozens of self-help groups set up around the state by women identified to be from below-poverty-line families. Research indicated they earned an average US$540 per year, enough to lift their households above the poverty line. They also gained through development of skills, political contacts, and improved self-image and self-efficacy.

About 500,000 workers – primarily in Africa and Asia – are estimated to be employed in IT impact sourcing, with double-digit annual growth (Carmel et al. 2014).

But working in the ICT sector can be marginal and precarious. These are facets typical of all types of income generation for the poor but ICT work has two features that can exacerbate this. First, a growing number of digital jobs are "liminal": existing on or beyond the boundaries of what is legal, as described in Box 5.3.

Box 5.3

Working in the grey and black digital economies

Quantitative evidence is lacking but there are growing examples of marginal livelihoods being created in the black (illegal) and grey (quasi-legal, quasi-illegal) digital economy. Examples include:

- Gambling: young men in Sierra Leone using smartphones to bet on the outcomes of sports events either with a formal online betting firm, or through personal networks (Sam 2015).

- Cybersex: the Filipino men and women who take their clothes off, and more, online for the titillation of paying customers (Cruz & Sajo 2015).

- Phone unlocking: the informal phone shops in Burkina Faso that unlock phones which have been locked to a particular network, or are in other ways code-protected (Hahn & Kibora 2008).

- Gold farming: the individuals in China who "work" within online gameworlds to create the virtual currency of those gameworlds and then, typically against game rules, sell it outwith the game for real money (Heeks 2008b).

- Click farming: the Filipinos working for local click farms that provide Facebook likes, YouTube views and fake Twitter followers for overseas clients (Clark 2015).

- Scamming: young Ghanaian men – "Sakawa boys" – online pretending to be either very rich (via inheritance or contracts) and needing advance fees to release the money, or pretending to be women and then seeking payments from online contacts for supposed travel or health needs (Warner 2011).

- Blackmail: young men in Morocco who use fake online profiles to build relationships with others online, persuade them to record intimate videos, and then threaten to circulate the video to their family unless paid (O'Neill et al. 2016).

Second, even when perfectly legal and associated with formal organisations, ICT sector employment can still be precarious, because of the constancy of technological change which may readily undermine the foundations for a digital livelihood. Box 5.4 provides an example.

Box 5.4

Grameen "phone ladies" and fragility of the ICT sector

A well-known example of employment in the ICT sector is Grameenphone's "village phone ladies" in Bangladesh who – in the days before mobiles were widely owned – had a mobile phone and would sell calls on the phone to customers in their village. In the mid-2000s there were claims of up to 300,000 women employed, earning net annual income of around US$600–800 (Yunus 2006, Alam et al. 2009). But surveys from mid-to-end-2000s (Shaffer 2007, Yusuf & Alam 2011, Boettiger et al. 2012, Jebin 2013) indicated a dramatic decline: numbers were down to less than 60,000 and average net income was reported anywhere from US$70 to 400.

Loss of Grameenphone's earlier quasi-monopoly and subsidies plus poorer quality of "phone ladies" as the programme scaled are a partial explanation: significant numbers of erstwhile customers in surveys reported still using shared phones but shifting to a competitor. But a significant explanator was growth in individual ownership of phones. One can identify similar vulnerabilities for hundreds of thousands who have set up cybercafés and kiosks (replacement by Internet access at home, work and on mobile

devices), or act as mobile money agents (replacement by ATMs that can accept or dispense cash) (Wamuyu 2015). The spread of the digital economy has therefore created jobs, incomes, empowerment and capabilities for millions on low incomes. But it has also created vulnerabilities to technological change.

The largely unanswered question – because digital employment for those on low incomes is at such an early stage – is what happens next. There are signs that those involved transition to emerging digital livelihoods. For example, "as they lose their Village Phone business, VPOs [Village Phone Operators i.e. 'phone ladies'] most frequently transition to selling other mobile-related products, whether it is talk time or mobile accessories" (Boettiger et al. 2012:226). Working in the digital economy may therefore, for the poor, combine opportunity and vulnerability and continuous change.

Intensive vs. extensive ways of making money

In Chapter 4, it was not clear whether intensive or extensive uses of ICTs make a bigger contribution to macro-economic growth. Here we can ask the same question, but applied to the micro-economics of the lives of the poor; proposing a "95:5 hypothesis" (text in this sub-section adapted from Heeks (2014c)). The 95:5 hypothesis would propose that typical intensive consumer-related uses of ICTs touch 95 per cent of people but make only a 5 per cent difference to their livelihood. Conversely, typical extensive producer-related uses touch 5 per cent of people but make a 95 per cent difference to their livelihood.

The two studies from Kerala, presented previously, provide an example. The Rs.133 increase in daily income from mobiles cited in Chapter 4's Jensen study was equivalent to a 9 per cent increase (fishermen earned about Rs.1,500 per day prior to mobiles). Given 75 per cent of income in South Indian fishing households comes from fishing (Sivasubramaniam 1991), that means ICT consumption increased household income by 7 per cent on average. Now compare that to the IT impact sourcing initiative in Kerala described in Box 5.2. It created digital producer roles for women from below-poverty-line families, which led to an average 75 per cent increase in household income.

As with most quantitative findings, these specific figures don't exactly match 5 per cent or 95 per cent but an overall average might get closer.

In terms of income gain for intensive use of ICTs, evidence sometimes shows a more than 5 per cent gain (Diga 2013b reports a 15 per cent increase), but others show a less than 5 per cent gain (May et al. 2011 report a 2.5 per cent gain) or no gain (Aker & Fafchamps 2013) or exactly a 5 per cent gain (Galperin et al. 2014). Can we say that 95 per cent of those living in the global South are digital ICT consumers? The number of mobile subscribers per 100 citizens in developing countries in 2016 was very close to that level (ITU 2016) and, as noted in Chapter 2, this is an overestimate of mobile ownership, especially among the poor, but compensated by the wider "digital provide" reach of mobile technology.

In terms of those with digital producer livelihoods, estimates are hard to come by because so few of those livelihoods are in formal, registered enterprises. In Chapter 4, we noted global averages of 4 per cent of the workforce in the ICT sector. Though figures will be lower in most developing countries, given continual growth in the number of digital producer roles, the overall result will at least be heading for 5 per cent. And – because these often represent whole livelihoods rather than incremental improvements to existing livelihoods – the 95 per cent impact figure will not be far off.

Given these pulls in various different directions, an endpoint of 95:5 per cent is not completely unreasonable, and certainly all the evidence points to some form of strong Pareto-type distribution.

Mathematically, 5 per cent of 95 per cent has the same development effect as 95 per cent of 5 per cent. That means these two uses of ICTs should be given equal emphasis by governments, development agencies, development informatics researchers, ICT4D practitioners, etc. But at present they are not. Intensive, consumption-related ICT application is given far, far more attention. In future that needs to be rectified, with equal emphasis given to poverty eradication by improving existing livelihoods with ICT; and to poverty eradication by creating new ICT-based livelihoods.

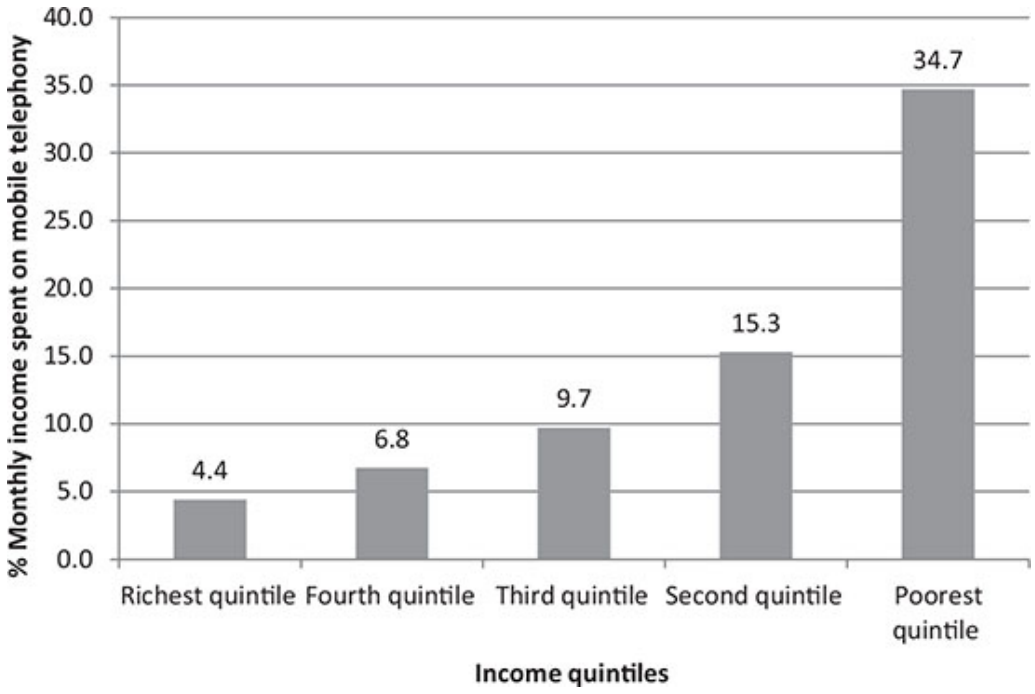
5.2.4. Spending money

Alongside consideration of the benefits of ICTs for the poor, one must also consider the costs. In some situations – access to a publicly-funded telecentre – financial (though not time) costs of using ICTs may be free. But in most cases, ICT usage costs money. Predictions during the 1990s were that the poor would only spend a similar proportion of their income on ICTs as that found in the global North: around 3 per cent (Forestier et al. 2002). This guided the – in retrospect amusing – predictions that the market for mobile phones might be at most some tens of thousands in typical developing countries because the poor could not and would not afford them.

Of course, we know how that prediction worked out. It was wrong partly because the cost of phones and calls fell dramatically. But also because the poor were willing to spend more – far more – than anticipated. An example from a set of Asian countries – Bangladesh, Pakistan, India, Sri Lanka, Philippines, Thailand – is shown in Figure 5.4 (data source: Aguero et al. 2011), and fits with data from South Africa showing rural users spending an average 22 per cent of income on mobile phone use (Rey-Moreno et al. 2016). ICT costs for the poorest are almost entirely taken up by mobile. (One estimate states that "Internet costs for the lowest income quartile will be close to zero because usage will be close to zero" (Heeks 2014d:11), but that is changing with diffusion of both mobile Internet and fixed Internet into lowest income communities.)

Such figures beg two questions.

Figure 5.4 Mobile spending across income quintiles in select Asian countries



First, where does this money come from? As discussed above, below and elsewhere, ICTs themselves can help the poor get, save and make money, which could then be released for expenditure on ICTs. Sometimes the poor avoid expenditure via cost-free access to ICTs: use of public access telecentres, gifts of mobile phones and airtime, use of zero-rated services, and beeping (as explained in Chapter 2, this means making a cost-free incomplete call to another number, for instance as a pre-arranged message or in the hope the other caller will spot the missed call and call back) (Donner 2007a, Chepken & Muhalia 2010, Sey et al. 2013). But there are other reports that some level of individuals and households – typically between one-fifth and one-half of respondents in surveys – is diverting expenditure on other items into ICT (mobile) expenditure:

- In some cases, the items foregone are discretionary, with the best-known example being the research whose title tells it all – "So You Want to Quit Smoking: Have You Tried a Mobile Phone?" (Labonne & Chase 2011).

- In some cases, the items foregone might be called semi-discretionary since their loss has a material impact. Examples include walking a significant

journey instead of taking the bus, stopping purchases of store-bought items like sugar or milk, or missing attendance at social functions (Diga 2007).

- And in a few cases, non-discretionary items are foregone such as energy for heating and lighting, or whole meals (iHub Research 2012, Duncan 2013).

Second, do the financial costs outweigh the financial benefits? The evidence here is limited and mixed. One multi-country study found rich and medium-income groups rate phones as being of positive economic value while the poorest group rated them as being of negative economic value (Souter et al. 2005), but this was prior to the widespread diffusion of mobiles. Only a small minority of respondents in an Asian survey had concerns about negative cost-benefit balance of mobile ownership (De Silva et al. 2008). But 75 per cent of mobile owners surveyed in rural Tanzania felt costs exceeded benefits (Mpogole et al. 2008).

However, the premise here may be misguided:

> [g]iven the likely interpretation by survey respondents of "benefits" in a cost-benefit question as relating to income generation. Ask the average OECD household if they earn more money from their telephone than they spend and they would look at you in bemusement. Just as in poor communities of the global South, the phone is used much more for social (including emergency) purposes than economic purposes (Duncombe 2012, Rahman et al. 2013), with social development uses of other ICTs also dominating over income-generating uses (Sey et al. 2013).
>
> (Heeks 2014d:12–13)

Where ICTs are used significantly for economic purposes, the cost-benefit picture looks different: a survey in Kenya skewed towards self-employed respondents found a majority reporting their mobile more than paid for itself via its financial contribution to their business (iHub Research 2012); and a longitudinal panel study in the Philippines found commercial farmers with a mobile phone earned enough for a 15 per cent increase in household spending (excluding expenditure on communications) (Labonne & Chase 2009).

So – as we will explore later in this chapter and book – ICTs bring far more than direct financial value to the poor; they also bring social value. We still tend to

make the assumption that social value is rationally calculated by the poor in justifying their expenditure. But, as Box 5.5 points out, this might not be so.

Box 5.5

The symbolic value of ICTs

Alongside "rational" calculations of the economic and social value of ICTs that may explain and justify the amount spent by the poor, a rather more debatable symbolic value may also be present. I remember talking with a group of women in rural Karnataka, India about reasons for adopting ICTs. One said – when she travelled to the state capital, Bengaluru – she wanted to look like she belonged there, and having a mobile phone was part of that. There is wider evidence of these symbolic and aspirational values – an association of ICTs with modernity, urbanity, wealth – that guide the expenditure decisions of the poor.

- "For many urban Indonesians, modernity has also become equivalent to mobility, and this includes physical and social mobility but especially the eye-catching use of mobile media . . . The mobile phone is foremost an embodiment of the desire for the new" (Barendregt 2008:160,168).

- "[i]mage, defined as 'the extent to which users of mobile payment systems have more prestige and a higher profile, where using these systems is considered a status symbol', is reported by Joubert and Van Belle (2009) as one of the three most significant factors that influence mobile payment systems adoption" (Chib et al. 2015:114).

These symbolic values are transmitted by observation, by the increasing presence of advertising in the lives of the poor, and via the mass and cultural media (Pal 2010, Sharma et al. 2013). They appear to be growing and it remains a debatable issue what the developmental implications are if the poor are spending their cash in part on the symbolic value of ICTs.

5.2.5. ICTs and financial inequality

Drawing the evidence above together, we can ask whether ICTs are technologies of equality or inequality: do they make the poor richer in either absolute or relative terms?

We can break this down into costs and benefits. On the cost side, things look bad. As shown, in relative terms, the poor spend far more than the rich on ICTs as a proportion of their income. In many cases, they also spend more in absolute terms for the same functionality with a cost premium due to their use of pre-paid tariffs and their presence in more remote, higher-cost locations (Kenny 2002, Barrantes & Galperin 2008).

On the benefit side, in absolute terms, we have seen examples above of ICTs being used to get and save and make more money than previously. Is this enough to deliver an absolute reduction in poverty? While one or two subjective surveys report some of the poor do not think so, the more reliable – though scanty – panel and experimental data reported earlier suggests ICTs do help reduce absolute poverty levels. This is likely to be truer the more that ICTs are used for business/economic purposes; and this mostly fails to capture the additional social, symbolic and other values of ICTs discussed in other parts of the book.

In terms of relative benefits, we can revisit some of the arguments from Chapter 4. The poor have fewer of the information value chain complementary inputs required to enable ICTs to deliver development outcomes. On that basis, ICTs would benefit the rich more than the poor. On the other hand, information failures – information absence, relative size of information asymmetries, relative expenditure on transport, etc – will all affect the poor more than the rich. On that basis, ICTs would benefit the poor more than the rich.

Also reflecting the previous chapter's argument, earlier ICT4D research worked on the basis that ICTs would increase inequalities between rich and poor individuals, and thus would not address relative poverty. There was evidence to support this: in the Philippines study reported earlier (presumably richer) commercial farmers gained more from having a mobile phone than (presumably poorer) subsistence farmers (Labonne & Chase 2009). Later research, though, has provided a thimbleful of data suggesting the opposite, taken from the same East African study cited above:

> [t]he proportional expenditure change per capita in a household with ICTs was felt more strongly by the poorest than the non-poor surveyed … The study thereby sees a slight movement of convergence between the poor and non-poor based on the gains resulting from ICT access.
>
> (May & Diga 2015:98)

They report that over a decade, the poverty reduction gains from ICT are twice as great for the poorest as compared to the non-poor. To this we should also add the "digital provide" evidence of spillover benefits from ICT users to non-ICT users (see Box 5.6).

In sum, the evidence base is weak – embarrassingly so given how central this issue is to ICT4D and just how much ICT4D research overall is produced – but we can conclude that ICTs are likely to reduce absolute poverty. They might reduce relative poverty and inequality but, equally, they might increase it.

Box 5.6

Reducing inequalities through the digital provide

Expanding on the discussion in Box 2.7, we can identify two main types of digital provide.

First there is a provide from ICT-owning to non-owning users. All forms of free public access computing fall into this category (Sey et al. 2013), but there are also less formal provisions: households in India sharing access and use of their PC with others without a PC (Dewan et al. 2010), or farmers in Ghana lending their phones to neighbours who used them to gather agricultural extension or market price information (Smith 2010).

Second there is a provide from ICT users to non-users. Again, ICT public access points may be involved: across a variety of impact categories including education, time and financial savings, and income "up to 63% of non-users whose family/friends are users said they perceived positive impacts from other people's use of public access venues" (Sey et al.

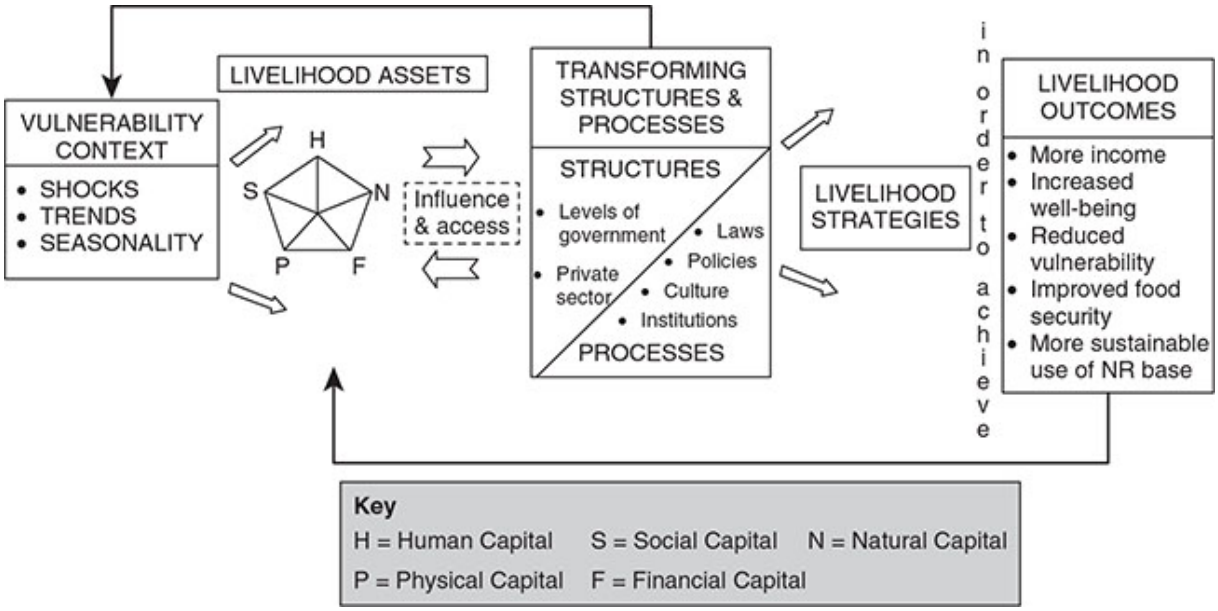
2015:78). We also saw less formal examples in Chapter 4 including the non-mobile-using fishermen in Kerala whose income rose by c.US$2 per day (Jensen 2007), and transmission of market price and related agricultural information to non-ICT-using farmers (Baumuller 2015, Burrell & Oreglia 2015).

In both cases, the digital provide will be inequality-reducing because non-owners/non-users will generally be poorer than owners/users and will get economic (and other) benefits without any ICT costs.

5.3. ICTs and livelihoods

The evidence presented at the start of the chapter suggested eradicating poverty was not simply a question of economic growth and money. This chimes with arguments that we need to extend the definition of poverty beyond just income. A key problem with income measures of poverty is that they measure an effect. But they tell us nothing about the foundations of poverty: how that income is to be earned and the barriers to that. From this standpoint, poverty can be defined as "the inability to attain an objective and absolute minimum standard of living" (May 2012:64).

Figure 5.5 The Sustainable Livelihoods Framework



So, what is required to attain a particular standard of living? That means creating a livelihood for oneself and the widely used Sustainable Livelihoods Framework (SLF) helps understand that process, and is shown in Figure 5.5 (DFID 1999).

The main argument of the framework:

> [h]as been that lives of the poor must be understood as the poor themselves understand their own lives – as a complex of interacting factors. Its elements [are] (DFID 1999):
>
> • *Vulnerability context*: the external environment that shapes people's lives via shocks (e.g. conflict, disaster), trends (e.g. demographics, changing global prices), and seasonality.
>
> • *Assets*: five types of capital – Human (skills, knowledge, health, ability to work); Natural (land, forests, water); Financial (income, financial savings, non-financial savings (e.g. jewellery, livestock)); Physical (infrastructure (transport, housing, water, energy, information/communications), producer goods (tools, equipment)); Social (networks, connectedness, group/organisation membership, relationships).
>
> • *Structures*: the public, private and NGO sector organisations that deliver policy, legislation, services, goods and markets.
>
> • *Processes*: the forces shaping how organisations and individuals behave (i.e. operate and interact).

- *Strategies*: "the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals" meaning actual livelihoods like farmer, shopkeeper, etc.

- *Outcomes*: what strategies achieve through use of assets via structures and processes within a context.

(Heeks & Molla 2009:41)

The SLF can be used in various ways in ICT4D: Box 5.7 shows its use in identifying the priority information needs of a community, as a prelude to ICT4D design and implementation. But our interest here will be more in relation to ICTs' impact in helping the poor create new or better livelihoods. We will now look at each one of the elements of the framework in turn.

Box 5.7

Information gap analysis

A logical approach to designing ICT4D interventions, say for a group or community, is information gap analysis. This looks at the gap between what information is needed in the community, and what information is currently supplied. This typically proceeds as three steps.

Step 1: Framing. The first step is to create some form of information template: a comprehensive set of categories of information that are relevant to local livelihoods. One simple approach is to use the SLF to categorise information on:

- Financial assets (income generation, credit, savings);

- Human assets (education, health);

- Social assets (community groups, friends/relations);

- Physical assets (housing, water/sanitation, energy, communications, transport, tools, technology);

- Natural assets (land, natural resources, produce);
- Vulnerabilities (insecurity, emergencies, disasters);
- Structures (policies, government, NGOs, private firms).

Cross-cutting dimensions sometimes added include the source of the information (social (family, friends), community, government, NGO, supply chain, media, etc), and the channel of the information (human, paper, radio, TV, phone (call, SMS), Internet, etc).

Step 2: Analysis. Gap analysis can be done by measurement of the demand-supply gap: the gap between the percentage of users saying an item of information is important or very important to them, and the percentage of users saying they are able to obtain this information. Or it can be done by measuring the quality of each item of information – for example, using the OCARA checklist outlined in Chapter 2 – and identifying information of poorest quality.

Step 3: Prioritisation. The analysis can then be subjected to prioritisation techniques such as community feedback (which may reveal a tension between top-down ideas of what the community *needs* and bottom-up ideas of what the community *wants*) and/or the selection criteria discussed under ICT4D strategy in Chapter 2 that consider the development impacts and implementation feasibility.

Source: developed from Heeks & Molla (2009)

5.3.1. Vulnerability context

Shocks are particularly disruptive to attempts by the poor to maintain their livelihoods, and they come in many forms. Chapter 8 considers environmental shocks and their relation to ICTs, while Box 5.8 considers the physical shock of violent conflict and its aftermath. Here we consider the use of ICTs for other types of emergency such as those related to health, crime or fire, given evidence that a major use of mobiles is for personal safety-related purposes (James 2015).

In a somewhat similar pattern to that outlined in Box 5.8, we can identify a number of different stages at which ICTs can assist:

- Pre hoc warning: ICTs can be used to transmit individual warnings. In rural Colombia, for example, a mix of informal and formal mobile phone based social networks are used to warn for potential emergencies including coffee plant diseases identified in an area, or the presence of armed groups (Ospina 2013).
- Durante hoc response: what people typically want during an emergency is a physical response. This can be sourced informally from nearby social contacts via mobile phone, but there is increasing presence of something akin to the 911/112/999 emergency services. The capacity of state emergency services to then respond is another matter, and some initiatives instead use private health, security, etc firms, which of course require payment (Hellstrom 2011).
- Post hoc restoration: a key requirement for those who have suffered an emergency is money. As seen above, ICTs can help in getting this.

Box 5.8

ICTs, conflict and peace

Violent conflict is an external shock that significantly increases the vulnerabilities of the poor, driving them into chronic poverty which then itself can generate further conflict (Goodhand 2003). ICTs enter this picture as a mixed blessing: they can both worsen and improve conflict situations.

On the downside, ICTs are increasingly the mechanism through which conflict is undertaken. They are an enabler: no modern warfare would be feasible without ICTs from the tactical use of mobile phones and similar devices to coordinate small groups of fighters to the full-scale strategic digital command and control systems of national armed forces. They are a battleground: cyber-warfare is on the increase with many overt and covert conflicts in developing countries replicated online, such as the tensions

between India and Pakistan (Goel 2011). And they are weapons: close to 10,000 people are estimated to have been killed in drone strikes in the Middle East and Western Asia (Cohn 2015). These drones remain under human control as do the current generation of semi-autonomous weapons, but autonomous smart missiles and drones are already available (Del Prado 2015).

ICTs do not themselves cause conflicts but their substrates do: for example, as demand increases for particular minerals used in their manufacture, so does the price, and the rewards for control over their production. Mining of coltan in particular – used to make capacitors for mobile phones and other ICTs – has fuelled conflict in the Democratic Republic of the Congo (Nathan & Sarkar 2011).

Against this negative balance sheet of exacerbating contextual vulnerabilities, the positives are more potential than actuality at present, but application areas include (Stauffacher et al. 2011, Comninos 2013, WB 2016):

- Early warning: identifying fast-spreading violent incidents in order to enable early intervention to prevent further escalation.

- Monitoring: use of ICTs to monitor and map conflict situations in order to assist the work of peace-keepers.

- Reconstruction: support for the work of state, international and local NGO actors in reconstruction in post-conflict zones; and for individuals seeking to reconnect with lost family members.

- Reconciliation: use of ICT platforms to facilitate dialogue between different sides in a conflict.

5.3.2. Livelihood assets

The five different types of capital can be understood as the building blocks of a livelihood: the assets that people put together in different ways in order to create a living for themselves. They encourage a perspective on poverty that sees it not as a uni-dimensional financial concept but as a multi-dimensional, socio-economic

concept (Anand & Sen 1997). As Box 5.9 discusses, there has been a tendency for development – including ICT4D – projects to focus on absence rather than presence of these assets, since the whole notion of poverty is inherently about lack.

Box 5.9

Seeing the doughnut not the hole in poor communities

"Seeing the hole, not the doughnut" is a way of describing what many development projects do – they see the things that a community does not have, and they often miss what the community already has, things like informal economies, the social structures, traditional healers, and the wealth of local knowledge, from boat building to cooking tamales. Oftentimes, the project only sees, for example, that there is not enough money and no internet connection, but not how people do succeed in their community. We propose that by understanding these everyday practices, new technologies can better fit the people they are to serve, thus becoming integral parts of their lives, and so will support sustainable development.

(Kitner et al. 2006:2)

Information gap analysis would be subject to this critique: it is a "hole" approach that focuses on what the community does not have rather than what it does have. Taking the "doughnut" approach might not be that radically different in practice – it may be more a difference in attitude – but it could mean a baseline analysis of the existing livelihoods context within a community or area; then using this to look at the current assets and strategies which ICT4D can strengthen.

This illustrates a much wider debate within international development between those who espouse a more top-down approach of aid-based external interventions vs. those who want a more bottom-up approach that identifies and supports local initiative. The debate is seen to be epitomised, respectively, in the differing views of Jeffrey Sachs (Sachs 2005) and William Easterly (Easterly 2006) (see John & Storr 2009, Pryke 2014).

> Of course there is some messy compromise in the middle that can emerge from these views, but they crystallise something fundamental in development, and form a framework within which ICT4D practitioners can usefully seek to locate themselves.

Running through the different assets, we have looked at financial capital in Section 5.2 of this chapter, Chapter 6 will discuss key elements of human capital, and Chapter 8 some aspects of natural capital. ICTs help plan and manage physical infrastructure but at a much higher level than individual communities, so the main impact on physical capital is the ICT itself as a physical asset, discussed in Chapter 2. That leaves social capital to discuss here.

Social capital can be defined as "the collective value of all 'social networks' and the inclinations that arise from these networks to do things for each other" (Putnam 2000:19). It is common to differentiate *bonding social capital* – that between close family, friends and neighbours who are socially homogeneous (the strong ties mentioned earlier) – and *bridging social capital* that links out to more heterogeneous social groups (weak ties) (Woolcock 2002). Bridging social capital may be further split to identify *linking social capital*, which connects a person to members of formal institutions beyond their community, such as government officials.

Social capital is not an unalloyed good: bonding social capital for instance can trap individuals in groups with damaging norms and values, can exclude others from the benefits of group membership, and carries obligations as well as rights (DFID 1999). But we have already seen examples of its value in the lives of the poor: social relations provide money, information about job opportunities and help in an emergency. There are other examples too: for instance, the association between higher levels of social capital and good health and well-being (Elgar et al. 2011). The different types of social capital are useful in different ways. Bonding social capital typically provides quick but limited resource support and ideas; bridging and linking social capital can provide new, different and larger-scale resources and ideas. Put simply, "bonding social capital helps people to 'get by' while bridging social capital helps people 'get ahead'" (Gaved & Anderson 2006:20). The problem for the poor is that they tend to have a good supply of bonding capital but be lacking bridging/linking capital.

There have been concerns that ICTs would damage social capital, causing us to withdraw into our virtual shells. But evidence reviews to date show only the opposite: for example, “The only perspective that has provided systematic evidence so far is the positive relationship between Internet use and social capital” (Neves 2013:607). ICTs – and here we focus on the communications technologies such as phones, email and social media – have two main positive impacts on social capital. The first is to strengthen existing social capital, for which there is a multitude of evidence, thanks to the lower financial and time cost barriers to communication that ICT provides. This would typically be bonding capital, and a common example is the ability of those in rural areas to better maintain their social connections with family members who have migrated for work to cities or overseas (Benitez 2012).

The second main impact is to create new social capital. This could be bridging (including linking) social capital and it is generally more valuable than reinforcing existing ties because it can provide the new, different, additional resources noted above. But it may be more difficult to achieve through ICTs; basic mobiles especially. An indicative study is research on the mobile call logs of Rwandan micro-entrepreneurs: 80 per cent were to existing contacts and 20 per cent were to contacts that were new (though that rose to 38 per cent for entrepreneurs who did not own a landline) (Donner 2006). Creation of bridging capital may well require additional intervention beyond just ICT – an ICT public access point at which people gather; a shared ICT training course; a community mapping exercise – though even here bridging may be within rather than outside the community (Gaved & Anderson 2006). Where links are built outside the community through ICTs, they may be quite shallow unless reinforced by physical meetings (Bhandari & Chang 2013).

Some studies note that communications technologies are being used far more for social than for economic (financial or other business) purposes (Souter et al. 2005, Okon 2015). However, the distinction between social and economic may be inappropriate, with the two categories overlapping (Sey 2011). We saw already that social contacts were a main source for getting money and getting a job, and micro-enterprises intersect the two categories: one survey of micro-enterprises in India found “40% of customers and 60% of best customers are also considered friends or family” (Donner 2007b:9).

5.3.3. Transforming structures and processes

The picture painted so far has been quite positive in terms of ICTs helping to buffer some of the contextual shocks/trends, and helping provide better access to livelihood assets. But the ability of the poor to transform those assets into better livelihoods is determined by a wider societal context. Although you have to dig a little deep into the SLF to find it, this context is largely about the distribution of power: structural (organisations and relations) and institutional (formal institutions like policies and markets, and informal institutions like culture) (DFID 1999). Looking back at our discussion of power in Section 2.6.2, especially at Figure 2.27, we might also add cognitive power around control over knowledge and meaning, even though that does not explicitly figure in the SLF. In some ways, this could be summed up as the sixth or missing form of capital – political capital – that either enables or constrains conversion of the other forms of capital into actual livelihoods.

Understood in this way, one of our recurrent arguments will swing in: that ICTs will tend to have a relatively incremental effect on livelihoods of the poor unless they can bring about change in the wider distribution of power i.e. unless they can transform the "transforming structures and processes". Digital empowerment, for example, thus tends to be a "caged" or "situated" empowerment that exists within limits imposed by the wider context (Svensson & Larsson 2016). We can illustrate this in relation to gender equality: one of the main SDGs.

> SDG 5. Achieve gender equality and empower all women and girls

There are both structural and institutional asymmetries of power which make it harder for women than men to access and own ICTs. Echoing Figure 2.27, these are reflected in lower access to resources such as money, skills and time; relative exclusion from key practices such as technology education and design; institutional norms about the role of women and their often-constrained access to public spaces; structural relations with men such as their lack of autonomy; and the gendered meanings and discourse related to ICTs (Antonio & Tuffley 2014). The resulting gender divide in access to ICTs was highlighted in Section 2.6, and there are gender divides in use as well.

Divides exist in relation to extent of use: in developing countries, there are 20 per cent more male than female Internet users, and that figure rises to 44 per cent in least-developed countries (ITU 2016). Divides also exist in type of use: for example, men use ICTs much more than women to communicate with friends and business contacts, while women communicate more with family members; and men use the Web more for economic and "entertainment" (including pornography) purposes while women use it more for social and educational purposes (Wahid 2007, Blumenstock & Eagle 2012). Box 5.10 provides a relatively extreme example which helps expose the structural power of men over women and the institutional biases, for example of local culture, against women's equality. But it also hints at the threats posed to men's traditional authority by new technologies such as ICTs.

Box 5.10

Indian village bars women from using mobile phones

A village council in eastern India has banned women from using mobile phones, saying they "pollute the social atmosphere" by encouraging women to elope with lovers.

The order was issued by the village council in Sunderbari, in the Kishanganj district of impoverished Bihar state, after a formal meeting on Sunday. The measure was designed to check "the breakdown of the institution of marriage", council leaders said. Penalties range from 10,000 Indian rupees (£115) for unmarried girls caught using mobile phones to 2,000 rupees for married women. Women may use a phone in the presence of a male family member, however, according to village leaders.

"Unrestricted use of mobile phones is promoting premarital and extramarital affairs and destroying the great institution of marriage. We are extremely worried", said Manuwar Alam, the president of the social advisory committee, explaining that at least six girls and women had eloped in the past year. "We had to hide our faces out of shame", Alam said. "We decided to do something that could firmly curb such cases, which were earning a very bad name for all of us".

> A combination of marginally improved education, more mobility and access to television has led to the traditional authority of fathers, husbands and male village leaders being challenged in much of India.
>
> Source: Burke & Kumar (2012)

These threats – and the affordances of anonymity and surveillance provided by ICTs – can see digital technologies associated with an intensification of gender divisions. Examples include ICT-related violence against women such as that reported in Zambia by male partners in arguments around use of ICTs; ICT-enabled harassment of women including trolling, cyber-stalking and revenge porn; and ICT-enabled control of women such as use of spyware by men in Cambodia to track and watch female partners (Cummings & O'Neil 2015, Porter et al. 2016).

However, the story is more complex than simple reproduction or intensification of gender divisions through ICTs. For some groups of women (younger, better-educated, richer, urban) and for some types of ICTs, there are signs that quantitative access/use gaps are closing (Van Dijk 2013, Pick et al. 2014). When women are able to use ICTs, there is some evidence – perhaps linked to their differential usage patterns – that they are able to gain more than men. At least, women in India and East Africa report greater socio-economic benefits from ICTs than men do (Khan & Ghadially 2010, Mascarenhas 2014b). And ICTs can be used to create women-only "safe havens" online in which women's voices can be heard and in which supportive, empowering and developmental communities can be created (Buskens & Webb 2014). Alongside these relative benefits are the absolute gains women get from ICT use; benefits already reflected in the general discussions of this and other chapters in the book: improving productivity, increasing financial and social capital, gaining new livelihoods, building skills and knowledge, accessing new services, etc (Duncombe et al. 2005, Wheeler 2008, Wamala 2012).

Yet these benefits – particularly in relative terms to men – remain incremental. This is even so in extensive applications: in the ICT sector where one might imagine the potential for a new set of transforming structures and processes which would be more gender neutral. For example, in the Sri Lankan ICT sector, many of those – men – in authority espouse a rhetoric of gender equality and

claim that structures and processes are "gender neutral" (Morgan 2012). Yet, because the ICT sector derives from and sits within wider society, these optimistic aspirations are not reflected in reality: only a minority of employees in the sector are women, clustered into lower-skill occupations; flexible working hours are not delivered in practice; career decisions are oriented to the needs of male spouses or female child-care responsibilities; and organisational cultures are described as "boys' clubs". Similar ICT sector gender divisions are reported in other countries such as Ghana (Steeves & Kwami 2012) and India (Mehta 2016).

We often associate the ICT sector with transformative effects – "transforming" the lives of those who gain a new livelihood; "transforming" the type of work being undertaken; "transforming" the shape of the macro economy. But in terms of the DIRT model presented in Section 4.2, this seems to be falling short of true transformation – the social structures and processes of the SLF are not static in the face of ICTs, but neither do they show much sign yet of radical change: these structures and processes may transform assets into ICT-enabled livelihoods, but they are not themselves being transformed.

This does not mean we just throw up our hands and walk away. Instead it reinforces the message of needing complementary inputs when ICTs are part of a development intervention. In this case, those complementary inputs will be changes in wider sources of power as discussed in Section 2.6.2; in particular seeking to change formal and informal institutional structures – policies, laws, regulations, markets, norms, values, etc – and to change socio-organisational structures – groups, networks, organisations, etc (Gillwald et al. 2010, Cummings & O'Neil 2015). As already noted in Chapter 3, a first step in ICT4D projects will be development of "critical awareness": an understanding of the power structures that lie behind inequality (Poveda 2016); and a second step will be development of "critical agency": enabling ICT4D beneficiaries such as women to make changes in those structures even if only on a localised basis (Roberts 2016).

5.3.4. Livelihood strategies and outcomes

There are three ways in which ICTs can impact livelihood strategies of the poor (Duncombe 2014), with some examples already seen of each:

- Maintaining an existing livelihood. This is particularly associated with a reduction in vulnerability, such as use of ICTs to mitigate the impact of shocks as described above. It will be discussed further in Chapter 8 in relation to application of ICTs to improve livelihood resilience.

- Enhancing an existing livelihood. Most of the examples given in Chapters 4 and 5 relate to this: the way in which digitisation can help to save financial assets; digital improvement can help provide better access to assets or access to better assets and can help enhance livelihood processes; and even some types of reorganisation can amend some of the livelihood processes and even structures to help micro- and small entrepreneurs whether they be farmers, retailers, producers, etc.

- Creating a new livelihood. ICT-enabled social capital was already shown to be increasingly valuable in helping get a new job, and ICT-enabled financial capital can help create a new livelihood: Gaur and Avison (2015) give the simple example of two women friends in Northern India who, through a mobile-enabled savings system, were able to save Rs.500 (c.US$8); enough for them to set up a small tea stall. This is a specific illustration of a much wider phenomenon: M-Pesa is estimated to have helped tens of thousands of women in Kenya graduate out of subsistence agriculture and into micro-enterprise (Suri & Jack 2016). ICTs also create new livelihoods through their impact on wider structures and processes. Examples already given include the reorganisations discussed in Chapter 4 where ICTs help to create or extend markets and supply chains that then incorporate the poor, or the creation and extension of job markets described earlier in this chapter including those within the ICT sector itself.

However, as previously noted, the opportunities for individuals to benefit in one of these ways will be significantly determined by context: the vulnerabilities that impose upon them, the transforming structures and processes that enable and constrain them, and by their agency, their personal capabilities and motivations.

Livelihood outcomes – examples are identified in the SLF in Figure 5.5 – are varied. But income is only one outcome. Others, more attuned to other

conceptions of development, also matter and it is to these that we now turn in subsequent chapters.

Additional material

Discussion questions

5.1. How is a goal of poverty eradication similar to, and different from, a goal of economic growth?

5.2. What is the nature of the relationship between ICTs and poverty?

5.2. Why is there so little evidence about the relationship between ICTs and poverty?

5.2.1. Do ICTs help the poor get additional money, or just get the same money they used to, only more quickly?

5.2.2. Do ICTs help the poor save more money than in pre-digital times?

5.2.3. Is it better to have a job inside or outside the ICT sector?

5.2.4. Is the amount of money the poor spend on ICTs justified in terms of the financial benefits it brings?

5.2.5. Who benefits more from ICTs: the rich or the poor?

5.3. On which of the main elements of the livelihoods framework – vulnerability context, assets, structures/processes, strategies – do ICTs have the most significant impact?

5.3.3. Do ICTs do more harm than good to gender equality in developing countries?

Assignment question

Can ICTs help to eradicate poverty in the global South?

Further reading

If you would like to know more about . . .	5.1. poverty eradication as a development goal	. . . then take a look at . . .	5.1. Ravallion, M. (2004) *Pro-Poor Growth: A Primer*, Policy Research Working Paper 3242, World Bank, Washington, DC >Discusses definitions, values, and routes to pro-poor economic growth
	5.2. ICTs and poverty		5.2. Heeks, R. (2014) *ICTs and Poverty Eradication: Comparing Economic, Livelihoods and Capabilities Models*, Development Informatics Working Paper 58, IDPM, University of Manchester, UK >Reviews the relation between ICTs and poverty from three different perspectives
	5.2.1. mobile money		5.2.1. Jack, W. & Suri, T. (2011) *Mobile Money: The Economics of M-Pesa*, Working Paper 16721, National Bureau of Economic Research, Cambridge, MA >Presents household survey data on the financial impact of M-Pesa Foster, C. & Heeks, R. (2013) Innovation and scaling of ICT for the bottom-of-the-pyramid, *Journal of Information Technology*, 28(4), 296–315 >Explains the stages and factors behind the successful growth of the M-Pesa mobile money system
	5.2.2. mobile savings		5.2.2. Cook, T. & McKay, C. (2015) *How M-Shwari Works*, CGAP, Washington, DC >Reviews the workings, users and uses of one m-savings application
	5.2.3. ICT-related employment		5.2.3. Andjeklovic, M. & Imaizumi, S. (2012) Mobile entrepreneurship and employment, in: *Maximizing Mobile*, World Bank, Washington, DC, 75–86 >Looks at various ways in which mobiles enable employment Nandi, R. (2014) Decent work and low-end IT occupation workers in Delhi, *The Journal of Social Science and Humanity Research*, 2(1), 9–23 >Explores informal and quasi-formal work in the ICT sector
	5.2.4. costs of ICTs to the poor		5.2.4. Diga, K. (2013) Access and usage of ICTs by the poor, in: *Connecting ICTs to Development*, L. Elder, H. Emdon, R. Fuchs & B. Petrazinni (eds), Anthem Press, London, 117–135 >Among other issues, looks at ICT expenditure and affordability

(continued)

	5.3. ICTs and the livelihoods framework		5.3. Duncombe, R. (2012) *Understanding Mobile Phone Impact on Livelihoods in Developing Countries*, Development Informatics Working Paper 48, IDPM, University of Manchester, UK >Explores the interaction between ICTs and components of the livelihoods framework, and proposes some amendments to the framework as a result
	5.3.2. ICTs and social capital		5.3.2. Neves, B.B. (2013) Social capital and Internet use, *Sociology Compass*, 7(8), 599–611 >Reviews evidence on the relation between social capital and ICT use
	5.3.3. ICTs, gender and development		5.3.3. Hafkin, N. (2002) *Gender Issues in ICT Policy in Developing Countries*, UNDAW, New York >Reviews key issues regarding ICTs, gender and development; and their policy implications Gurumurthy, A. (2004) *Gender and ICTs*, BRIDGE, Institute for Development Studies, University of Sussex, UK >Critical analysis of gender divides, potential for ICTs, and priority actions Buskens, I. & Webb, A. (eds) (2014) *Women and ICT in Africa and the Middle East*, Zed Books, London >A series of case studies of use of ICTs for women's empowerment

6 ICTs and social development

In reading this chapter, you will learn to:

- explain social and human development as a development goal;
- categorise the relationship between ICTs and social development (health and education);
- summarise evidence on the relationship between ICTs and social development (health and education);
- outline the capabilities framework;
- summarise implications of the relation between ICTs and capabilities.

The previous two chapters focused significantly on economic development: a view that associates development with an increase in financial wealth. However, discussion of the Sustainable Livelihoods Framework in Chapter 5 was a reminder that an economic perspective on development is not the only one. In this chapter, we look at one of the alternatives – social development – and its relationship to ICTs.

6.1. Social development as a development goal

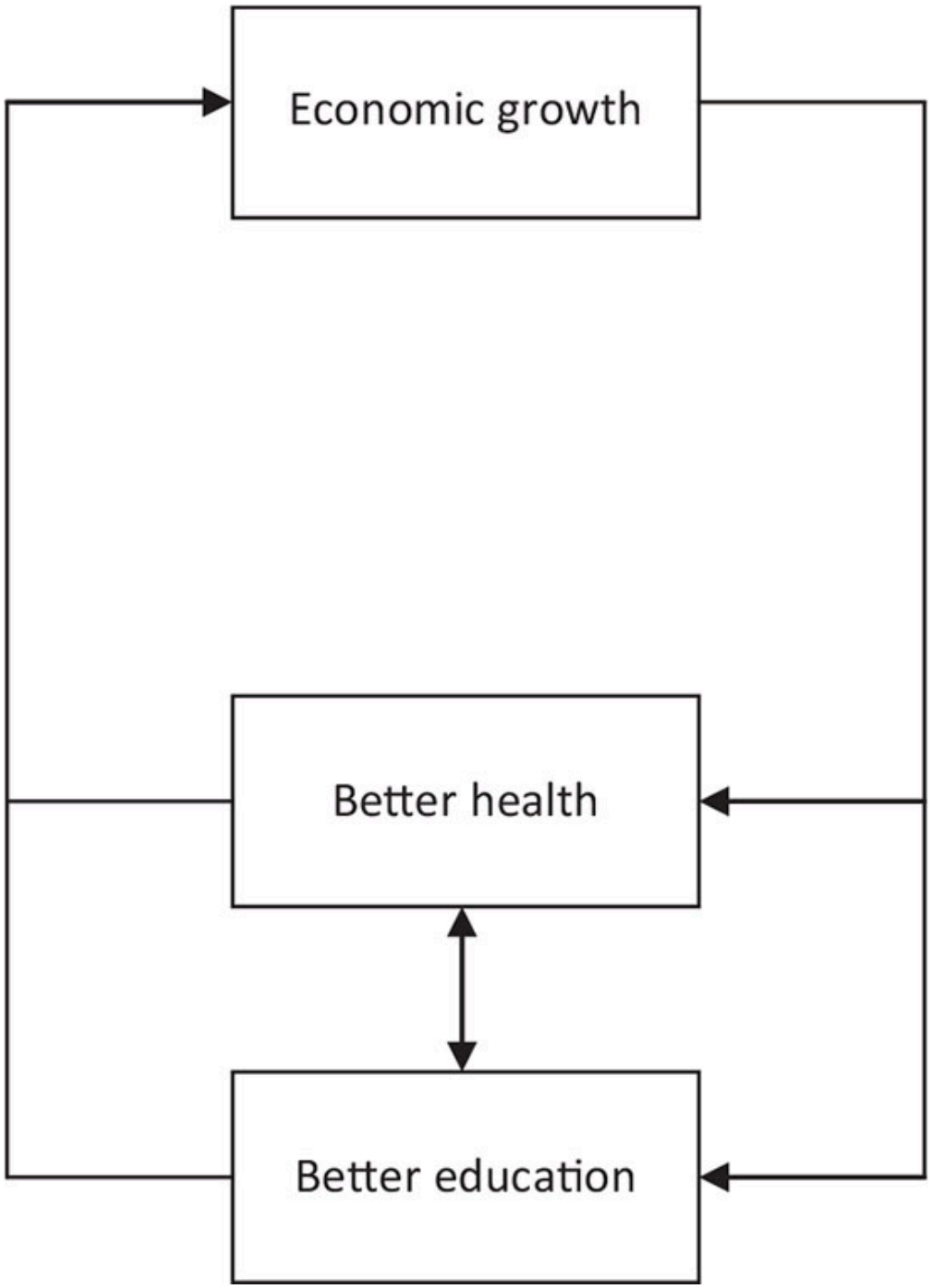
Of all the perspectives on development – alongside economic, political and environmental – social development is the most difficult to pin down because it runs the risk of being a "catch all" for everything not explicitly covered by the other categories (which, in any case, overlap with one another).

While there has been disagreement on the mechanisms through which it should be achieved – via community development, via government intervention, via incorporation into markets – the focus for social development has always been on the welfare or wellbeing of individuals (Midgley 2014). One line of thinking within social development defines this further in productivist terms, linking it to the ability to have a productive livelihood. This returns us to the previous chapter with the idea that social development helps build human capital. So, while there are other ways of understanding social development, we will understand it here in human capital and development terms.

This is the view which, for example, underpins the widely used UN Human Development Index and which in part derives from the capabilities perspective on development, a topic to which we will return later in this chapter. Our particular focus will be on the development of skills and knowledge through education (teaching and learning), and the development or maintenance of good health. Following the productivist perspective, we can see these as *means*: better education and better health can enable an individual to make a better livelihood. But being well-educated and healthy are also *ends* in themselves, goals that the development process can aim for. So, as shown in Figure 6.1, there is a two-way relation between health, education and economic growth; for example:

> Empirically, high levels of population health go hand in hand with high levels of national income. This is not unexpected. Higher incomes promote better health through improved nutrition, better access to safe water and sanitation, and increased ability to purchase more and better-quality health care. However, health may be not only a consequence but also a cause of high income. This can work through a number of mechanisms … The first is the role of health in labor productivity. Healthy workers lose less time from work due to ill health and are more productive when working. The second is the effect of health on education. Childhood health can have a direct effect on cognitive development and the ability to learn as well as school attendance. In addition, because adult mortality and morbidity (sickness) can lower the prospective returns to investments in schooling, improving adult health can raise the incentives to invest in education.
>
> (Bloom & Canning 2008:1–2)

Figure 6.1 Relation between health, education and economic growth



Just as there is a two-way relation between economic growth and health/education, so there is a two-way relation between ICTs and health/education. As we saw in Chapter 2, you need good health and –

particularly – you need skills and knowledge such as digital literacy in order to make effective use of ICTs. But our focus here will be the mirror image, looking at how ICTs can impact health and education in developing countries. As noted, we will then look at a wider foundation for these aspects of human/social development, investigating the link between ICTs and development of capabilities.

6.2. ICTs, health and development

SDG 3. Ensure healthy lives and promote well-being for all at all ages

6.2.1. e-Health applications

To understand the role of ICTs in improving health in developing countries, a valuable starting point will be a simplified model of the main healthcare system actors, as shown in Figure 6.2, starting with ordinary citizens who take some responsibility for their own health but may also at times be patients within the healthcare system; healthcare professionals of which there are many kinds but here summarised into more medicine-oriented professionals and more healthcare-oriented professionals; managers of healthcare facilities; and higher-level policy-makers.

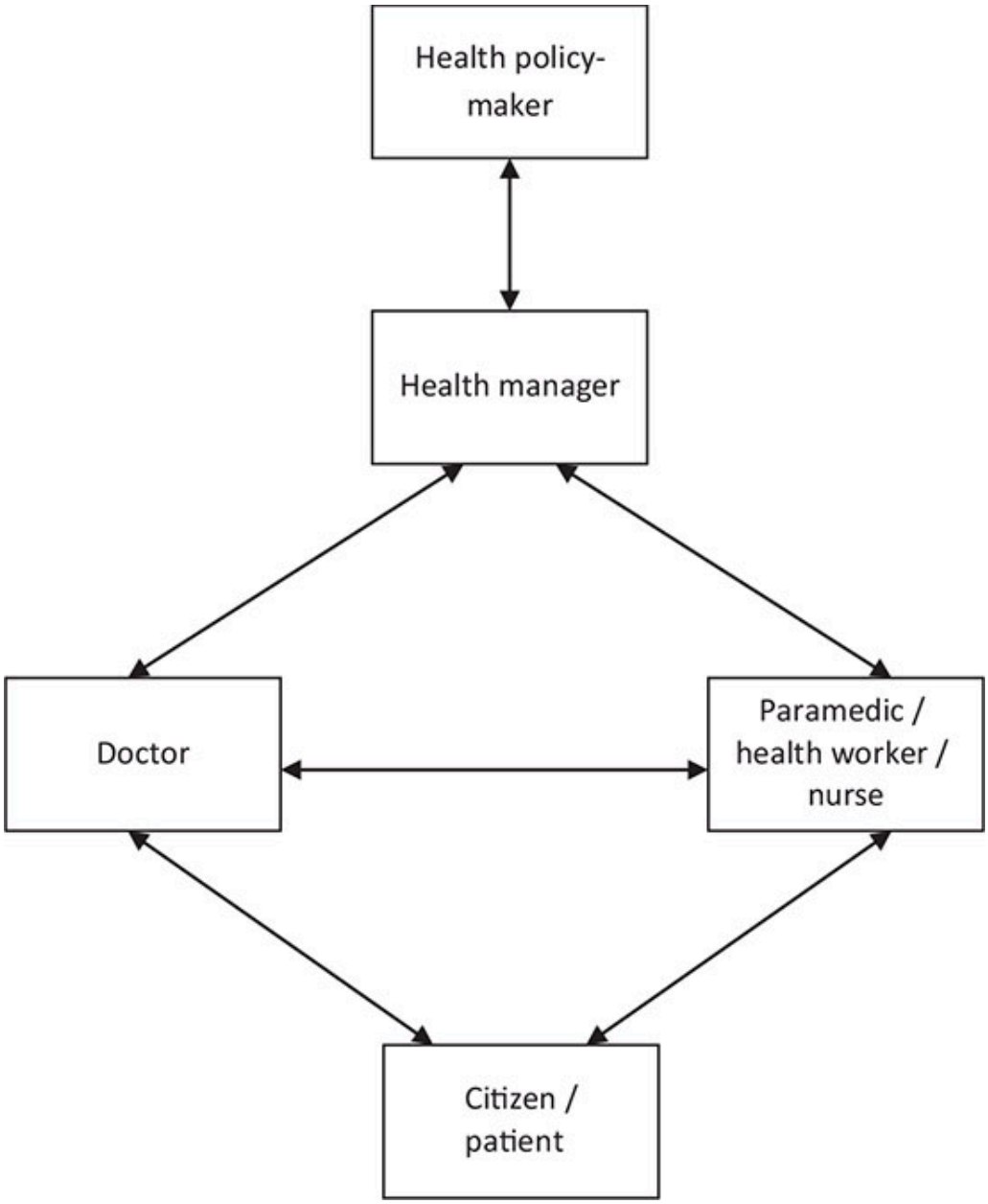
We can then re-work this with an overlay of key ICT system applications, as shown in Figure 6.3, with examples of each of the types of information system (IS) described next.

Public health information systems

These carry health information to members of the public, seeking to change their health-related behaviour. There is a reasonable bank of evidence on impact. For example, an experimental design study in Pakistan compared a control group of pregnant women with those sent mobile phone text messages about safe motherhood by their health worker (Sinha & Garro-Strauss 2013). The number of women choosing to deliver their babies at a health facility increased from 35 to 55 per cent (compared to virtually no change in the control group). It is the

content much more than the medium of the health messages that matters, but ICTs enable those messages to be sent at low cost and customised. An experiment in Kenya split a group receiving responses to texted sexual health queries into three groups – one received an automatically generated generic response; one received a human-generated personalised response; and one received the latter plus a "social cue": a message of encouragement indicating many others in their community were also working to improve their health (Kitagawa 2015). Of those pre-experiment who never used a condom, 30 per cent remained in the generic group, but only 20 per cent in the personalised group, and less than 7 per cent in the social cue group; there was a similar pattern of increasing numbers moving into the always-use-a-condom category.

Figure 6.2 Key health system actors

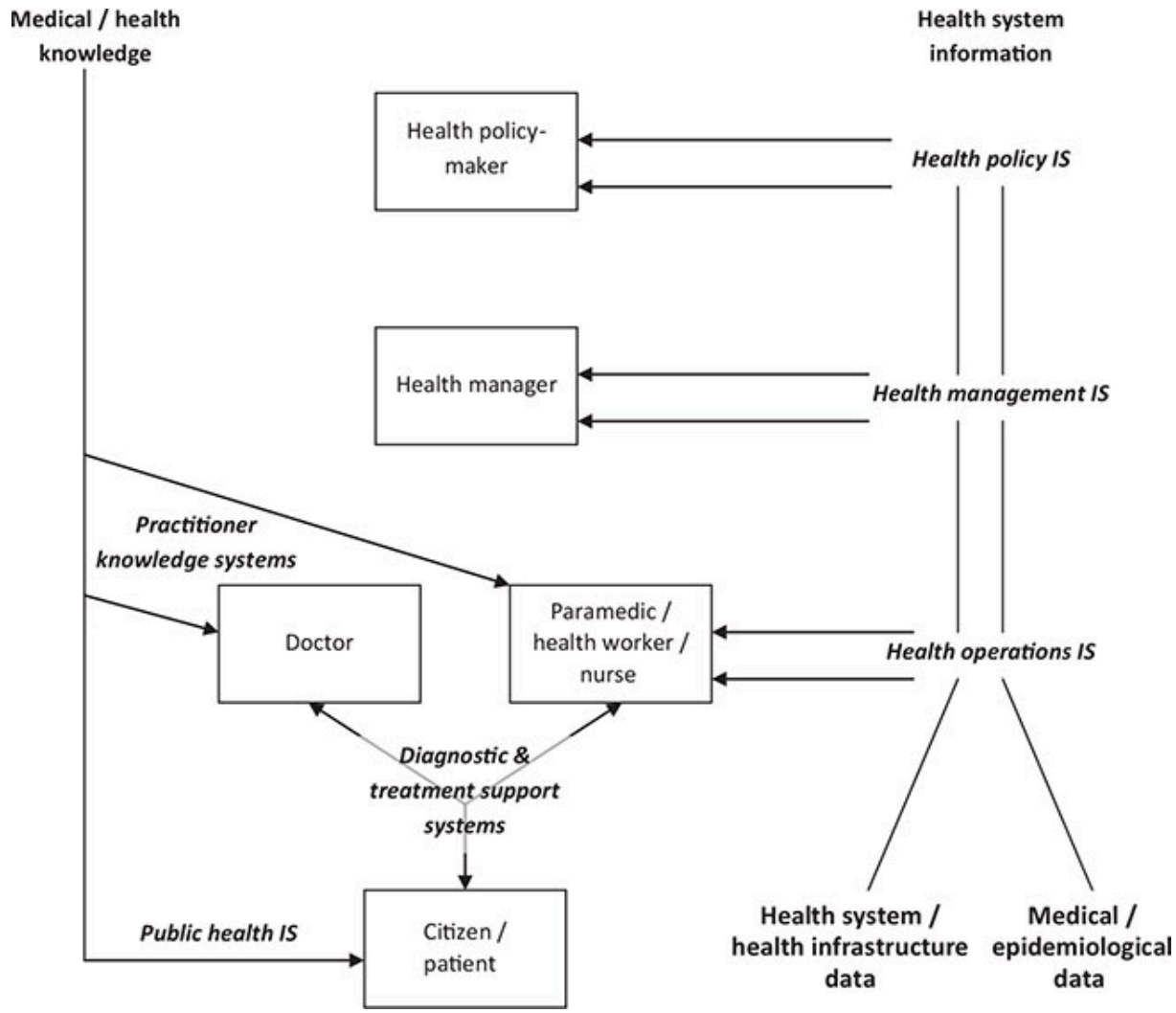


Diagnostic and treatment support systems

This application domain has been the focus of much of the interest in e-health and development. Simple digitisation can have an impact. For example, in Tanzania, there was a move from paper-based to digital-based administration of the Integrated Management of Childhood Illness protocol, a step-by-step procedure for diagnosis of children (Mitchell et al. 2013). Examining the two, 21 per cent of healthcare workers using the paper-based system completed the ten core

diagnostic items, compared to 71 per cent with the digital version, with much greater consistency between different healthcare workers. Accuracy of diagnosis was 83 per cent with the paper system but a statistically significant 91 per cent with the digital system. This also helped reduce the incidence of prescription of inappropriate drug treatments (Shao et al. 2015).

Figure 6.3 Key health system ICT applications



A major application in this domain is telemedicine: remote diagnosis of patients. This can be regarded as simply journey substitution: instead of bringing the patient to the specialist (typically residing in a distant urban centre), the two are

connected in cyberspace and data rather than people are moved, with one estimate from Africa of US$25 on average saved per patient (Bagayoko et al. 2014). However, the barriers to, for example, a poor and/or very unwell rural patient travelling to have a consultation with a hospital specialist are far greater than just journey cost. Thus telemedicine falls more into the improvement or perhaps even reorganisation categorisation of extent of change in DIRT terms (see Section 4.2).

One example is the IKON tele-radiology project in Mali (IICD 2015). This arose to address a key challenge – that Mali has eight regional hospitals with x-ray equipment but almost all the specialist radiologists best able to interpret the x-rays scans were in the capital, Bamako. Internet links enabled the scans to be sent from the regional hospitals to the radiologists, and for the radiologists to discuss with and train regional doctors, with an average of around 800 scans per year. As a result, between 2005 and 2013, the percentage of cases in which the regional doctor was able to give an initial diagnosis rose from 7 per cent to 76 per cent; the cases in which there was agreement between regional doctor and radiologist rose from 0 per cent to 73 per cent; and the proportion of inaccurate diagnoses fell from 27 per cent to 3 per cent. Alongside saving travel costs and improving health outcomes for individual patients, the project also helped build diagnostic capacity across the country.

Most models to date have assumed the involvement of healthcare professionals in the diagnosis and treatment process. However, growth in availability of Web- and app-based health information enables citizens to increasingly self-inform, self-diagnose and self-treat. This is a more radical change to healthcare processes which may empower patients, increase speed of diagnosis and treatment, and reduce load on the health system; or may lead to a growth in mis-diagnosis and mis-treatment (Carida et al. 2014). A half-way house may be managed self-care supported by ICTs. One instance of this was the use of automated mobile phone calls for monitoring and behaviour guidance plus a home blood pressure kit for hypertensive patients in Honduras and Mexico (Piette et al. 2012). Compared with a control group, the intervention group were found to have significantly lower blood pressure, especially for those in a low-literacy sub-group, and to report fewer problems with general physical and mental health.

Practitioner knowledge systems

Although this will largely be discussed in the section on e-education, online learning systems have become increasingly available to healthcare professionals. A study of one of the most long-established systems – Réseau en Afrique Francophone pour la Télémédecine which provides educational materials in Francophone Africa – found participants spend an average 13 per cent of their working time on online education, that healthcare competencies were felt to be kept continuously updated by the system, and that it "improves retention and facilitates the recruitment of young HCPs [healthcare professionals] to remote locations" (Bagayoko et al. 2013:670).

Health operations information systems

The core activities of frontline health workers – diagnosis and treatment – plus capacity-building, have already been covered. Other operational IS for these staff mean relatively peripheral applications such as time/journey planning. But other operational areas of the health system have seen more valuable ICT uses. For example, introduction of a Web-based reporting system for health laboratory test results in Peru roughly halved the time it took for those results to be reported, reduced by two-thirds the number of late results, and reduced error rates from 13.5 per cent to 2 per cent (Blaya et al. 2011). Studies of computerisation in testing in Asian hospital laboratories produced similar results but undertook an overall cost-benefit analysis to show introduction of ICTs reduced per-test costs by an average 34 per cent, even allowing for the additional costs of the ICTs (Jan et al. 2012). Another example is the growing use of ICTs in medical supply chains to try to avoid "stock-outs" – absence of key drugs or other supplies – and to reduce inefficiencies and losses (Kwan 2014). In Tanzania, for instance, the "SMS for Life" system was used to report levels of anti-malarial drugs in health facilities in three rural districts (Barrington et al. 2010). The proportion with no stock of at least one anti-malarial fell from 78 per cent pre-system to 26 per cent.

Health management/policy information systems

These are "traditional" management information systems that supply information for higher-level health facility, system or policy decision-making. They are badly

needed because of the poor state of many health data systems, as Figure 6.4 (Khan 2015) illustrates.

A major initiative in this area – already discussed in Chapter 3 – has been the work of the Health Information Systems Programme (HISP) which developed from the University of Oslo and initial application in South Africa into a global network. Its key product is District Health Information Software v2 (DHIS2) which is used in nearly 50 countries with national roll-outs in 16 in sub-Saharan Africa and South Asia. It has faced a lot of challenges, in part because it has often been the first ICT application experienced by its potential users. But there is now evidence of its impact at least at the early stages of the information value chain. A before-and-after study in Uganda, for example, showed DHIS2 to increase the number of health facilities reporting patient data from an average 28 per cent to 72 per cent, and the number of districts reporting patient data on time to increase from 22 per cent to 77 per cent (Kiberu et al. 2014). Evidence further down the chain is rather harder to find, but a trial in Kenya that layered a visual reporting tool on top of DHIS2 found health managers better able to understand the data they were receiving, and able to give examples of better decisions they had made – for example about reducing the numbers of women dropping out from pre-natal care (Nutley et al. 2013).

Alongside these traditional information systems dealing with the continuous operation of health systems, are information systems linking to more acute events such as disease outbreaks and health emergencies. There are ongoing epidemiological surveillance systems, such as those used to monitor potential outbreaks of dengue fever in India and Sri Lanka (Thevathasan 2015). And there are even more acute systems, such as those used to collect, analyse, map, report and predict information relating to the West African Ebola outbreak that began in 2014 (Bah 2016).

Related information systems – both decision support systems used for prediction, and management information systems used for tracking and reporting – can be found addressing issues of hunger and food security, as shown in Box 6.1.

Figure 6.4 Paper-based hospital records (Pakistan)

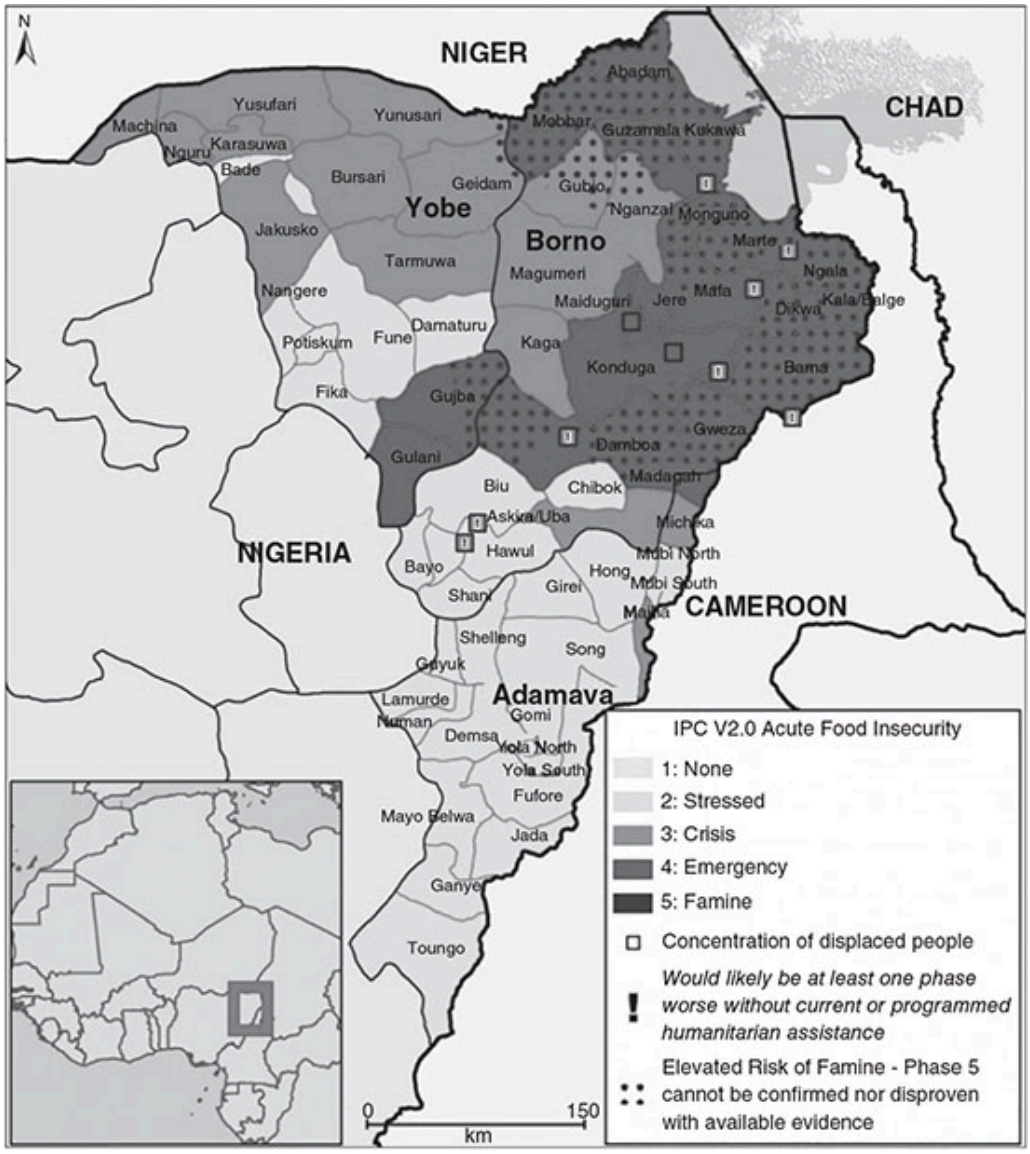


Box 6.1

ICTs, food security and hunger

Agricultural applications of ICTs described in Chapters 4 and 5 are part of the means by which digital technologies can contribute to food security. But ICTs can also help more immediately in situations of hunger. They can help in prediction. The Famine Early Warning Systems Network (FEWS NET) operates across multiple developing countries and integrates remote sensing, weather, food price, household nutrition and other data to produce food insecurity predictions (see Figure 6.5 for a prediction for North-East Nigeria (FEWS NET 2016)). As an example of system use, from late 2010, it provided a "timely, accurate, and actionable" early warning of famine in Somalia (Hillbruner & Moloney 2012). Unfortunately, other information value chain components – tools to turn data into clear information for decision-makers, incentives to turn information into action, authority and leadership to drive action forwards – were lacking, meaning the response was late and famine was not avoided, being declared from mid-2011.

Figure 6.5 FEWS NET food insecurity prediction for Nigeria



p.218

ICTs can also help operationally during food crises. A simple example comes from digitising the operational and management information systems used to control food distribution programmes in times of hunger. In Ethiopia, for instance, UNICEF faced problems because it could only monitor by having individuals travel out to each of its 1,800 feeding centres and then travel to report back, leading to delays of anywhere from two weeks to two months (VWC 2012). It replaced this with the RapidSMS system which allowed

direct texting of stock, arrival and consumption levels of high-nutrient food packets. The texts were automatically received and processed by central servers in Addis Ababa, then displayed as graphs indicating where there were food availability problems. These could then be rapidly addressed.

Impact overview

As with other ICT4D applications, we must keep sight of our chronological place in calibrating the impacts of e-health in developing countries. There are very early examples of "tele-health" – families in the Middle Ages sending urine samples for diagnosis by distant doctors, surgery on an injured man in the Australian outback guided by telegraph in 1917, treatment of ship-borne passengers by radio, and the advent of emergency ambulance call-outs by telephone from the 1920s (Sosa-Iudicissa et al. 1998). However, the broader pattern is that it was some decades after analogue ICTs – radio, telephone, television – became commonplace in the global North before tele-health applications based on these technologies became widely available. That availability-application gap has been shorter for PCs and the Internet but is still a period of some years (Field 1996, Benson 2002). With mobile phones only becoming widespread in developing countries during the 2010s, and the Internet still restricted in its diffusion, our expectations of impacts must be muted.

They must also be muted because health indicators such as under-5 mortality or incidence of heart disease are medium or long term and their causes are multi-factoral. Thus there are both measurement and attribution problems for e-health projects: how for example would you measure the impact of an individual e-health project on life expectancy? So one has to rely on proxy or interim measures. Even then, there are few examples of short-term, directly attributable measures except perhaps in relation to public health IS linked to behavioural changes.

Given the patchy evidence on e-health and development with relatively few systematic reviews, we often have to rely more on the kind of individual illustrations just described. These do give some sense that ICTs help address some of the key problems within health systems in developing countries (VWC 2012, Sinha & Garro-Strauss 2013):

- Poor health awareness and behaviour among the general population: public health information systems are combating this.
- Lack of skilled healthcare workers: practitioner knowledge systems are helping to build skills, but there is also evidence that digital systems could improve staff recruitment and retention.
- Poor supply chain management: operational IS have a role here.
- Inefficient use of equipment: telemedicine applications help ensure more and better use of medical equipment.
- Urban–rural inequalities: all of the digital applications – if implemented in rural areas – can help to close relative and possibly absolute gaps.

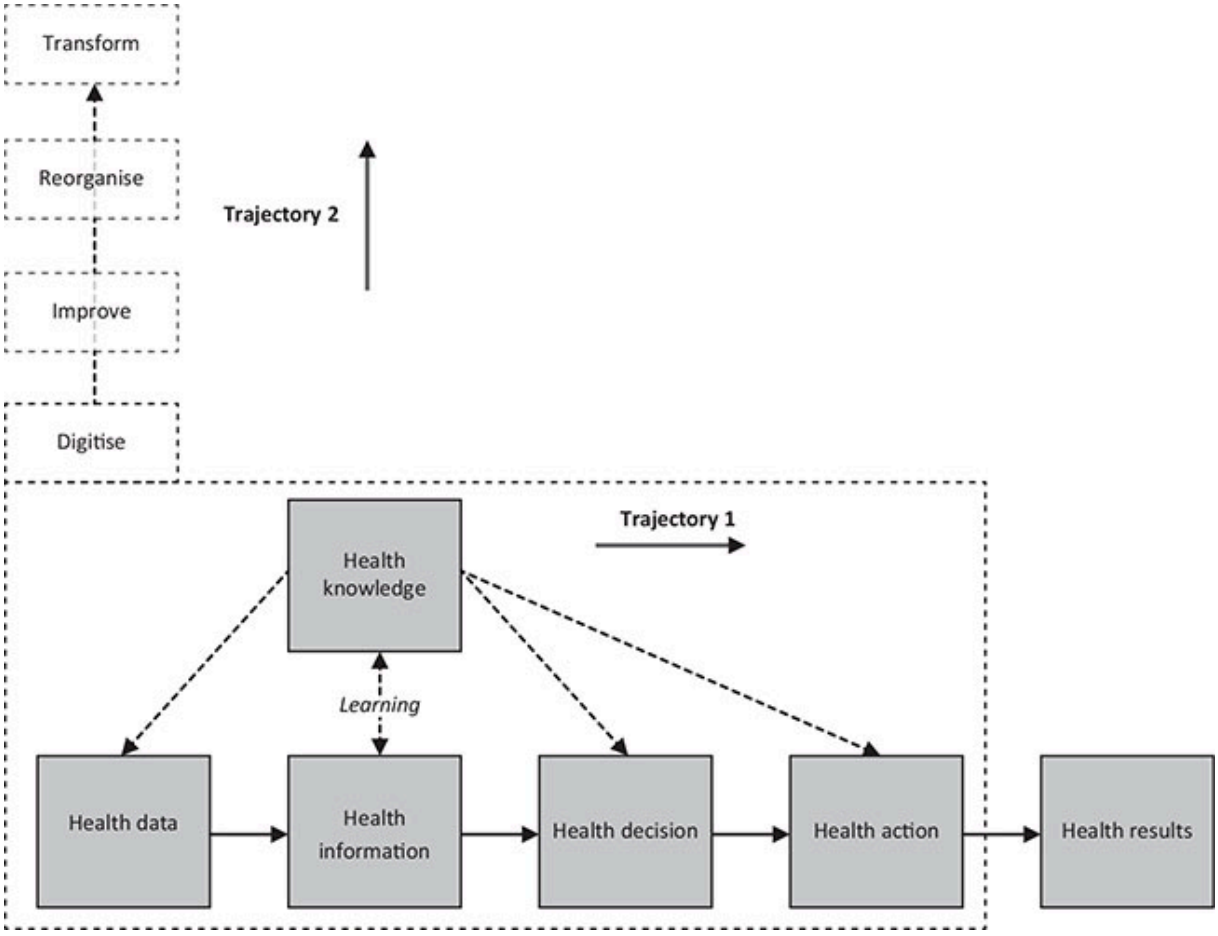
Trying to look beyond the individual projects and impacts, there are signs of two trajectories for e-health in development, both expected given we are still at a relatively formative stage, and summarised in Figure 6.6.

The first is movement from left to right along the information value chain. Initial projects have focused particularly on creating a usable base of data that can form the foundation for better decisions and actions within health systems; and on improving the information for, and knowledge of, health workers and patients. Once these foundations are in place, e-health has been able to move further along the chain to help improve decisions and actions such as better and faster diagnostic decisions and treatments, and improved health management planning and resource allocation (ibid.). The impact to date on policy seems more limited, except for policy decisions to adopt certain data standards and e-health applications. Likewise, the proven results in terms of improved health outcomes are more limited than for building the health infrastructure.

The second trajectory is slow movement up the DIRT categorisation of extent of process change: the extent in this case to which the information value chain processes are changed. A major focus has again been foundational – basic digitisation that converts paper- or manual-based processes to digital. There is potential for greater process change to bring greater benefits – compare the diagnostic impact earlier of Integrated Management of Childhood Illness digitisation in Tanzania vs. the process improvement of the Mali IKON telemedicine application. Reorganisation of health processes is a real rarity;

transformation is not really identifiable. But the potential grows with growing ICT diffusion: the Tanzania Integrated Management of Childhood Illness case, for instance, uses ICT to enforce consistency and minimum quality thresholds and is the first step on the road to computerised diagnosis.

Figure 6.6 Trajectories of e-health for development



6.2.2. e-Health and development challenges

The listing above presents a fairly positive picture of e-health applications in development. However, it is reasonable to summarise that the *leitmotif* of e-health and development literature has been challenge more than it has been achievement. Developing countries are not alone in this – the UK National Health Service has

been described as “a late and slow adopter” of new healthcare technologies (Peirce et al. 2015:69) – neither are e-health applications alone in this. We will therefore try to focus here on the particular challenges faced by e-health applications in developing countries.

Ensuring the information value chain runs all the way from data to results is especially challenging in the context of health in developing countries. The poor state of health data makes it hard even to secure the first stage of the chain: providing data that meets even a minimum of the OCARA (see Chapter 2) criteria for data quality. Health systems (remembering Figure 6.4) remain paper-intensive; they are fragmented both horizontally and vertically (for example with different hospitals using different data systems; with health centres and government agencies using different data systems; and with splits across public, private and non-profit health providers) making interoperability and use of data standards difficult; with further challenges to interoperability due to the particular need to maintain confidentiality of health data (Friederici et al. 2012, Fornazin & Joia 2014).

Technology can help to deliver data more efficiently but – unless moving to digital decision-making – it then runs up against problems of human decision-making. Telemedicine applications can hit this barrier: if there is a set number of specialists in the country, then connecting them into multiple other sites will achieve nothing unless they can be made to work more efficiently or work longer hours. As seen in the IKON project, capacity-building of other decision-makers is thus increasingly built into telemedicine projects.

Similar issues arise with health management and policy IS: decision-making processes and capacities are often weak, so data can be delivered to decision-makers but then remain unused. A national health information systems project in Ivory Coast recognised this and the need to move beyond just technological intervention, to include decision-making and implementation capacity-building (Nutley et al. 2014). The result in health districts was a rise from 40 per cent to 82 per cent of decision-making discussions that included health information system data, and a rise from 43 per cent to 64 per cent of referring decisions upwards in order that they could be actioned. In part, what these additional interventions also seek to achieve is moving e-health intervention from data-push to decision-pull:

not shoving data at decision-makers but improving the data demand from decision-makers.

This moves us towards the issue of incentives and motivations – as argued in Chapters 2 and 3, a core to understanding success or failure of ICT4D applications. These may impact e-health from a more objective direction; for example, given the severe shortage of funding that health systems face in developing countries, e-health may be a low priority. In the IKON telemedicine project, for example, there were significant differences in uptake between regional hospitals, with a key explanator being the hospital director's view on the value of continuing to pay for Internet connectivity from the hospital budget given competing priorities (IICD 2015). But the impact may also come from a more subjective direction: in the same project, another determinant of uptake differences was the attitude of the regional doctors, some of whom were reluctant to be seen seeking external assistance with their diagnoses.

The issue of motivation can be overlain on that of data quality in order to bring a deeper understanding, as summarised in Box 6.2.

Box 6.2

Addressing the ICT4D data quality challenge

Data quality is a major problem for ICT4D applications – not just health management / policy information systems but in all sectors and other types of application. There are technical elements to this but, until the process can be fully automated, human factors play a significant part. As summarised in Figure 6.7, a simplified version of our earlier motivation model (see Chapter 2) would say that human perceptions about how data is or is not used shape their motivations which shape their actions which have an impact on data quality.

This might not be a major problem but for the fact that many data systems in developing countries involve long chains – Figure 6.8 shows chains of different roles (the example below draws some key potential human roles from CIPSODAR) and chains of hierarchical levels (real examples may

involve even more local levels between facility and district) – which place the early roles far from the data user roles.

Figure 6.7 Data quality and motivation

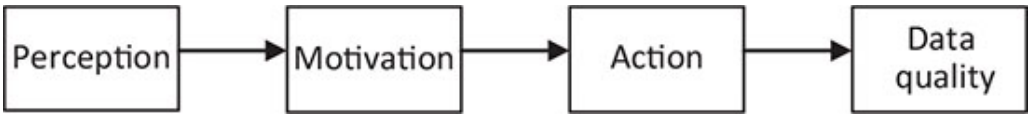
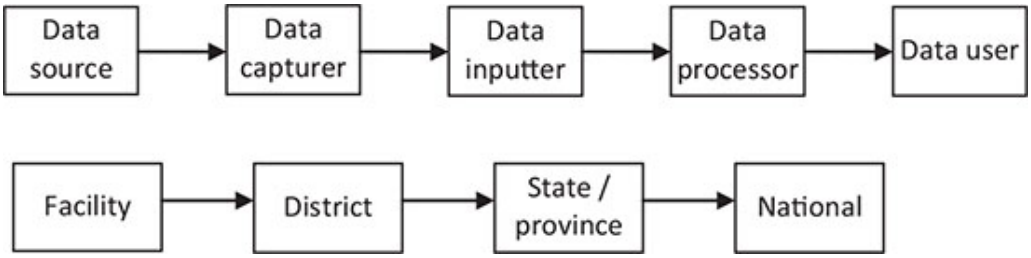


Figure 6.8 Data system chains



The result is often that the early-role actors may have little incentive: they may perceive that the data has little relevance to their own priorities, or perceive that the data is not meaningfully used. The outcome can be data not returned, or returned late, or with little care as to its quality in other ways (for a health data example, see Garrib et al. (2008); for an education data example, see infoDev (2006)). Or these actors may have skewed incentives: feeling they will be punished (for example, if health centres appear to be performing poorly in their district) or rewarded (for example, if hospitals appear to lack resources in their state), dependent on the data. Again, the outcome "may run anywhere on a continuum from omitting certain facts, to misrepresentation, to outright lying" (Heeks 2006a:83).

Possible solutions (summarised in Figure 6.9) include:

- Ensure there is a data user: which may require support for decision-makers or redesign of data gathered/presented to match true decision needs.

• Merge data roles: the fewer different roles there are, the fewer perceptual and motivational problems are likely to arise.

• Make early-role actors into data users: if these actors use the data they handle, they have a stake in its quality. This may involve providing frontline data sources – healthcare workers, community workers, teachers, school heads, etc – with some decision-making autonomy; and feeding back to them aggregated data from higher levels for comparative purposes.

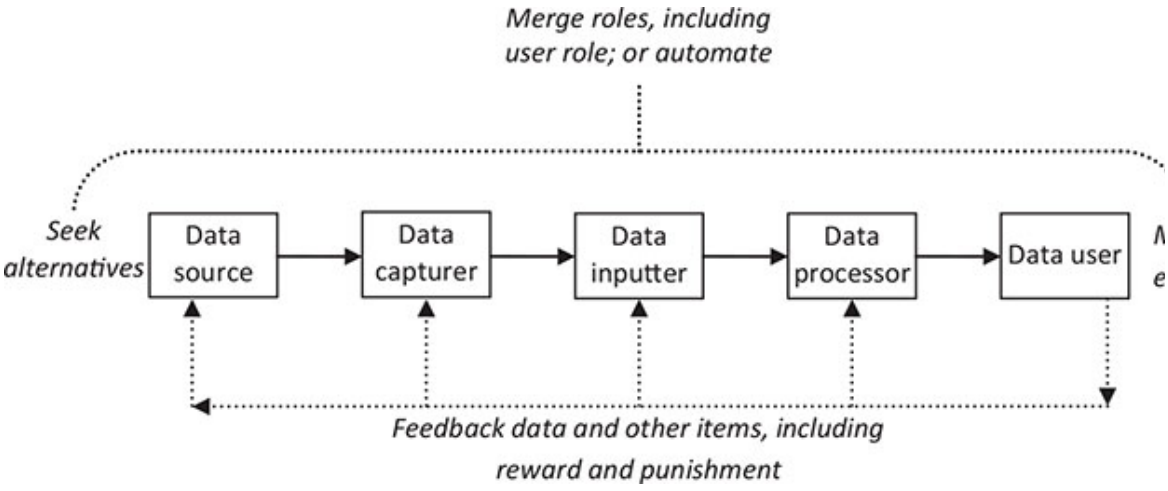
• Provide other feedback to early-role actors: an explanation of how their data was used, or charts to highlight those who have not yet returned their data.

• Align reward/punishment: ensure incentives around data use do not skew motivations away from data quality.

• Automate: remove humans from the data chain including using data from digital sources (such as mobile phone records) and using smart applications where decisions are made by the digital technology.

Source: Heeks (2006a)

Figure 6.9 Ways to address data quality problems



We can interpret all of these issues as design–reality gaps (see also Box 6.3). There can be gaps between a design assumption of high-quality, interoperable data and a reality of poor-quality, fragmented data; between a design assumption of capable decision-making skills and a reality of poor skills; between a design assumption of well-motivated health professionals and a reality of poor motivation; etc. There are many other examples of design–reality gaps identifiable:

- m-Health system designs that require reliable telecommunications infrastructure which, in practice, is not present (Nyemba-Mudenda & Chigona 2015).
- A Nigerian health IS that struggled because a design assumption of funds to cover SMS costs was not met in reality (Ezenwa & Brooks 2014).
- A Tanzanian drug stock-out reporting system design that assumed a functioning drug supply chain when in reality that chain imported drugs into the country only irregularly and insufficiently (Mikkelsen-Lopez et al. 2014).

Addressing these e-health challenges therefore requires gap closure tactics of the type identified in Chapter 3. Alongside specific actions to modify design or change reality for individual ITPOSMO dimensions, this will also include generic gap-closing actions such as user-centred design, user participation, prototyping, development of user-designer hybrids, incremental roll-out and a "core-periphery" approach that imposes a few core standards but otherwise allows local flexibility of practices (Heeks 2006b).

Box 6.3

Institutional logics and e-health systems

A characteristic challenge for e-health systems is the gap that exists between a system design based on medical rationality, and a reality of local working practices that are different (Kanjo 2012). Local practices are typically different because they take into account local beliefs and culture, because they treat patients as people rather than as a bag of medical symptoms, and

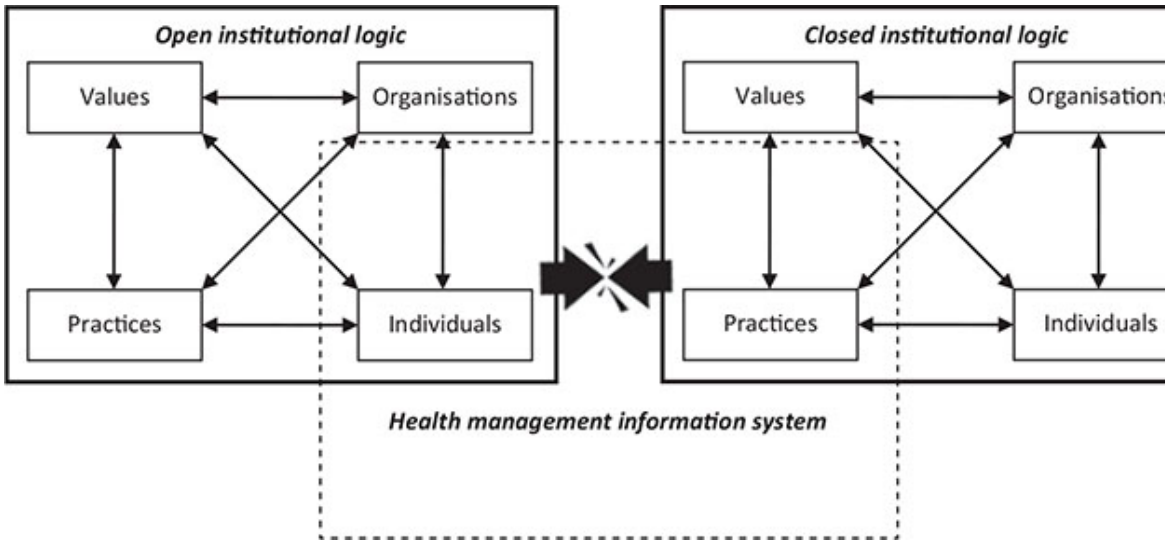
because healthcare workers are flawed humans rather than rational automatons. We could interpret this simply in terms of design–reality gaps, but a related alternative view draws on "institutional logics".

Institutional logics may be defined as values and practices of networks of individuals and organisations that shape meaning and behaviour. Major logics operating in society include market logic that underpins capitalist economics, and state logic that underpins the functions of most governments (Thornton et al. 2012). A typical circumstance is that two or more institutional logics will intersect and often conflict around an ICT4D project: Chapter 5 already gave the example of market and welfare logics intersecting in IT impact sourcing projects, and Chapter 2 identified public–private partnerships as a source of conflicting logics in ICT4D.

This is also true of e-health projects (Asangansi 2016) (and e-education projects: Stratton et al. 2016). For example, we can see the conflict of institutional logics when an attempt was made to introduce a new health management information system (HMIS) into all of Brazil's local government municipalities, aiming to track expenditure on different aspects of health and sanitation (Heeks & Santos 2009). On the one hand were the system designers and a team of central government officials associated with Brazil's "sanitarist" movement. They formed a network of "open logic", which believed in norms of transparency and accountability, which inscribed these norms into the HMIS, and which undertook rational management oversight practices. Ranged against them were a set of local officials who formed a network of "closed logic"; adhering to values and practices of politicised decision-making, a lack of accountability of officials, and exclusion of civil society from decision-making. As summarised in Figure 6.10, these two institutional logics conflicted when the system was introduced.

The result was some compromise and hybridity between the two logics when the system was partially redesigned, but the two logics also continued to operate alongside and separately from each other, restricting the uptake and impact of the HMIS.

Figure 6.10 Conflicting institutional logics in a Brazilian e-health project



6.3. ICTs, education and development

SDG 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

6.3.1. e-Education applications

Just as we did for health systems in developing countries, so we can also map out two very similar diagrams – see Figures 6.11 and 6.12 – showing the main stakeholders and ICT applications in a typical education system.

Public education information systems

The desire for education is strong among ordinary citizens in developing countries: educational use of ICTs is often the top priority when citizens are surveyed (Gomez 2014), with some evidence this ranks higher with women than men (Wahid 2007), and with educational impacts ranked among the top benefits of ICTs (Sey et al. 2015). Most uses of ICT for educational purposes are

fragmented, individualised and instrumental – a typical example would be looking up an entry on Wikipedia in order to understand a particular topic for an immediate learning need.

Figure 6.11 Key education system actors

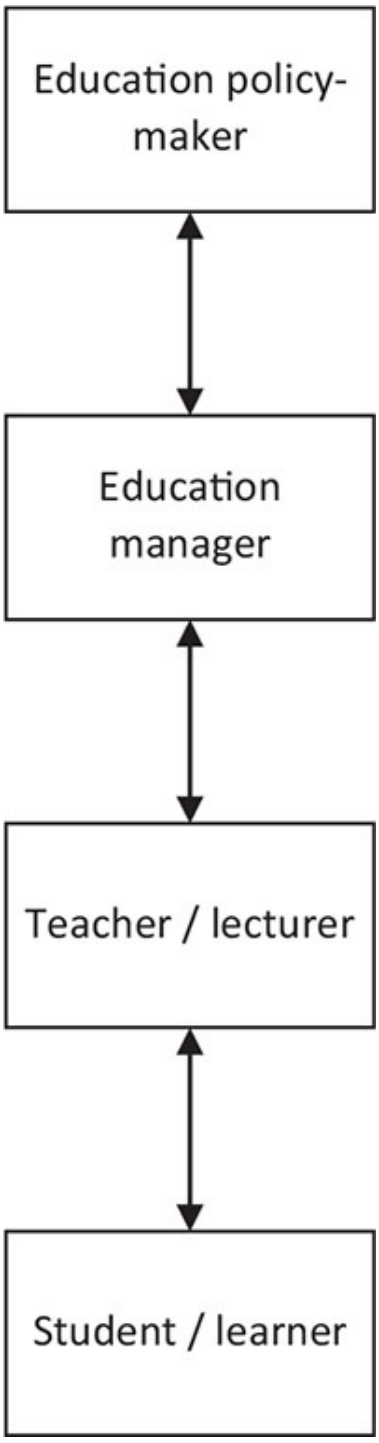
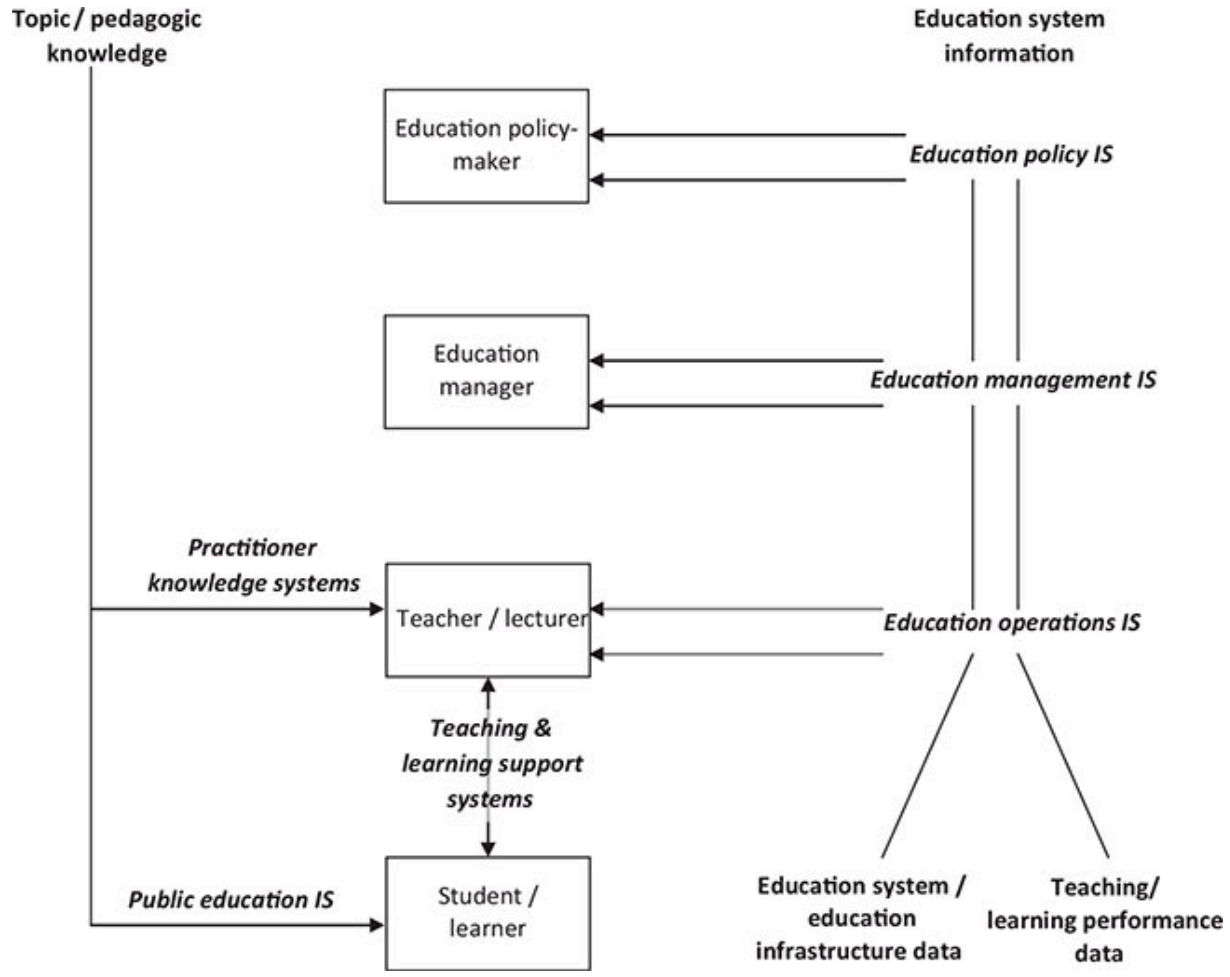


Figure 6.12 Key education system ICT applications



More structured approaches are increasingly available online. These can run from instructional videos on YouTube through to much more systematised offerings such as MOOCs: massive open online courses. These come in varieties including xMOOCs (with tutors present as experts and thus overlapping into the next e-education category) and cMOOCs (that focus on connecting autonomous learners to work together via blogs, forums, etc), and quasi-MOOCs (which offer less-structured tutorial-type content as open educational resources) (Jobe & Hansson 2014). All MOOCs have problems with very high drop-out rates – a Kenyan MOOC on human rights was typical with only 6 per cent completing all modules, and 2.5 per cent submitting the examined assignment (ibid.). However, in this and other cases (Maitland & Obeysekare 2015) multiple learning gains can be demonstrated: not just the knowledge content of the MOOC, but linguistic capabilities (most developing country learners as yet will participate in MOOCs not in their first language), knowledge of different educational methods and technologies, knowledge of different national or global perspectives (depending

on the scope of the MOOC), and formation of social capital via relationships built with other MOOC participants.

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MOOCs also have problems with access: in the Kenyan MOOC, 80 per cent of participants were male and 75 per cent had a college education (Jobe & Hansson 2014); globally, those studying on Coursera's MOOCs are 60 per cent male and 83 per cent have at least a bachelor's degree (Zhenghao et al. 2015). However – and reflecting a pattern we've seen elsewhere in ICT4D – while it may be more difficult for those in marginalised groups to access digital education opportunities, if they are able to do so, they may benefit more than others. Some 42 per cent of non-OECD Coursera MOOC completers without a college degree reported a tangible career benefit such as finding a new job, compared to only 33 per cent of OECD-based completers with a graduate degree; and the former were significantly more likely to report tangible education benefits (such as completing prerequisites for an academic programme) than the latter (ibid.).

Teaching and learning support systems

There are certainly beneficial impacts that can be identified under this application domain. As with other applications of ICTs, there can be journey substitution and related savings if e-learning can replace the need for travel to a physical education institution: Indonesia's Ministry of Transportation is estimated to have saved up to US$30m by substituting e-learning for the need for its merchant marine officers to come onshore for their training (Flor 2015). And there is – not surprisingly – widespread evidence that those using ICTs as the channel for learning also gain ICT-related competencies: for instance, a programme distributing home computers to low-income families in Romania found a measurable increase in computing skills and knowledge (Malamud & Pop-Eleches 2011). See also Box 6.4.

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Box 6.4

E4ICT

The focus for Section 6.3 of this chapter is "ICT4E": use of ICTs for educational purposes. But "E4ICT" – education to teach ICT competencies – is also important, including "ICT4E4ICT": use of ICTs to teach ICT competencies such as the digital literacy discussed in Chapter 2. The core of this sub-domain has been an assumed value for hands-on ICT skills given the association between such skills and adoption/use of ICTs (Deen-Swarray 2016). Many initiatives follow a "push" model that sees the provision of training leading to skill development as, for example, in the Siyakhula Living Lab project in South Africa where ICT training courses were arranged for those involved (Pade-Khene 2012).

The alternative is a "pull" model that assumes the provision of ICTs will induce usage and skill development. This can be adventitious such as the skills gains reported above from Romania. A well-known and extreme example of a deliberate intervention was the "Hole in the Wall" initiative. Staff at the National Institute of Information Technology, led by Dr Sugata Mitra, worked in Kalkaji in the southern part of New Delhi, near to a slum area. In 1999, they built a computer kiosk on the boundary wall of the Institute campus – the hole in the wall – with a monitor visible though a glass plate and a touch pad (Mitra 2000). No announcement or instruction was provided; adhering to a "minimally invasive education" philosophy. But children from the slum area began to use the computer, teaching themselves and each other as they went along. They taught themselves a variety of ICT skills; an outcome subsequently replicated with construction of other hole-in-the-wall kiosks (Dangwal et al. 2005).

Beyond these foundations are a variety of "E4ICT" findings which reinforce messages from earlier chapters:

- Scope of competencies (Chapter 2): there is a value for training that provides digital literacy skills applicable across the whole information value chain rather than just application-use skills (Kimaro 2006).

- Intermediation (Chapter 2): there is a value in training "infomediaries" who support and build ICT competencies in other users (Bjorge et al. 2015).

- Appropriation (Chapter 2): for local users to truly appropriate ICTs to their own needs, they need training in higher-level digital producer

capabilities (FAO 2003).

- Power structures (Chapter 2): for users to derive more than incremental benefits from ICTs, they must also be trained in critical understanding and agency to address the power structures that perpetuate social inequality (Poveda 2016).

- Intervention design (Chapter 3): it is important to close gaps between the design of ICT training curricula and the realities of the training context (Bass & Heeks 2011).

- Extensive gains (Chapter 4): alongside trainee-side benefits, ICT training also brings trainer-side benefits, creating training enterprises both small and large that form part of the ICT sector that extends the scope of economic activity in a country (Rangaswamy & Nair 2012).

- Employment creation (Chapter 5): focusing only on the supply-side of skill development is not enough to turn ICT competencies into a job; that requires also a demand-side focus such as good links between the training course and ICT sector employers (Nandi 2014).

- Gender differences (Chapter 5): women place a greater value than men on the development of ICT skills, with those skills also having positive impacts on other aspects of female human capital such as self-confidence and self-efficacy (Khan & Ghadially 2010, Yafi et al. 2015).

- Pedagogic design (Chapter 6): there is a value in moving to peer-/group-learning pedagogies when training for ICT skills (Ndaiga & Salim 2015).

But the heart of ICTs' intended potential in this domain is its impact on learning other competencies. Both teachers and students tend to be positive towards the idea of using ICTs in learning (Shraim & Khlaif 2010). And one can find positive evidence of the impact of ICTs on learning. A randomised trial in India of children playing maths education games found they increased maths scores by 0.47 standard deviations with some improvement still present one year after the end of the intervention (Banerjee et al. 2007). There were similar though somewhat smaller improvements for children engaged in computer-assisted educational activities for English language training (He et al. 2007).

Echoing the point above, this seems particularly true for more marginalised groups if they can overcome barriers to access to e-learning: use of digital assistive technologies levels the performance playing field for disabled students in Sierra Leone (Jones & Pal 2015), use of mobile phones promotes better numeracy skills development and retention when used in education programmes for illiterate adults in Niger (Aker et al. 2010). Students initially weaker on maths in the Indian example above gained almost twice as much as those at the top of the performance spectrum (Banerjee et al. 2007).

However, alongside some examples of positive evidence, the dominant narrative of evidence is either a lack of impact on learning, or even a negative impact on learning. Box 6.5 finds this for what is probably the most well-known ICT4D e-education initiative: the One Laptop per Child (OLPC) programme. But there are other examples:

- A randomised study of computer-aided instruction in schools in Ecuador found those in the treatment group performed slightly worse in language tests than the non-ICT-using control group, though the difference was not statistically significant (Carrillo et al. 2010).
- The Romanian project mentioned earlier saw the school English and maths scores of children reduce by around 0.33 standard deviations during the year after home computers were distributed (Malamud & Pop-Eleches 2011).
- There is damage and disruption to learning due to pupil and teacher mobile phone calls in the classroom, and due to time spent on social networking or late-night calling substituting for study time (Porter et al. 2016).

Box 6.5

The One Laptop per Child initiative

The OLPC initiative was the brainchild of Nicholas Negroponte at the Massachusetts Institute of Technology Media Lab. It was formed as a non-profit in 2005 with the aim of bringing low-cost educational technology to

children in developing countries. Following design and development work, the first laptop – the XO – became generally available for mass-purchase by national governments in 2007, with Uruguay being the first, ultimately deploying more than 500,000 units. Large-scale purchase and distribution programmes have subsequently been undertaken by a number of other countries including Peru, Rwanda, Argentina and Mexico with smaller-scale deployments in dozens of other countries (see Figure 6.13 (OLPC 2009b)) totalling more than 2.5 million distributed in total (OLPC 2009a, 2013, 2015). In many of the deployments, children took the XO home with them at the end of the school day.

OLPC can be summed up as having not achieved what it was anticipated to achieve, and having instead achieved some unanticipated outcomes.

In terms of learning, the results – mostly from quasi-experimental designs – are disappointing at best and, given the very large expenditure of money and time involved, terrible at worst:

- Peru: "No evidence is found of effects on enrollment and test scores in Math and Language" for those using the XO in school vs. those not (Cristia et al. 2012:1); XO usage at home was associated with higher XO proficiency scores but made no difference to other ICT skills scores or to maths, reading or cognitive skill scores: "The only significant impacts were those reported by teachers who stated that children in the treatment group were significantly less likely to exert effort at school compared with their counterparts in the control group" (Beuermann et al. 2015:55).

- Uruguay: XO usage in school was not associated with any change in children's average maths or reading scores (De Melo et al. 2014).

Figure 6.13 OLPC use in Nigeria



- Nepal: “The exposure to computer-assisted learning in Nepal had no impact or a negative impact on student learning, non-cognitive skills and attendance. Students from grade 2 in treatment schools did particularly poorly in year-end English tests compared to control school students . . . [with a] large and statistically significant negative impact” (Sharma 2014:2,36). The impact on maths scores was also negative though the difference was not statistically significant. (This also chimes with other evidence (Carrillo et al. 2010, Mo et al. 2013) that ICTs may have a less negative – or more positive – impact on maths compared to reading abilities.)

However, there have been a couple of unanticipated outcomes:

- Economic gains: households containing children with XOs in Uruguay saw an increase of more than 30 per cent in household income compared to those which did not; there was a greater impact on lower-income households as many higher-income households already had ICT access (Marandino & Wunnava 2014).

- Innovation: a key impact of the XO was the high-profile threat it posed to other hardware manufacturers, triggering a wide-scale response from Intel, Microsoft, Asus and most other major PC makers that effectively created the netbook market and made low-cost Internet-connected devices widely available for the first time (Kraemer et al. 2009).

Two explanations can help here. The minor explanation is a possible inverse-U curve relating use of ICTs and learning outcomes: limited use of targeted e-learning interventions – such as those described in the India research above – improves learning. But a point is reached with ever-greater use of ICTs where it starts to substitute for more effective forms of learning: one further piece of evidence from the India work showed maths scores dropping heavily (by nearly 0.6 standard deviations) where computer-assisted learning was a substitute for a teacher-delivered curriculum (Linden 2008). A similar pattern was observed in a global review: "results suggest that limited use of computers at school may be better than not using computers at all, [but] using them more intensively than the current OECD average tends to be associated with significantly poorer student performance" (OECD 2015b:16).

But more important than this is DIRT (see Section 4.2): simply digitising – swapping educational atoms for educational bits – does not achieve much. To make significant gains, ICTs should be used to lever an improvement in the process of learning or even a reorganisation of the pedagogic approach:

- Empowering teachers: in Peru, a participatory e-learning project was used to not only build the ICT competencies of teachers but also – within the constraints of Peru's educational system – empower them to guide how ICT was used in their classrooms (Olivera et al. 2015). (This therefore represents an overlap with the next application of ICTs to build practitioner knowledge.)

- Changing pedagogic processes: rather than using ICTs to merely replicate the existing didactic approach, it was used in Senegal to promote "a more learner-centred approach based on active learning" (Rashid et al. 2013:205), resulting in very significant improvements in national exam performance.

- Changing pedagogic structures: using a traditional didactic model but enabling collective interaction between students can have positive effects: use of video-conferencing within training for Ethiopian medical professionals enabled them to form a community of practice between themselves and the US trainers which developed knowledge to a deeper level (Negash 2010), and use of mobile phones in a women's literacy project in Pakistan enabled formation of support groups who motivated one another to maintain their post-training literacy skills (Lee 2013).

Practitioner knowledge systems

One simple summary of experiences to date is this: if you have a dollar for e-education investment, you are better off putting it towards training teachers than training students. There is a value in generic capacity-building of teachers via ICT-based systems, but there is a specific value in three things: building teachers' ICT competencies so they are more capable and confident in using ICTs in education; helping them change their pedagogic methods to make most effective use of ICTs; and creating teacher communities of practice online to share experiences and best practices (Unwin 2005, Gudmundsdottir 2010, Kalema et al. 2016).

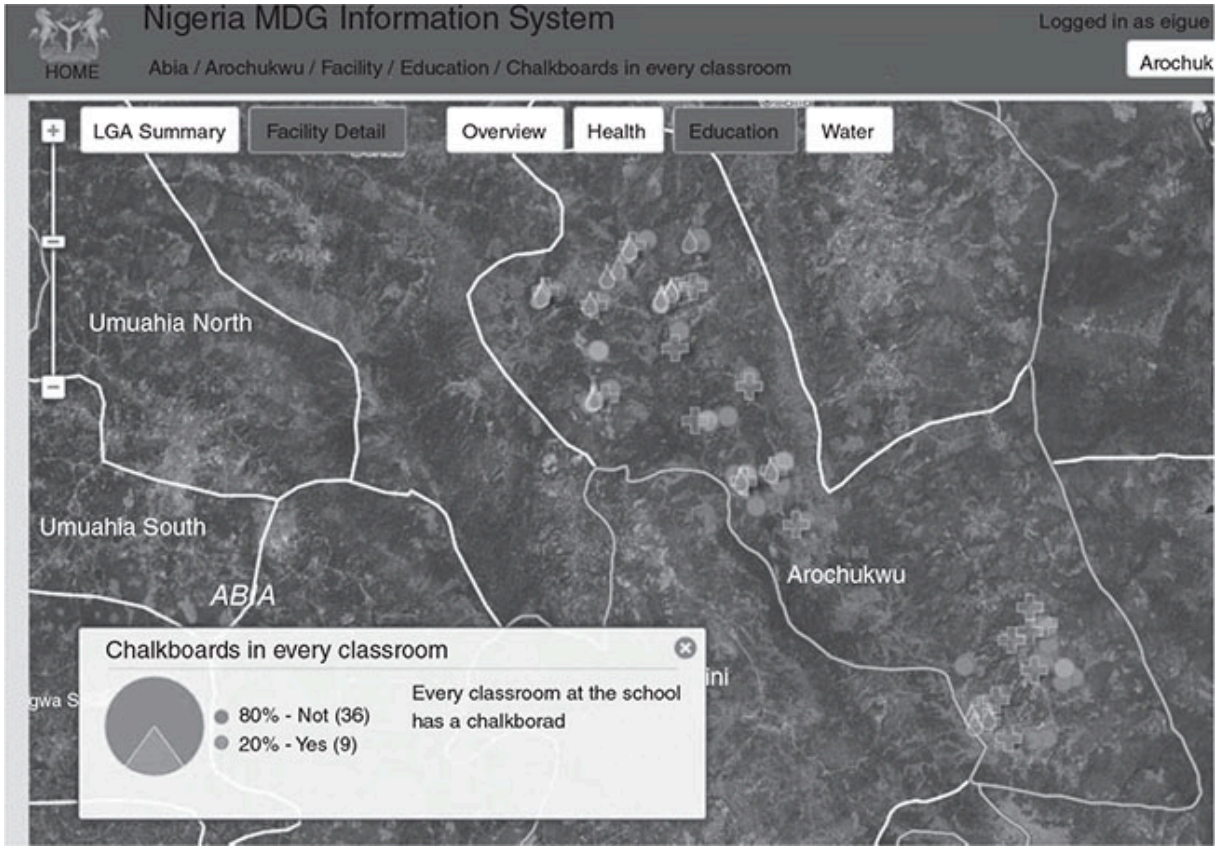
Education operations/management/policy information systems

While there are operational activities within the education system, many – such as school supplies – are far less critical than in the health system and have thus not been an ICT4D priority. There is growing use of basic operational systems around attendance, such as those used in Kenya to notify parents via text message of their children's absence from school (Chattopadhyay 2015). For higher-level information systems, there is a major education management information system (EMIS) – OpenEMIS – though its roll-out has so far been much more limited than for its health equivalent under HISP (Toner 2015). The picture is similar to that for HMISs – that there has been more evidence of providing a better foundation of data than there is evidence of better educational decisions, actions and results deriving from the new information system (infoDev 2006, Nayyar-Stone 2014, Iyengar et al. 2016). However, where use of data is institutionalised into

budgetary or other planning processes, the information value chain runs at least as far as decisions: Ghana and Pakistan's national EMIS have been used as part of decentralisation as all districts were required to produce operational plans and budgets; and a new EMIS in Nigeria with a map-based interface (see Figure 6.14: OSSAPM & The Earth Institute (2011) cited in Iyengar et al. (2016)) was used because incorporation of its data was mandatory for all local authority grant applications.

Impact overview

Figure 6.14 Education MIS display example from Nigeria



For many e-education systems – at least those involved with direct e-learning – there is a faster and rather more direct potential connection between ICTs and

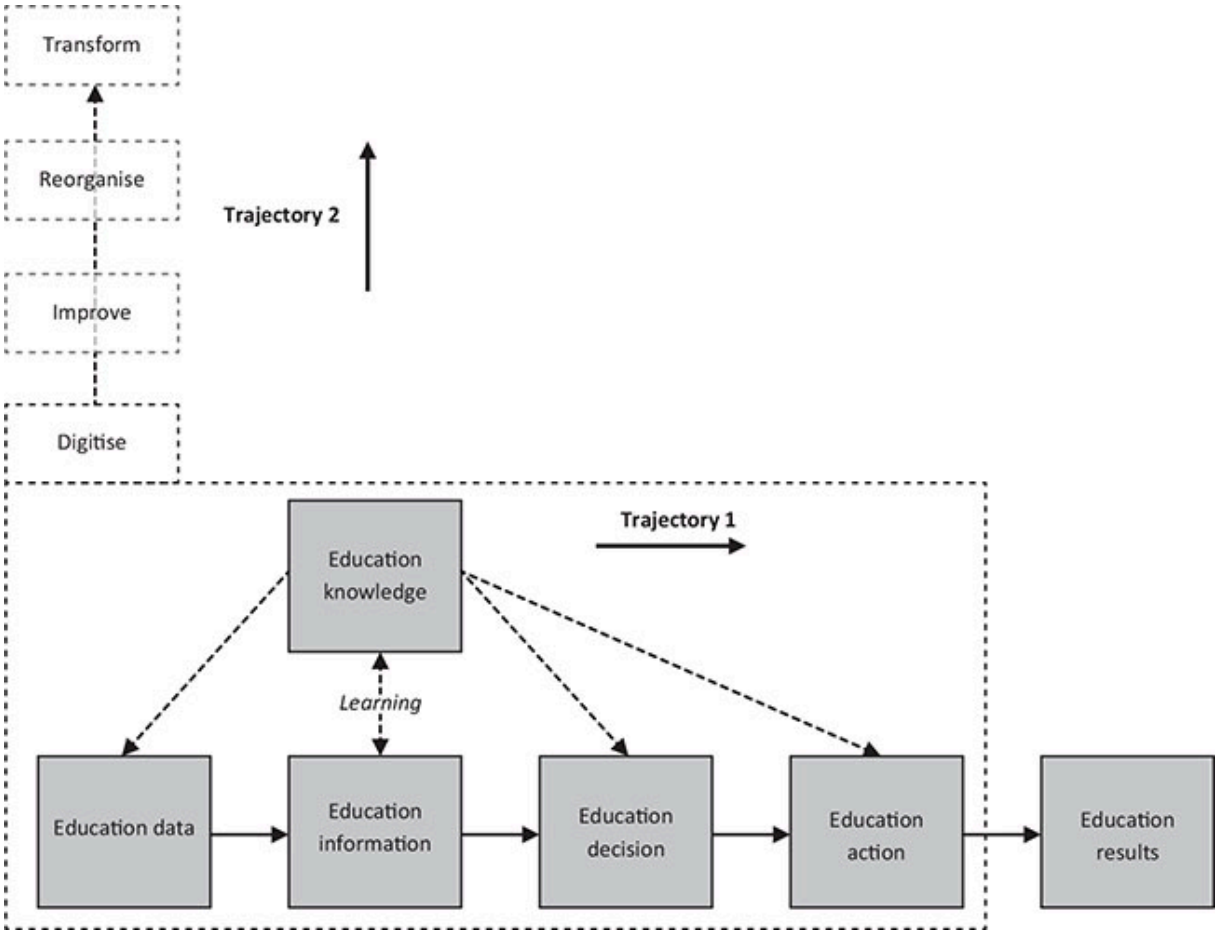
impact than we saw for e-health. Yet the picture is rather more downbeat: it would be difficult to conclude from the evidence above that ICTs have so far made a decisive contribution to learning in developing countries. The hope would be in the trajectories represented in the evidence: summarised in Figure 6.15, and directly echoing those for e-health.

The results on management and policy information systems suggest e-education is gradually working its way along the information value chain. Though, as yet, greater influence on action and results is only at an emergent stage. And the results from teaching and learning support systems suggest it takes more than just adding ICTs i.e. more than just digitisation as the first step on the DIRT ladder, in order to improve teaching and learning.

6.3.2. e-Education and development challenges

Not surprisingly, the challenges faced by e-education systems in developing countries have similarities to those seen for e-health systems, but with different emphases. Data quality surfaces less often as an issue but does exist for educational MIS (infoDev 2006) and, for e-learning, in the form of problems with low quality of teaching materials and content (Behar & Mishra 2015). The capacity and confidence of teachers is central to e-learning – indeed to most forms of learning; hence the stress above on the value of practitioner knowledge systems that strengthen and empower teachers.

Figure 6.15 Trajectories of e-education for development



Motivation is a recurrent theme, especially around e-learning. In part, this relates to the motivation of teachers to introduce and make effective use of ICTs in the classroom. That motivation may often be lacking: teachers frequently feel overworked and underpaid, and see no incentive to take on the additional load of e-learning; something which may threaten their power and teaching practices (Furuholt & Orvik 2006, Rashid et al. 2013). Even more central is the motivation of learners. There are some signs that well-designed active learning or the incorporation of group learning into digital systems can improve motivation. But teachers also seem to provide a quite deeply embedded motivational presence in the learning process. Hence, the finding from review studies that teacher-only and technology-only learning are less effective than blended teacher-plus-technology learning (ibid., Smith 2013).

Once again, we can interpret these challenges in design–reality gap terms: the design requirement for particular teaching skills to be present vs. the reality of their absence; the design assumption of learner motivation vs. the reality of its absence. And there are examples relating to other ITPOSMO dimensions:

- Participation in MOOCs was difficult or impossible for students in many parts of Liberia due to a design requirement for high-speed, reliable Internet connectivity mismatching a reality of slow and intermittent connectivity (Madaio et al. 2016).
- Slow progress with ICT usage in South African schools was partly due to a design assumption of top management support that was not met in reality (Blignaut et al. 2010).
- A programme for significant extension of use of ICTs in education in Pakistan stalled when design requirements for high levels of funding were met with a reality of little or no funding for various programme elements (Palvia et al. 2015).

As ever, addressing these challenges will require measures to close the gaps between design and reality. Of all the gaps, it is the one related to Chapter 3's "prime question" that matters most: the issue of motivation. e-Education systems must find or develop the motivation of the key user stakeholders – be they learners, teachers, educational decision-makers, etc – if the systems are to deliver development results. As an example, an SMS-based reporting scheme to monitor and encourage teacher attendance at schools in Uganda had no impact unless a financial incentive was provided: a monthly bonus for those who were present for all reporting points (Cilliers et al. 2014).

Those seeking greater impact from e-education systems also face the habitual design–reality gap theme of risk/reward when seeking to move up the DIRT ladder. Improving educational processes and reorganising educational systems may bring greater benefits, but it is more difficult to achieve: attempts to simultaneously change both technology and pedagogy often run into problems (Kullman & Lee 2012) and are frequently constrained by institutional and structural barriers to change (Olivera et al. 2015).

6.4. ICTs, capabilities and development

One of the difficulties for ICT4D projects seeking to address social development is that the ICTs involved can be used for purposes other than those intended. For example, midwives given access to mobile phones using them for personal calls (Chib 2010), and school students given access to the Internet using it for music downloads or computer gaming (Porter et al. 2016). Such uses are often seen as "non-developmental" by project staff and there may be attempts to ban or block such use (Sey et al. 2013). But an alternative perspective, based on Amartya Sen's capability theory, might see things differently.

6.4.1. Development as freedom

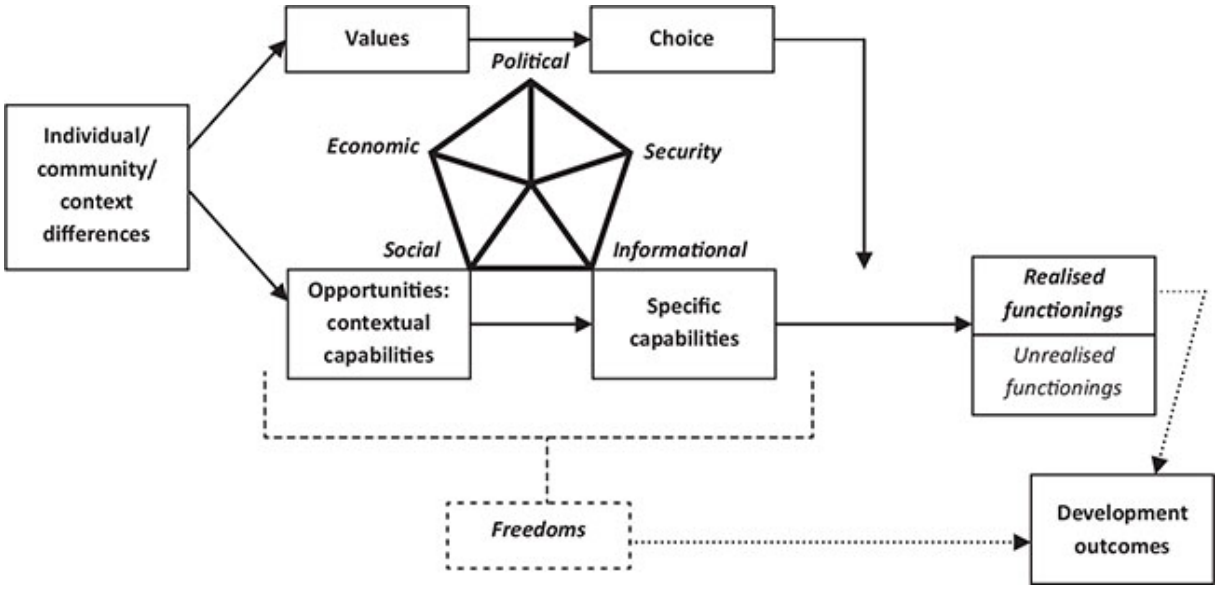
Sen's approach can look rather complex, but it has a simple basic idea of development: development means an increase in freedoms, both the freedoms of what you could do in theory, and the freedoms of what you actually do in practice. Figure 6.16 (adapted from Heeks & Molla 2009) presents a summary overview and what follows presents a simplified version of the framework.

The core idea of freedom is defined as "what the person is free to do and achieve in pursuit of whatever goals or values he or she regards as important" (Sen 1985:203). Freedoms are divided into five areas:

- Economic: for example, wealth is a freedom; employment is a freedom.
- Political: for example, democratic participation or freedom of speech.
- Social: such as literacy or computer literacy or knowledge.
- Informational: Sen calls this transparency but we can interpret this as the ability to access information.
- Security: freedom from crime and violence, misery, starvation and death.

Freedoms are understood as two related things: capabilities and functionings. In simple terms, "a functioning is an achievement, whereas a capability is the ability to achieve" (Sen 1987:36). Capabilities are freedoms that are "the alternative combinations of functionings that are feasible for a person to achieve" (Sen 1999:75), and which can be understood as specific to the individual and also as more general opportunities. From their set of capabilities, a person has a choice about what they seek to realise as functionings; with realised functionings being "what a person is actually able to do" (ibid.). Though generally associated with individuals, capabilities and functionings can also be associated with groups, such as the freedom to take collective action within a household, community, social group, etc.

Figure 6.16 The capabilities framework



Upstream from these are various differences: both the way in which individuals differ (in age, gender, health, etc) and the way in which the communities and contexts in which they live differ (for example, in terms of their institutions and structures). This includes differences in values: the differing preferences, norms, beliefs of an individual – which are shaped by the values of their community and wider context. And it includes differing opportunities: the capabilities the context

affords for various freedoms to be realised (in terms of access to government services, technology, finance, etc). In more detail:

- Economic facilities: “the opportunities that individuals respectively enjoy to utilize economic resources for the purpose of consumption, or production, or exchange” (ibid.:38).
- Political liberties: the civil rights to determine who governs, to hold them to account; “They include the political entitlements associated with democracies in the broadest sense” (ibid.:38).
- Social opportunities: “the arrangements that society makes for education, health care and so on, which influence the individual’s substantive freedom to live better” (ibid.:39).
- Transparency/informational guarantees: “the need for openness . . . the freedom to deal with one another under guarantees of disclosure and lucidity” (ibid.:39).
- Protective security: “a social safety net for preventing the affected population from being reduced to abject misery, and in some cases even starvation and death” (ibid.:40).

Development can therefore be understood as combining three things. On a broad scale, expansion of the contextual capabilities that provide a context of opportunities. And at a narrower scale, expansion of the specific capabilities an individual can select from, and expansion of the realised functionings they are able to do or be in practice. These differences create the basis to understand the pattern of incremental-not-transformational development, as Box 6.6 illustrates.

Box 6.6

ICTs, disability and capabilities

As noted in Chapter 2, disability is one of the social dimensions of the digital divide: if you are disabled you are less likely to have access to ICTs. However, if disabled citizens can get access to ICTs, they can experience a significant expansion in their freedoms in terms of both potential capabilities and realised functionings; giving a sense of levelling the playing field.

For example, access to mobile phones for blind entrepreneurs in Indonesia was developmental in increasing existing freedoms or providing new freedoms (Anwar & Johanson 2015). Valued capabilities they chose to realise as functionings included the ability to directly contact family members, the ability to form a network with other blind entrepreneurs, and the ability to overcome mobility challenges by arranging their own transport (for themselves, for emergencies or for deliveries). Mobile phones have therefore made these disabled entrepreneurs more independent, and more readily able to experience the freedoms that sighted entrepreneurs take for granted.

However, the mobile phones do not directly address wider opportunities/contextual capabilities, leaving a typical situation in which, for example, "access to educational institutions for people with disabilities is low, public spaces are inaccessible, and the workplace has little awareness of people with disabilities participating as productive employees" (Pal et al. 2015). So ICTs may level one or two playing fields for the disabled but they do not level the overall sport.

6.4.2. ICTs, capabilities and development

Though ICT- and information-related examples have been mentioned above, we need a way to link ICTs more directly to Sen's ideas. One approach – mentioned in Chapter 1 – is the Choice Framework (Kleine 2013), but here we draw on the idea of ICTs as commodities (Zheng & Walsham 2008) and summarise their relationship as shown in Figure 6.17 (adapted from ibid.; itself adapted from Robeyns (2005)).

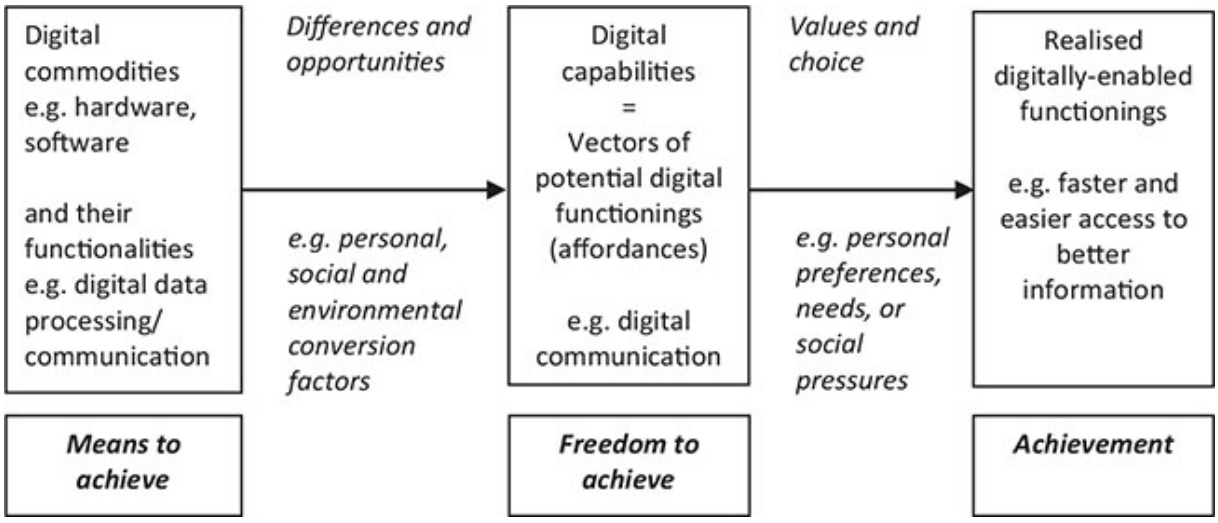
Commodities such as ICTs are a means to achieve functionings, and can best be understood in terms of the CIPSO functionalities identified in Chapter 1. Which

of these baseline functionalities of ICTs actually becomes a capability in any given context (an affordance in the language of Chapter 1: information, communication, computation, transaction, coordination, etc) depends on a set of conversion factors (ibid.):

- Personal factors: an individual's resource endowment. For instance, someone with high-level ICT skills will convert more ICT functionalities into capabilities than someone with few or no ICT skills.
- Social factors: the institutional and other structural conditions in a particular context. For instance, a woman in a situation of gender equality will convert more ICT functionalities into capabilities than a woman in a situation of strong constraints on women's freedoms.
- Environmental factors: including geography, human/technological infrastructure, and other public goods and resources. For instance, someone in a situation of reliable Internet connectivity will convert more ICT functionalities into capabilities than someone with poor connectivity.

Then, from among the digital capabilities – what an individual is able to achieve with ICTs – they will choose the particular digital functionings to achieve: better communication, journeys avoided, increased knowledge, etc. Choice is determined by a combination primarily of personal and social/institutional factors, though wider environmental elements may play a role. Some specific examples are given in Box 6.7. (We could add further complexity by recognising that ICTs are also a conversion factor: for example, helping turn other productive goods into capabilities; and an enabler of other conversion factors: for example, helping build non-ICT skills or helping change social norms and preferences.)

Figure 6.17 ICTs and the capabilities framework



Box 6.7

Converting ICTs into functionings

In a Cambodian village telecentre project, the presence of power and telecommunications infrastructure, the provision of local training and support, and an inclusive/non-discriminatory approach enabled a set of digital capabilities to be available for a large number of villagers (Grunfeld et al. 2011). These included valued capabilities of accessing news, of learning English, of learning good health practices, of learning new agricultural techniques, of communicating with family and friends. A key factor ensuring these capabilities were developed and then realised was the "motivation and enthusiasm" of villagers to learn and communicate.

In China, healthcare capabilities during the SARS epidemic were constrained for both health workers and patients (Zheng & Walsham 2008). Despite widespread means to achieve in the form of ICT infrastructure, limitations on broader informational and even political freedoms – censorship, freedom of speech limitations and inaccessibility of government data – constrained their conversion into informational and communicative affordances. The absence of these capabilities meant workers and patients were not able to be informed about the epidemic, nor able to check

diagnoses, share experiences and good practices, etc. Extrapolating from this, we can say that the impact of e-health and e-education projects may therefore be limited if the wider contextual capabilities listed above are not also addressed.

We can identify a number of ICT4D implications that connect with earlier chapters, beyond the idea above of some equivalence between capabilities and the affordances discussed in Chapter 1. The first is that digital capabilities can be encapsulated as digital roles, leading to the ladder of roles presented in Chapter 2. Second, and also looking back to an earlier model from Chapter 2, this helps reinforce the relevance of the information value chain. The capabilities framework moves us beyond just focusing on rolling out ICT infrastructure – which is just a means to achieve – and beyond just the ability to access and use ICTs – which is a freedom to achieve – to think what is actually achieved by using ICTs i.e. the decisions and actions and results of those actions. And it also recognises the enablers and barriers – skills and money; cultural norms and one's position in society; extent of infrastructure – that intervene between the technology and its effective use; and also the personal choices people make about how to use ICTs, thus linking in to ideas about motivation.

Third, and linking to Chapter 3, following the capabilities perspective demands a particular approach to ICT4D design. Development is no longer generic but should be brought down to the level of the individual and, repeating the phrase above, "whatever goals or values he or she regards as important". Discovering this requires a "radically participatory, bottom-up approach" to ICT4D design and implementation (Kleine et al. 2012:44); one that involves all beneficiaries (or a representative sample for larger projects); one that starts by discussing goals and values rather than jumping to focus on the technology; and one that retains involvement of beneficiaries throughout.

Staying with Chapter 3, a capabilities perspective on ICTs would also give a rather different view of impact and evaluation. Instead of asking "What is the impact of ICTs?" in some general sense, a capabilities-oriented evaluation would ask, "To what extent do ICTs help people achieve the things they value doing or being?" This returns us to our starting point of supposed "non-developmental" uses of ICTs. The midwives making personal phone calls and the school pupils downloading music or playing games are being helped by ICTs to achieve things

they value: “these usage patterns represent the choices people make about what is important to them and how they use technology to meet those needs” (Rangaswamy & Cutrell 2012:61). From a Senian viewpoint, then, these are developmental; they represent ICTs increasing freedoms: both substantive freedoms as ends in themselves, and also instrumental freedoms in helping develop competencies which are means applicable to other developmental uses.

However, this does not give carte blanche to claim that all and any uses of ICTs are developmental (Sen 2010; see also Box 6.8). One must look at value: does the individual value their use of ICTs, or is it more like a compulsion or addiction? One must look at the impact of realised digital functionings on other freedoms of the individual. Perhaps there are opportunity costs, for example: with the time spent on freedoms of entertainment, gaming, etc being time that cannot be spent achieving other functionings. And one must also consider “unfreedoms”: the way in which one person’s freedoms may constrain the freedoms of others. One person’s freedom to search for pornography is another person’s unfreedom to be exploited by the porn industry or to be shamed online for all to see. One person’s freedom to commit computer crime is another person’s unfreedom to be unable to do what they want online.

Box 6.8

FOSS and freedoms

Free and open source software (FOSS) would, at first sight, look like a Senian win. It should allow users freedoms “to run the program, for any purpose . . . to study how the program works, and change it . . . to redistribute copies . . . to distribute copies of your modified versions to others” (Rosenberger 2014:14). It thus enables an expansion of freedoms (both potential capabilities and actual functionings) that proprietary software does not.

In a visit to a FOSS producer in India, though, I discussed this with a group of our MSc students. What emerged is that capabilities of software modification and distribution are restricted to a few “hacker” types; most FOSS capabilities will not be valued by the majority of users and/or they

will lack the conversion factors to develop these freedoms. Software users also value freedom from software bugs, freedom to exchange data with a large group of other users, freedom to transfer skills to new working contexts, and relatively low skill barriers for conversion of means into capabilities. FOSS has been variable in the extent to which it delivers these (though improving over time). The capability advantage of FOSS over proprietary software may therefore be narrower than it at first appears.

However, there is one more issue to throw into the pot: the contextual power and constraints on freedoms that proprietary software corporations may impose (Franklin 2013). In this sense, use of proprietary software may be a variant of Sen's (1999:15) "Lee thesis" – named after Singapore President Lee Kuan Yew – under which individuals give up certain wider (such as social and political) freedoms in exchange for income-generating capabilities associated with economic freedom. (Something similar happens with social media: with individuals surrendering personal and political freedoms in exchange for social freedoms.)

Additional material

Discussion questions

6.1. How are social development and human development similar and different?

6.2.1. Which of the six types of e-health application is likely to have the most significant impact on health development?

6.2.2. What will best help ensure the health information value chain can be completed on an e-health project?

6.3.1. Which of the six types of e-education application is likely to have the most significant impact on educational development?

6.3.2. Come up with three ideas for identifying or creating user motivation in the context of e-education systems.

6.4.1. Which two freedoms do you most value, and why?

6.4.2. You are advising an e-health (or e-education) team to integrate the capabilities framework into their project. What will you advise?

Assignment question

What are the key benefits and challenges associated with applying ICTs to social development goals of health and education?

Further reading

If you would like to know more about . . .	6.1. social development as a development goal	. . . then take a look at . . .	6.1. Chapter 5 of Midgley, J. (2014) *Social Development*, Sage Publications, London >Discusses core issues around development of human capital in terms of health, education and nutrition
	6.2.1. e-health applications		6.2.1. Sinha, C. & Garro-Strauss, D. (2013) Research on e-health across health systems, in: *Connecting ICTs to Development*, L. Elder, H. Emdon, R. Fuchs & B. Petrazinni (eds), Anthem Press, London, 161–195 >A review of evidence and experience from IDRC's e-health projects Piette, J.D., Lun, K.C., Moura Jr, L.A., Fraser, H.S., Mechael, P.N., Powell, J. & Khoja, S.R. (2012) Impacts of e-health on the outcomes of care in low-and middle-income countries, *Bulletin of the World Health Organization*, 90(5), 365–372 >Rather brief but wide-ranging review of evidence
	6.2.2. e-health and development challenges		6.2.2. Braa, J., Monteiro, E. & Sahay, S. (2004) Networks of action: sustainable health information systems across developing countries, *MIS Quarterly*, 28(3), 337–362 >Provides some specific insights into sustainability of large-scale health management information systems, but included here more as one example of the huge literature of analysis and lessons that has derived from the HISP initiative

(continued)

	6.3.1. e-education applications		6.3.1. Rashid, A.T., Camara, A., Ng, M. & Richero, A. (2013) Making the grade, in: *Connecting ICTs to Development*, L. Elder, H. Emdon, R. Fuchs & B. Petrazinni (eds), Anthem Press, London, 197–213 >A review of evidence and experience from IDRC's e-education projects
	6.3.2. e-education and development challenges		6.3.2. Hawkins, R. (2002) Ten lessons for ICT and education in the developing world, in: *The Global Information Technology Report 2001–2002*, G.S. Kirkman, P.K. Cornelius, J.D. Sachs & K. Schwab (eds), Oxford University Press, Oxford, UK, 38–43 >Dated and representing the World Bank's perspective but the lessons are still relevant
	6.4.1. the capabilities framework		6.4.1. Sen, A. (1999) *Development as Freedom*, Oxford University Press, Oxford, UK >The classic text on the capabilities framework
	6.4.2. ICTs, capabilities and development		6.4.2. Zheng, Y. (2009) Different spaces for e-development: What can we learn from the capability approach?, *Information Technology for Development*, 15(2), 66–82 >Overview of applying the capabilities framework to ICT4D Kleine, D. (2013) *Technologies of Choice?*, MIT Press, Cambridge, MA >Detailed and field-based application and development of the capabilities framework to ICT4D

7 e-Governance and development

In reading this chapter, you will learn to:

- explain governance-related goals in development;
- define and illustrate public value;
- analyse the public value of, and challenges to, e-services in developing countries;
- utilise models to analyse the role of ICTs in e-accountability and e-democracy initiatives;
- analyse the role of motivation and power in e-governance initiatives.

With Chapters 4 and 5 having covered the relation between ICTs and economic development, and Chapter 6 discussing ICTs and social development (specifically the health and education components of human development), Chapter 7 turns to ICTs and political development. Specifically, it focuses on ways in which ICTs relate to three aspects of "good governance": better public services, improved accountability of the state and increased democracy.

7.1. Good governance as a development goal

> SDG 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

While there may be disagreements about the mechanisms by which they should be achieved, there is no disagreement that eradication of poverty and better health and education are worthy development goals, and there is little disagreement about what those goals mean. When we come to the issue of governance, though, matters are more complex – just look at the many different forms of governance in different countries across the world.

Governance can be defined as "the manner in which power is exercised in the management of a country's economic and social resources for development" (WB 1992:3) with that power particularly associated with the way in which socio-economic decisions are made and implemented. In almost all countries – except failed states – a significant set of the powers of governance are entrusted to government: a particular apparatus of the state that makes and implements a particular set of decisions, consisting of the legislature (that makes laws and policies), the executive (that implements those laws and policies) and the judiciary (which applies and interprets the laws). (States, in turn, being defined as entities possessing a government that exercises sovereignty (recognised authority) over a particular population and territory; typically a country (Biersteker 2013). Government is the changeable but concrete agent and sub-set of the more permanent but abstract notion of the state.)

Why does this matter for development? First, because governance and institutions have been shown to impact the ability of countries and citizens to achieve other socio-economic development goals: failed, fragile and ineffective states are all shown to hamper economic growth and improvements in human development indicators (Goodfellow 2014). Second, because most perspectives see political development (albeit defined in various ways from, for example, greater security to greater freedom) as one of the main development goals. So "good governance" is both a means to and an end of development (Kingsbury 2004).

While good governance is an abstract concept that all could agree on, the same is not true of its practical definition. This applies especially to the intended role of government: modernisation- and dependency-based approaches to development see government playing a dominant role in development; neo-liberal approaches see a much more limited role, with a greater role played by markets; human and sustainable development approaches vary but tend to be somewhere in between. It also applies to the role of democracy: there is much debate on whether or not

democracy is either a necessary component of or a requirement for development (Adelman 2007) and, tellingly, it is not mentioned explicitly in any of the SDGs or their associated targets. This matters for e-governance because only in knowing what the vision is for better governance – including the role of government – can one then know how best to apply ICTs.

What *is* mentioned in the SDGs is "effective, accountable and inclusive institutions" and this serves to identify three core components of governance (summarised in Figure 7.1):

- Effective governance: refers to the quality of public goods and services though may also be expanded to include the efficiency of production of these outputs. This is particularly associated with delivery of public services – which may be delivered by public, private or NGO sector actors – though policy can also be seen as an output (see example in Chapter 8).

- Accountable governance: refers to the ability of citizens to hold public institutions to account for the decisions and actions they have taken.

- Inclusive governance: refers to the ability of citizens to participate in the exercise of power, particularly in relation to public decisions and actions. Notwithstanding the uncertainty over its role in development, this is typically understood in terms of democracy.

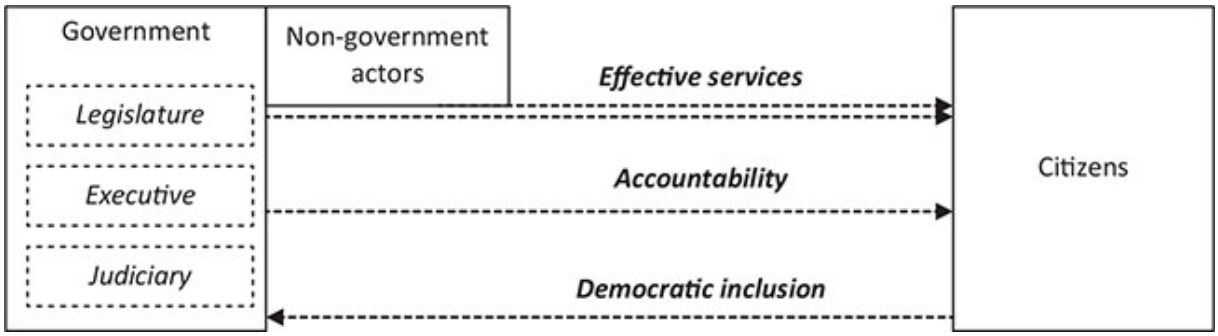
The role of ICTs in helping address all three components will be investigated in turn. First, though, we will consider a framework to understand different views on governance. (Note that the other aspect of the SDG – peace and its converse, conflict – was discussed briefly in Section 5.3.)

7.1.1. Introducing public value

A guiding framework for reform in the public sector since the 1980s has been "new public management" which, in its simplest formulation, sees that the public sector can be improved through the application of private sector management techniques. Yet the public sector differs from the private sector in fundamental

ways including objectives, accountabilities, competition, resourcing, etc (Heeks & Bhatnagar 2001). One result is that new public management has been criticised as an inappropriate basis for public sector reform, sparking the search for an alternative paradigm.

Figure 7.1 Generic good governance agenda



One such alternative, emerging in the 1990s but gaining more of a foothold in the 2000s, is the "public value" paradigm. Public value is the public sector equivalent of the value that private companies create for their shareholders: the return on investment that citizens get as a result of their financial and political support for the state. In simple terms, "public value is what the public values" (Talbot 2011:28): the "collectively expressed, politically mediated preferences . . . of the citizenry" (O'Flynn 2007:358). If public value is determined by citizens, it is created by the decisions and actions of government and it can therefore be a guiding principle that shapes those decisions and actions, including those around use of ICTs in public service delivery.

One apparent challenge of using public value as a guide for e-governance is its determination by citizens. What citizens decide is public value in one country may be different from what they decide is public value in another country. So this is not a one-size-fits-all approach. Planning an e-governance project under a public value paradigm means adopting a particular process rather than pre-set goals (Stoker 2006). Echoing some of the guidelines from Chapter 3, it means initial consultations to understand what public value means in the particular context, and adopting "an adaptable and learning-based approach" to implementation (ibid.:49).

7.2. e-Services and development

At root, the definition of public services is a political one since they are defined as those services to be provided by government rather than by the private sector (Newman & Clarke 2009). Typically, these political judgements may tend towards the moral e.g. that universal access to the service is a fundamental right that the market will not deliver, or towards the financial e.g. that there are efficiencies or economic externalities/benefits in public control of services that will not be delivered by the private sector. These judgements may be shaped by the public value attributed to public services in a particular context.

At different times and in different countries, these political judgements have varied and so the definition of public services has varied with a moveable boundary between different models (Flynn 2000). At one end of the continuum, the public sector itself delivers public services. In the middle, it finances public services but with non-public providers. At the other end, it merely regulates private provision (though arguably this would now fall outside the remit of "public services"). Typical potential components of public services include law and justice, defence, fire and emergency health, water and sanitation, power and telecommunications, housing and social services, public transport, health and education, plus more regulatory, compliance-based services such as taxation and licencing.

Because issues of cost and efficiency are constants in the provision of such services, and because they present a key interface between government and citizens, there are ongoing pressures to improve the provision of public services. Use of ICTs is seen as a key solution to such pressures in developing countries (Ciborra 2005). Below we investigate the impact of introducing ICTs into public services, and also challenges to successful introduction.

7.2.1. The impact of e-services in developing countries

A public value approach means that goals and evaluation indicators will be situation-specific. For instance, in Sri Lanka, a public value assessment of e-services used three service criteria (information quality, service quality, user-

orientation) and four organisational criteria (efficiency, openness, citizen-responsiveness and environmental sustainability) (Karunasena & Deng 2012).

From this and other examples (Heeks 2008a, Cordella & Bonina 2012), we can see that a public value perspective on public e-services incorporates elements one would expect from a private sector/new public management perspective such as cost, efficiency and service quality. But it will also include other measures unique to public value such as inclusivity, fairness, empowerment and trust, and other citizen perceptions of government.

Some of these public value-specific criteria – transparency, accountability and participation – will be taken up in the following sections of this chapter. Here we will assess the impact of e-services in relation to three other public value criteria: cost (including income), service quality and image. Although these have private value interpretations, in each case we will incorporate a public value-specific perspective. Our starting point will be an e-services case study from Bhutan, summarised in Box 7.1.

Box 7.1

Impact of e-services implementation in Bhutan

The government of Bhutan – a small kingdom in the Himalayas to the North of India – introduced ICTs into the public service of registering vehicles and applying for driving licences. A rolling evaluation was undertaken from the time of first implementation up to two years after full roll-out; a sufficient period to allow the full impacts of this e-services application to become apparent. The evaluation accorded with the precepts of public value, and is summarised in Table 7.1.

Table 7.1 Summary of e-services impacts

	Indicators	*Summary of survey results*	*Impa*
Efficiency			
Internal	Internal cost per service delivery	• Cost-cutting could not be achieved, with internal costs increasing by an average 41% • High indirect costs offset about 22% of the savings in direct costs	Nega
	Staff allocation of working time	• Overall reduction of administrative workload has been observed • Small ROs [regional government offices] could reallocate staff to more important tasks • Time saved by administrative burden was not fully leveraged in the head office	Fairly posit
External	Lead time per service type	• Improvements were observed in almost all services to varying degrees • A drastic impact was found in licencing services, with up to three months cut in lead time in the most-remote ROs • Modest impact was gained in registration-related services	Posit
	Customer's time taken in office	• Actual change in time taken by applicants could not be traced accurately • Impression of customers in efficiency of licencing and registration services had significantly improved, according to customer survey	Fairly posit
Governance			
Internal	Sense of internal control by management	• Reports from the management of RSTA [Road Safety and Transport Authority; responsible overall for service] demonstrate an increased sense of internal control • Weaknesses of the paper-based system, such as lost or illegible records, and abuse of the system by some customers were removed • However, a new type of misconduct occurred using the new information system	Both posit and nega
External	Sense of fairness/rule of law felt by customers	• Notable increase in the positive impression among customers about the awareness of rules and regulations among RSTA staff	Posit

Source: Adapted from Miyata (2011) © Commonwealth Secretariat, reprinted by permission of Taylor & Francis Ltd, www.tandfonline.com on behalf of Commonwealth Secretariat.

Cost: the Bhutan e-services project was selected as a case example because it is one of very few that handles costs properly, with three notable features:

> Process level: this study adopts an activity-based costing approach. This shows that the direct cost of issuing a driving licence fell from US$1.57 to US$1.17. This is an almost universal finding: per-process costs of public services fall with digitisation (Bhatia et al. 2009).
>
> Organisational level: alongside the process costs, this study includes the ICT costs and seeks to use a total cost of ownership approach to these – including not just technology but also ICT staff costs, and including not just set-up but also annual operational costs. Adding these to the activity costs, annual costs of the vehicle service actually increased: US$15,800 per year before e-services; US$22,610 after e-services. Few studies properly account for equipment and human costs of e-services, but there are signs this finding is not uncommon: that overall organisational costs do not fall as a result of digitising public services (Weerakkody et al. 2015). One reason is:
>
> [t]he need for government e-services to be run in parallel with existing face-to-face, phone and postal service channels in order to bridge the digital divide and avoid excluding large sections of the population from access to government services; public e-services thus being a supplement to, not substitute for, other channels.
>
> (Heeks 2011)
>
> Another reason was noted in Chapter 4: that the "equation" of cost saving through automation comes from North America and relies on saving money through cheap ICT replacing expensive human labour. But that equation is reversed in most developing countries: ICT is somewhat more expensive, and human labour is considerably cheaper.
>
>
>
> Societal level: this study includes an external, societal perspective on cost that considers savings for service users; something a private value perspective would be unlikely to include. Service user savings derive from three sources:

a) Lead time reductions: in the Bhutan case, "the lead time from application to receipt was reduced by minutes, weeks, even months for outlying offices" (ibid.). This is commonly found: for example, lead times for issuing birth certificates in Morocco dropped from 48 to 6 hours after introduction of e-services (Fischer et al. 2013); and lead time for preparing and paying taxes in Costa Rica dropped from 402 hours to 163 hours (WB 2016).

b) Wait time reductions: e-services often reduce the specific time spent waiting in an office for service – 40 minutes on average was saved by citizens across a group of Indian e-services projects (Bhatia et al. 2009); waiting times in a South African e-services project were reduced by more than half, saving an average of one and a quarter hours (Munyoka & Manzira 2013).

c) Journey reductions: in the Indian survey, an average of roughly one journey to a government office was saved per full service transaction (Bhatia et al. 2009); in the South African case, two journeys were saved on average (Munyoka & Manzira 2013).

As seen in earlier chapters, journey savings bring important financial benefits to citizens, and one might also see cost savings in the time that citizens save. In some cases, there may also be direct financial savings, for example from avoiding paying for documentation – 450,000 students per year apply for public university enrolment in Egypt and had to pay US$5 each for the paper form and documents; free provision of digital documents when e-application was introduced thus led to an overall saving of more than US$2m (Hassan et al. 2010). These gains come partly from changing the technology of public services through digitisation, and partly from changing public service processes through simultaneous improvement.

Technology and process change also underpin another key cost impact of e-services: removal of corruption. The Bhutan case digitised some processes but did not change them: there were some reports of improved internal control over corruption but no hard evidence. Limited impact on corruption following service digitisation is a replicated finding (Bhatnagar & Singh 2010). But processes can be changed within e-services projects; improved or reorganised, for example to disintermediate: removing human service gatekeepers from the process, allowing users direct and unmediated access to digital public services. Where this happens,

impacts can be more dramatic: digital process improvements were undertaken in the Bhoomi e-services project in India, "while about 30% of users were paying bribes in the manual system, less than 1% are continuing with the practice in the computerized system" (ibid.:119). Process changes in South Africa similarly led to an average drop of 58 per cent in the proportion of users reporting paying bribes for service delivery (Munyoka & Manzira 2013).

In all, the evidence base is poor but it looks a reasonable conclusion to say that e-services are not – as yet – saving money within developing country governments; but that their external impact can deliver financial public value through cost savings to users such as citizens and businesses.

Income: the public sector is not typically associated with income generation, but there are at least three ways that ICTs may help make money for government. Rarely, governments might charge for use of ICT channels in order to defray the additional costs. More often, ICTs might help increase uptake of paid-for public services, and thus increase income that way. For example, automation of internal and external processes for payment of water bills in Bangalore, India was associated with growth in annual revenue for the Bangalore Water Supply and Sewerage Board from US$27m to US$68m (NIC 2012).

Additionally, ICTs can be applied to collection of taxes and duties; something generally associated with a significant improvement in revenue generation for government. For example, computerisation of Ghana's customs system was associated with a 50 per cent increase in revenue collection (Schuppan 2009) while a direct before-and-after study on the Philippines local government e-taxation system showed an average 71 per cent increase in revenue collection (Canares 2016). Not only do these increased resources help improve the capacity of governments in developing countries, they also improve governance more generally: "state-building in developing countries is significantly undermined because governments don't rely very much – if at all – on their citizens for taxes; as a result, governments find it easy to ignore citizens when making policy" (Heeks 2009d). By increasing the financial reliance of government on citizens, e-taxation systems strengthen the link between government and citizen. As Box 7.2 notes, this is also true, though in different ways, for e-ID schemes.

Box 7.2

e-ID schemes

A major problem for conventional public services is that individuals – in various roles as citizen, complier or customer – register separately with each service, and that many individuals in developing countries lack a clear means of identification. This makes public service delivery inefficient and potentially ineffective (Harbitz & Axt 2011). The solution has been some form of ICT-enabled national identity or registration scheme – an "e-ID scheme" – typically consisting of a unique ID number for each citizen, a shared database of those numbers and an identifier such as an ID card or smart card (Ibrahim & Abubakar 2016).

The demonstrated benefits of such schemes are efficiency and effectiveness that reverses the initial problem. As an example, in Middle Eastern states, e-ID schemes have allowed e-services to move up the DIRT levels from digitisation to reorganisation (see Section 4.2), creating "one-stop government" or "whole of government" interfaces for citizens which provide a single point of access to the range of interoperable public services and which eliminate any need for human intermediation in delivery of many public services (Al-Khouri 2013). The citizen may also gain a legal identity that brings with it certain citizenship rights (Whitley et al. 2014).

The price of this, though, is a quite significant shift in power from citizens to the state. In terms of resource power, the state can now see all interactions a citizen has with government including related information such as citizen location, and can collate a single view of the citizen where previously that view would have been fragmented into separate travel, health, educational, criminal, economic, etc profiles. In terms of practice power, the state might also be able to remotely control access to services. e-ID schemes have therefore become a battleground between scheme vs. civil liberties proponents. An example case is India's massive unique ID – "Aadhaar" – project which has managed to maintain its momentum despite wide-ranging technical, social and political criticisms (Sathe 2014, Menon-Sen 2015). Its survival is largely due to constant attempts to legitimise itself to key

stakeholders; for example, by portraying itself principally as a tool for poverty reduction and financial inclusion (Srinivasan & Johri 2013).

Service quality: savings in time and costs for users of e-services are consistent with private value, and can lead users to feel the quality of service has improved, as was the case in Bhutan. In India, this was also the case, with ratings of service quality increasing by an average of 17 per cent after introduction of e-services: time and cost (including bribe payment) reductions contributed to this but so did a reduction in error rates in services from 6 per cent to 3 per cent on average (Bhatnagar & Singh 2010). As with cost, greater change along the DIRT stages may be associated with greater changes in service quality perceptions: the one Indian e-services project that made no process or structural changes saw service quality ratings decline.

In the main, then, private value dominates perceptions of e-service quality, and other developing country studies similarly report judgements of service quality to be primarily driven by time, cost and accuracy considerations (Fischer et al. 2013, Munyoka & Manzira 2013). However, separate public value criteria do play some role. Driven partly by their own experiences and partly by moral or political views on the role of public services, citizens particularly value transparency (that the service delivery process should be open), consistency (that service delivery should be the same each time it is experienced and wherever it is experienced), and fairness (that service delivery should be the same for all citizens) (Karunasena et al. 2011). ICTs tend to improve all three aspects – digitised processes do not vary from one delivery to the next, and are readily tracked online by both citizens and internal managers – and so e-services also contribute to improvements in perceived service quality in this way.

Image of government: level of trust is an input variable that affects citizen decisions to adopt and use e-services (see Box 7.3 below). But trust in government can also be an output variable affected by use of e-services. Where that trust is low, any shortcomings in e-services might only reinforce the poor image of government as, for example, in South Africa's vehicle registration and licencing system: an ongoing partial failure that has served to increase distrust of government (Rajapakse et al. 2012). By contrast, in Bhutan, the e-services application seems to have improved the image of government (Miyata 2011) and this is the more typical outcome, with well-designed e-services improving how

citizens view government including their trust in government (Madon 2008, Garcia-Murillo 2013, Weerakkody et al. 2015).

e-Services initiatives in a number of developing countries have extended to the DIRT level of reorganisation by incorporating new intermediaries into the service delivery chain through the use of local telecentres or common services centres – sometimes run by the private sector – to replace the traditional government office, with the centre operators using the e-services applications on behalf of citizens rather than those citizens themselves going online. In such situations, issues of image and trust are becoming more complex – citizens start to take a differentiated view of the different actors involved, for example the "front office" service intermediary and the "back office" of underlying government processes (Rajalekshmi 2007). But there is still intermingling of the two: trust in the new centres derives in part from trust in government, and the image of government may be improved or damaged by impressions of the new intermediary. In these cases, a new type of "hybrid state" is emerging; an ICT-enabled model of service delivery that is part-public, part-private (Kuriyan & Ray 2009). It "attempts to combine the accountability of an elected government with the efficiency and customer service associated with the private sector" and in so doing changes not only the citizens' image of government but also government's own perception of itself (ibid.:1670).

Public value: reflecting on the findings above, we can see that the impact of e-services in developing countries moves beyond the narrow confines of private value to the wider scope of public value. But, as yet, this too rarely seems deliberate – too often, e-services design is driven by a private value perspective borrowed from e-business rather than a public value-specific approach (Karkin & Janssen 2014). But government is not the same as business, and e-government is not the same as e-business. Allowing public value to be a guiding principle for e-services design would reflect these differences.

7.2.2. Challenges of developing country e-services

The preceding text has given a positive view about the impact of e-services in developing countries, but this needs to be tempered. Usage levels of e-services are relatively low in developing countries: for example, only accessed by 4 per

cent of citizens in Sudan and 2 per cent in Egypt. DIRT progress is quite limited with online transactional services being a rarity, and progress in other ways too has been limited: less than one-third of countries worldwide offer m-government applications with the majority of these being in the global North, despite mobile being a prime way through which citizens in the global South want to contact government (Abdallah & Fan 2012, UNDESA 2016, WB 2016).

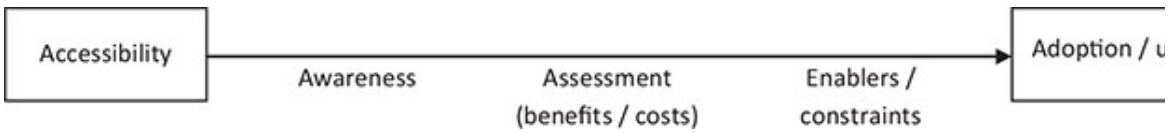
The model in Box 7.3 helps explain low usage rates, and these feed a negative interaction between supply and demand: low adoption levels demonstrate low demand, low demand means few pressures on government to improve supply of e-services, and low supply in turn weakens adoption rates. This cycle can be broken but only if Rogers' Diffusion of Innovations criteria (see Chapter 3) can be met – a clear advantage for citizens over existing public services, low design–reality gaps, simplicity and the ability to observe the benefits that users get from e-services.

Box 7.3

e-Services adoption in developing countries

There is a significant body of research on adoption of e-government services in developing countries – it's a popular PhD topic for unadventurous students. We can summarise findings from Asia, Africa and the Middle East outlined in the sources listed below via the model shown in Figure 7.2 (a variation on the value chain digital divide model in Section 2.6.2).

Figure 7.2 Model of e-services adoption in developing countries



Looking at each item in turn:

- Accessibility: the foundations listed in Chapter 2 must be in place to ensure e-services are potentially accessible, including electrical and ICT infrastructure and a sufficient base of digital literacy.

- Awareness: rather obvious, but citizens must be aware of particular government services and aware they are available online. Often they are not and substantial promotional campaigns are required.

- Assessment: citizens perform an internal cost-benefit analysis in deciding whether to adopt e-services and will only do so if that balance looks more favourable than their current method of service access. So e-services must not only be easy to access and use and deliver some of the benefits identified earlier, but they must also be perceived to be easier and more beneficial by potential users: the Unified Theory of Acceptance and Use of Technology sums these up as effort expectancy and performance expectancy.

- Enablers / constraints: the commonly-identified enabler is compatibility of the e-service with citizen values and experiences; the commonly identified constraint is lack of trust in e-services, particularly concerns about security and privacy breaches. These can be used to guide good design of e-services applications and interfaces.

Source: Rokhman (2011), Al-Hujran (2012), Rehman et al. (2012), Alawneh et al. (2013), Okunola & Rowley (2013), Ray (2013), Tan et al. (2013), Abdel-Fattah (2014), Nasri (2014), Chopra & Rajan (2016), Sigwejo & Pather (2016)

Of these – linking back to Chapter 3's "prime question" – it is relative advantage that matters most (Rokhman 2011), indicating the importance of motivations and incentives in driving e-services adoption. This applies to the demand side: citizen motivations to use e-services matter. These may be lacking, particularly where there are various accessibility, awareness and other constraints to be overcome. Hence, governments may need to provide additional e-services incentives: carrots such as lower fees for passports or licences obtained electronically, and later deadlines or earlier refunds for e-tax usage; or sticks such as compulsory use of e-channels for some groups (Chan et al. 2008, Ojha et al. 2009).

And it also applies to the supply side: public sector motivations to develop and implement e-services matter. There is surprisingly little evidence of such motivations existing, at least formally. Public officials may sometimes perceive

personal benefits from e-services and other e-governance projects, and there are institutional isomorphic motivations – the "me too" syndrome – that cause one public agency to copy the ICT solutions from other agencies (Heeks & Davies 2001). However, in the absence of drivers from citizen demand and government supply, the drive for e-services may be external, for example from international donors or the perceived needs of international investors (Furuholt & Matotay 2013). But this "ventriloquised" push for e-services will be weaker than a drive from inside the country, particularly from inside government itself.

The presence of motivation to develop and use e-services applications is a design requirement for such applications, so its absence in reality represents a design–reality gap. Problems with motivation can therefore be placed within a wider framework of design–reality gap analysis. There are many examples of such analysis helping to explain challenges of e-services and other e-governance applications (Heeks 2003, Islam & Gronlund 2007, Lessa et al. 2015). As Box 7.4 explains, the idea of gaps can also be linked to other dualistic framings of e-services.

Box 7.4

Dualistic analysis of challenged e-services projects

The idea of there being a gap between design and reality can be reframed in various different ways, to offer a slightly different analytical angle. One reframing – already noted in Chapter 6 – is the use of institutional logics. Echoing the case in Chapter 6, this often sees a clash between a rational, "objective" logic of the designers vs. a political logic of those within government charged with using or implementing the system. An example comes from an e-procurement system in the Indonesian city of Yogyakarta which sought to introduce an open logic of efficient and transparent procurement, clashing with the closed logic of existing – often corrupt – procurement processes (Wahid & Sein 2013). The system faced an uphill struggle to become institutionalised but was able to overcome this because the city mayor – as an "institutional entrepreneur" – both adopted and championed open logic.

An institutional logics approach tends to focus on the content (symbols and practices) of the incoming design and the existing reality. An alternative is to look at the network of actors that support the design logic vs. those who support the previous reality logic. One approach here has been the use of actor-network theory, which can be used to map the formation, mobilisation and domination or disintegration of networks of actors (human and non-human, including the ICT itself); one network associated with the incoming design, one network associated with the previous reality.

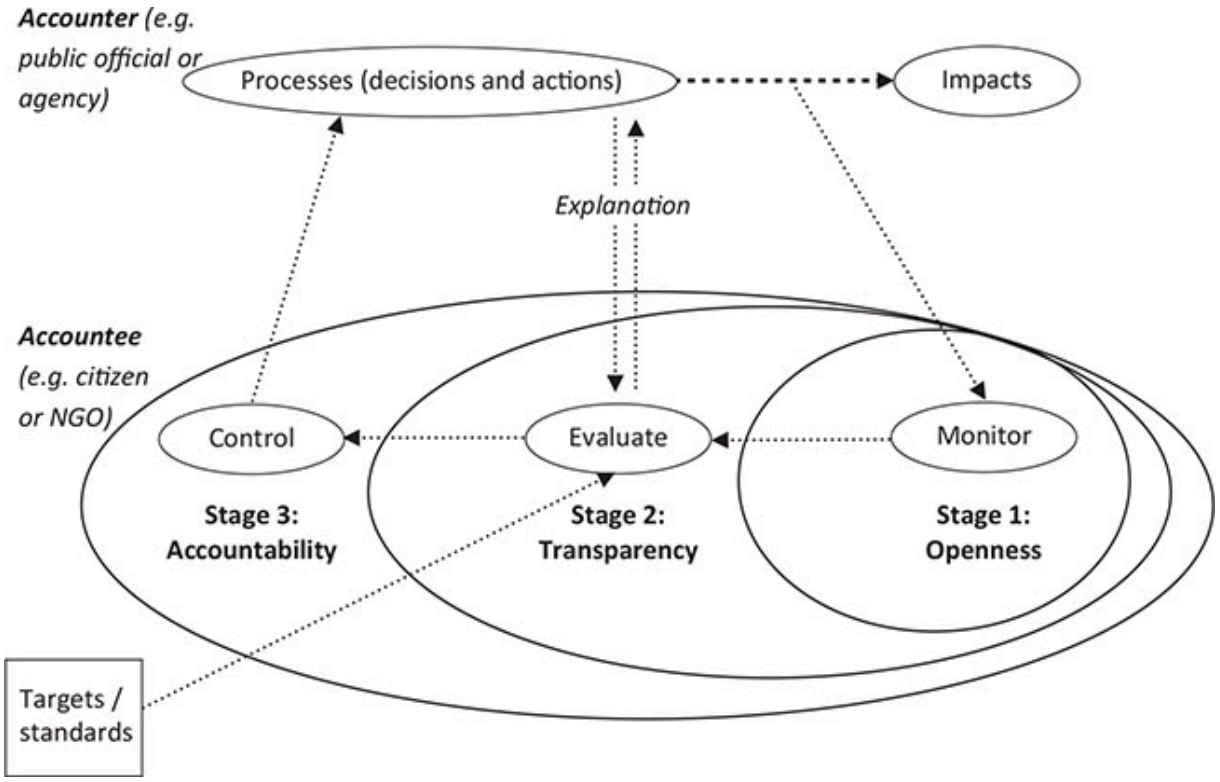
An example comes from an attempted digital improvement of expenditure management within various arms of the Sri Lankan government (Heeks & Stanforth 2015). A network of international consultants and donors formed to try to impose a cutting-edge e-government design, but found itself opposed by a counter-network of government officers, the existing digital systems and senior public officials. The latter favoured a more incremental solution i.e. a smaller gap between design and reality, and this was delivered, ultimately enrolling all actors into a network supporting this new approach.

7.3. e-Accountability and development

We can find macro-level evidence that ICTs have a role to play in this expression of public value: “Each additional increment of about 150 Internet users per 1000 people in a country was associated with a 34.7% decrease in government corruption, with this association being mediated by an increase in voice and accountability” (Kock & Gaskins 2014:35). But to understand the role of ICTs in accountability more fully, we need a micro-level information-related model of accountability. One such is shown in Figure 7.3 (developed from Heeks 2000).

At the top, is the accounter – the person or body to be held to account; for example, a public official or organisation. They take decisions and actions which have impacts, and they are the source of information about this behaviour. At the bottom, is the accountee – the person or body holding the accounter to account; for example, a citizen group. Information flows between the two and we can understand what can happen as three stages:

Figure 7.3 An informational model of the accountability cycle



- Stage 1: Openness – information is received by the accountee about the specific decisions and actions and impacts of the accounter, who should be an identified individual or group.
- Stage 2: Transparency – the information from the accounter is contextualised through comparison with pre-defined benchmarks and/or through interactive explanation to the accountee.
- Stage 3: Accountability – the accountee can impose some mechanism of control over the accounter; this could be a reward for meeting or exceeding a benchmark, or a punishment for falling short of a benchmark.

The three terms – openness, transparency, accountability – are often used interchangeably, but here we have a better sense of their difference and

relationship, with earlier stages being both a precursor and sub-set of later stages. In some ways, this mirrors a typical information value chain – Stage 1 being delivery of information; Stage 2 being decision-making; Stage 3 being action. Figure 7.3 also represents a theory of change: that changing the behaviour of the accounter will only occur if the accountee can monitor *and* evaluate *and* control. So real impact will only occur where all three stages are built into e-accountability projects. Box 7.5 gives an example where this has happened, but there are also plenty of examples where it did not. Open government data projects can suffer from this: in Chile, for instance, there has been strong implementation of Stage 1 with a substantial number of datasets about government activity made available online (Gonzalez-Zapata & Heeks 2015). But there is little evidence yet that this is having an impact on transparency and accountability. This may be typical of early-stage open government data projects, but it might also be because – there's a clue in the name – their worldview is openness and not the later stages of the model.

Box 7.5

Control mechanisms in an e-accountability project

CGNet Swara was set up in central India in 2010, allowing citizens to phone in and record complaints about shortcomings in government actions and impacts. Redress for these complaints – which typically cover issues of poor delivery of healthcare, education, water/sanitation, power, pension/wage payments, food distribution, etc – is then sought (CS 2017). There are hundreds of examples of successful redress – for example an outbreak of cholera in a village that was going untreated but which, after report via CGNet Swara, led to the visit of a medical team which stemmed the outbreak (Marathe et al. 2015). Most examples are less immediate but still, on average, problems had been unresolved for 2 years prior to report, and took just 19 days to resolve after report with, on average, 61 people benefiting from each complaint resolution (Marathe et al. 2016).

To understand this difference, we can refer to Figure 7.3. For a complaint to arise, it must already have passed Stages 1 and 2: the citizen has become

aware of the issue and evaluated it to determine it is a problem. The reason complaints are not resolved without CGNet Swara and are resolved with it comes down to control. Ordinarily, citizens have little power vis-à-vis government and have no effective mechanism to exercise control and force a change in behaviour. CGNet Swara describes itself as a "voice-based portal", but its ability to exercise control over government is more structural than technological. CGNet Swara is a central team of activist-journalists who moderate, check, edit and publish the complaints online. There is then a follow-up team and a set of "field champions" who work to get the complaint resolved by talking with government, interacting with local media, and mobilising citizens via petitions and other feedback mechanisms in order to put pressure on government to take action (Marathe et al. 2015).

ICTs are an essential mechanism to the success of this accountability initiative – reporting, checking, publicising, mobilising – but the key factor is the increased control over government through the "collective voice" that the core team and its network of champions and citizens create. In terms of the Figure 2.27 power model developed in Section 2.6.2, CGNet Swara has thus given citizens access to new accountability resources, practices and structural relations which, in turn, have made them more motivated to report problems.

7.3.1. Challenges of developing country e-accountability

We noted above that the accountability model in some ways incorporates the information value chain. Information value chain barriers can therefore also undermine e-accountability initiatives. From 2010, there was a series of citizen e-accountability initiatives in East Africa such as:

- Maji Matone, which allowed citizens in Tanzania to report problems with rural water supply via mobile phone, to amplify these reports via local media, and to pass them on to the government's District Water Engineers to fix the problems (Daraja 2013).

- Uwezo, which – via posters, radio and mobile text messages – provided parents in Kenya with both generic information about education and specific

information about their child's educational performance (Lieberman et al. 2014).

- Sema, which was very similar to Maji Matone and allowed citizens in Tanzania to report water supply problems via mobile phone text message (Wesselink et al. 2015).

In general, these initiatives have not demonstrated significant accountability impacts: Maji Matone only received 53 messages; there were no demonstrable differences in behaviour between Uwezo treatment and control group locations; and the Sema project concluded "public crowdsourcing in the context of empowerment and accountability regarding public services is not a viable approach in Tanzania at the present time" (ibid.:72).

A number of these citizen e-accountability projects and others in East Africa (Sika et al. 2015) were pilots or at an early stage: we have warned elsewhere in this book that these may face particular problems that are less debilitating for later projects. However, they clearly demonstrate information value chain barriers. Some of these relate to human and technical infrastructure: low levels of literacy among citizens, and limitations in coverage and reliability of power and telecommunication networks. But a core issue has been motivation and incentives – taking us back once again to Chapter 3's "prime question".

For the accountability cycle shown in Figure 7.3 to work, three motivations must be in place:

a) The accounter must be motivated to provide necessary data to the accountee. For citizen complaint systems, the data is usually already in the public domain, so this is not an issue. But there are repeated examples of public servants and public agencies resisting open provision of data about their actions (Bertot et al. 2010).

b) The accountee must be motivated to monitor, evaluate and control. All three East African initiatives identified above fell down on this issue. Citizens had un-motivations; for example, a majority felt current provision from government was adequate, or that it was someone else's responsibility

to hold public services accountable, or that raising specific concerns was pointless because they would not lead to any actions. And there could be de-motivations – over half thought complaining about a public service would lead them to be punished in some way (Lieberman et al. 2014). This can feed a generalised sense of powerlessness such as that some citizens feel in the face of government, as summed up by one respondent: "What do we expect from our government? It is like the rain: if it does not rain we try to survive, when it rains we are grateful" (Daraja 2012). In other words, just as no one would try to change the weather, they would not try to change the actions of government.

c) The accounter must be motivated to alter their behaviour on the basis of any controls directed at them. It's like the old joke: "How many psychiatrists does it take to change a light bulb? One, but the light bulb must really want to change". Sometimes, public servants do "really want to change": the water engineers in the Maji Matone case were happy to receive details of broken pumps since they had no means of identifying where equipment needed fixing other than random visits that generally wasted their time (Daraja 2013). But equally, we must acknowledge those in the public sector in developing countries who do not "really want to change". There are plenty of examples where the status quo suits public servants – because they are very busy, or corrupt, or more generally rely on informal, personalised networks and practices – and they are therefore not motivated to support the changes that e-accountability systems would engender (Fischer et al. 2013, Dasuki & Abbott 2015).

Successful e-accountability initiatives therefore ensure that the whole information value chain / the whole accountability cycle can run:

a) Examples of attending to accounter motivation include use of formal laws, regulations and decrees; requirements to sign pro-accountability contracts or agreements; public displays of senior official support; and pressure from citizen groups (Wahid & Sein 2013). But "anti-motivation" may also need to be attended to, such as inadequate salary levels for public officials which encourage corrupt behaviour (Dasuki & Abbott 2015).

b) Examples of attending to accountee motivation include automated data collection such as installation of sensors onto water pumps to report which ones are broken (Nel et al. 2014), use of anonymous reporting so citizens cannot be punished, and building a positive feedback loop so that examples of accountability actions having an impact are widely reported (Daraja 2013, Marathe et al. 2015).

c) Examples of building control into designs include creating collective structures of control like CGNet Swara; using ICTs to strengthen the work of existing organisations with powers of control such as local branches of Transparency International or the Human Rights Commission (Sika et al. 2015); and introducing choice as a control mechanism. Choice can sometimes exist for public services – such as offering citizens performance information about urban hospitals, allowing them to choose which hospital to attend, and thereby hopefully driving up performance – but often means bringing private providers into the equation, for example bringing private mechanics into the picture to fix broken water supply systems (McGee & Carlitz 2013).

But this will be challenging to achieve. One of the recommendations in complex situations is to start with a small, incremental change that is less risky. So – from the DIRT ladder – just try simple digitisation. Yet, that is what many of the failed projects have done and this did not work. The reason it did not work is that these projects were often digitising a fiction: adding ICT to a rational and functioning system of accountability that only existed on paper. Instead, the real processes and institutions were informal, personalised, politicised, sometimes corrupt. To make "simple" digitisation work in such situations actually requires bringing to prominence more objective processes and structures that are subordinate or even dormant – the type of reorganisational or even transformative change at the top of the DIRT ladder that can make a real difference but which in practice is very hard to bring about.

We have described above challenges that can hamper the e-accountability of the public sector. But, as Box 7.6 notes, that accountability itself may sideline the important e-accountability of other development actors.

Box 7.6

e-Accountability of non-state actors

A whole variety of non-state actors participate in governance and development. Since they are therefore institutions of development, SDG16 enjoins us to consider how they too can be made more accountable. Yet, to date, the focus for e-accountability and related initiatives such as open data has been almost entirely on government, with too little attention paid to other actors (Davies et al. 2013). Examples include:

- *Private sector*: small and micro enterprises make limited use of ICTs but tend to be well-integrated into their local communities and have a form of communal accountability (Kiggundu 2002, Best & Kenny 2009). For larger firms, there tends to be relatively good accountability to shareholders but fewer pressures in developing countries for accountability to, say, consumers or citizen groups than are experienced by state institutions (Haglund 2008, Fombad 2012). What thus matters particularly is the capability and motivation of government to hold private firms – including multinationals – to account. There are signs ICTs could have some impact but examples are relatively rare: offering consumers in the global North the ability to trace fair trade supply chains originating in the global South (Kleine et al. 2012); citizens in China expressing anger via social media over a multinational company's oil spill (Yin et al. 2015).

- *Development organisations*: despite often promoting accountability of the state, development stakeholders themselves have often been rather weakly accountable (De Renzio 2006). The growing use of ICTs by development organisations – something, oddly, the development informatics community has spent very little time researching – provides opportunities to change this. There is a tendency for ICTs to reinforce the "upwards and inwards" accountabilities that already exist: of Southern NGOs and local donor offices to donor headquarters in the global North (Lewis & Madon 2004); at the expense of downwards accountabilities to local citizens including development beneficiaries. However, the growing digital connections between local development actors and local civil society and beneficiaries may alter this. For example, use of International Aid

Transparency Initiative data standards in Colombia and Web publication allowed the Allianza alliance of civil society organisations to effectively monitor in-country aid expenditures by international donors (Linders 2013), while use of mobile money to channel humanitarian assistance from NGOs to low-income citizens in Mukuru, Kenya, shifted the dynamic to increase accountability of the project to its beneficiaries (Madon & Kamau 2015).

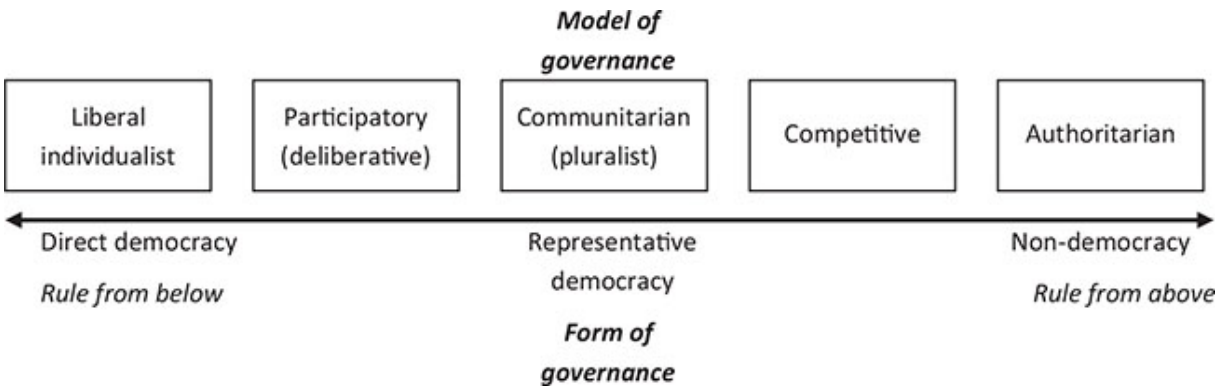
- *Insurgent/terrorist groups*: groups fighting to overthrow or undermine existing states make extensive use of ICTs and, indeed, could not exist in their current form without ICTs (Espeseth et al. 2013, Ishengoma 2013). While this use includes visible cyber-propaganda, many of the digitally enabled processes – recruitment, training, operational use, command and control – are kept as hidden as possible, and are not subject to any normal sense of accountability. However, ICTs may play a role in holding such groups accountable for their actions, particularly among populations where there is a mix of views about such groups. A well-cited example is the mobile phone-recorded video of a young girl being flogged by the Taliban in Swat Valley, Pakistan (Sen 2010). Circulation of this video shifted a set of public opinion leading to the Pakistan army being mobilised against the Taliban in Swat.

7.4. e-Democracy and development

Even more than with accountability, issues of democratic inclusion move well beyond the confines of new public management and private value: they are about public value and they also lie at the heart of governance. But what the public actually values about this aspect of governance is fixed in neither time nor space: there are different models of democracy that may be aspired to. These come with various different names, but Figure 7.4 summarises one set (developed from Van Dijk 2000 and Steibel & Estevez 2015). Box 7.7 provides an alternative perspective based not around governance but around rights.

We can explain these five governance models and identify ways in which ICTs may be applied to each one. This is a reminder of an earlier message that before applying ICTs, we need to have a clear vision of which type of governance we are aiming for; in other words, a clear vision of public value in relation to democracy.

Figure 7.4 Different governance models



Liberal individualist. This model:

> [e]ncompasses characteristics of … personal expression and the pursuit of self-interest. It refers to the "democratic traditions, which posit the individual as a rational, autonomous subject who knows and can express their own best interests. This knowing subject is assumed by a diversity of liberal democratic theories, from classic liberalism to libertarianism" (Dahlberg 2001: p. 160).
>
> (Steibel & Estevez 2015:251)

This view adheres closely to the notion of direct democracy, which would see ICTs being used to bypass existing institutions of representative democracy (such as Parliament or Congress), and to give control over political decisions directly to citizens. Given the relatively limited presence for politically liberal/libertarian views in the global South, examples are not common. One instance is the use of ICTs to enable participation in referenda in Uruguay (Margheritis 2015). Citizens making political decisions and having those decisions acted upon represents the end point of what we could call the political value chain, but upstream from that is the expression and formation of political opinion around decisions. Social media allows for liberal individualist opinion with anonymised and loosely moderated online forums fitting fairly well with this model. The result – reflecting one view of liberal individualism – is that one sees more monologue than dialogue. For example, analysis of an online discussion about Cuban politics showed 80

per cent of content to be simple personal declarations, and only 20 per cent were responses to the inputs of others, with 80 per cent of the content also being negative including "flaming" others (Ampofo 2011).

Participatory (deliberative). This is a half-way house between direct and representative democracy, which rejects the fragmentation of the liberal individualist position but also the formal organisation of the pluralist position (Van Dijk 2000). The formation and aggregation of citizen views rests heavily on constructive discussion, often called deliberative democracy. This approach:

> [p]ursues rational-critical arguments, by focusing on public issues and putative equality … "deliberative democracy relies upon inter-subjectivity … A legitimate (and rational) decision rests not upon the expression of pre-given wills but upon the deliberative process by which everyone's will is formed" (Dahlberg 2001: p. 168).
>
> (Steibel & Estevez 2015:252)

The frequently-cited gold standard for deliberative democracy is based on the work of Jurgen Habermas (such as Habermas 1989). Various criteria can be extracted from Habermas, and also from Dahlberg (2004) and Freelon (2010): openness to change one's views and to understand the views of others, judgement of arguments on rational-critical grounds, restriction of discussion to areas of common concern, equality of opportunity for all, and autonomy from state and corporate interests. While these may never be achieved in practice, they can be used as a framework for evaluation.

One example is the growth of "e-participatory budgeting". This takes a proportion of a public budget – typically from local government – and allows and enables citizens to discuss and then decide online how that money should be spent. One case is that of the city of Belo Horizonte in Brazil which first began e-participatory budgeting in 2006 with an allocation of just over US$11m and selection between a series of different possible urban development projects (Sampaio et al. 2011). The decision-making process was supported by educational videos, virtual maps, online discussion forums and online chat facilities. The online process was judged against

Habermasian criteria and – though by no means perfect – was found to be reflective, with some dialogic content and a significant level of rational-critical argument, and with a focus on the core topic, and little sense of external interference. While there are dangers of inequality through digital exclusion, in this instance most neighbourhoods with a high concentration of votes were among the poorer ones.

Communitarian (pluralist). This model:

> [u]pholds the cultivation of social cohesion and group identity. It "argues that sustainable democracy must be based upon the shared values and conceptions of 'the good' that bind people into community … the communitarian self is understood to be constituted within relationships structured by social roles and shared subjectivity" (Dahlberg 2001: p. 163).
>
> (Steibel & Estevez 2015:251)

Unlike the other governance models, this one emphasises the role of the organisations of civil society; hence the notion of democratic pluralism.

ICTs are very good at supporting the activities of particular politically relevant communities. The example is given in the next section of ICTs helping support political parties, but other examples of support for specific communities include:

Trade unions: the UNI Global Union online forum, for example, has enabled trade unions to organise at regional and international levels to address the consequences of globalisation, and to organise collective representation to transnational corporations and institutions of governance (McGrath et al. 2012).

Other civil society organisations: Cidade Democratica is a portal in Brazil that identifies governance problems and then allows proposals for solutions and expressions of support to be posted: "While formally citizens are the central target of Cidade Democratica, its primary audience in fact consists of NGOs, civil movements, and loosely structured groups of volunteers. These groups and organizations use the platform for their own advocacy needs, promoting their political causes and amplifying the amount of their supporters" (Fung et al. 2013:42).

Social movements: for example, in Morocco, ICTs have enabled feminist social movement organisations to mobilise support and build a basis for action both within their own movements and in

collaboration with other movements, and have helped to organise specific protest actions and to manage the administration of the organisation (Moussa 2013).

In all these and other cases, digital technologies are shown to enhance the cohesion and sense of identity of particular communities (though of course that may be at the expense of shared cohesion and identity within an overall country).

Competitive. Under this model:

[t]he election of representatives is considered to be the most important operation in the political system … A central role for bureaucracy, political parties and leaders with authority is inevitable. Politics has to be seen as an everlasting competition between parties and their leaders for the support of the voting public. In this way the best leaders and representatives are elected.

(Van Dijk 2000:41)

Use of ICTs here would support politicians (in office and challenging for office), political parties and elections. There are many examples of this from around the global South. For instance, the majority of politicians in Argentina have a Facebook profile and Twitter account, and many have their own Facebook page and website (Welp & Marzuca 2014). Similarly, all political parties in the country have their own website, focused mainly on basic information about the party, promotional materials and links to social networks. Few give contact details of party officials, and none of them host discussion forums, pointing to the focus on electoral competition with other parties, rather than a more participative democratic model (ibid.).

ICTs can be used in various elements of the electoral process. Upstream, ICTs can be used to assist with voter registration, with the logistics of managing polling stations, and to remind voters to vote. An example was use of biometric voter registration in Nigeria for its 2015 election (an application like many that has had mixed results) (Mungai 2015). Mid-stream, ICTs can be used to enable e-voting i.e. casting one's vote via digital technologies. A number of countries use this in digitisation mode to directly replace the paper ballot. Improvement mode – allowing for remote voting via the Internet or mobile phone – has been little used to date though some

groundwork has been done in testing of prototypes and voter perceptions (Abdelghaffar & Galal 2014, Kumar et al. 2015). Downstream, ICTs can be used to help tally votes and calculate and broadcast the results. For example, electronic voting machines – a form of e-voting but still in conventional polling stations – have been used in India for elections since 2004, and allow more secure and faster election results (Prasad et al. 2010).

Authoritarian. This is:

> [a] form of social organization characterized by submission to authority … Authoritarian governments are those in which political authority is concentrated in a small group, usually unelected by the people, who possess exclusive and arbitrary power. Authoritarianism need not be manifested in such extreme forms as totalitarianism, in that social and economic institutions can exist which are not under the government's control, but it is characterized by highly concentrated, and centralized power maintained by political repression and the exclusion of potential challengers, using political parties and mass organizations to mobilize people around the goals of an elite.
>
> (WQ 2016)

Authoritarian regimes have passed through their original phase of seeking to reject the Internet due to its political costs (that rejection running in conflict with the desire for ICTs' economic benefits: a conflict referred to as the "dictator's dilemma"), into a second phase of seeking to control the Internet (via filtering, blocking and disconnecting services), which overlaps with a third phase of proactive e-repression in which:

> [s]tates make use of e-surveillance to gather evidence that is used to repress their opponents. But they also actively use ICTs for repressive purposes: disseminating propaganda inside and outside the country; hacking into the websites of internal social movements and the email/mobile accounts of organisers; planting disinformation into social movements' communications; using viruses and other tools of cyberwarfare to attack political challengers … This presents evidence that the dictator's dilemma is solved: ICTs can be simultaneously harnessed for economic growth and political restraint.
>
> (Heeks & Seo-Zindy 2013:4)

As one illustration, China shows elements of both second and third phase. For example, its localised application of Skype incorporates routine logging of all calls made, and filtering of all full-text chat messages so that terms like

"Falun Gong" and "Dalai Lama" would not be transmitted, and would be specifically recorded (Fischer et al. 2013). Cyberspying software – albeit of unknown origin – was also found on computers across the globe belonging to institutions including NGOs and embassies with interests relating to Tibet. Moving more clearly into third-phase action, China's well-known "50-cent party" and others are paid to place pro-government propaganda into social media and online news channels (Miller 2016).

Box 7.7

ICTs and human rights

Rather than looking at ICTs and different models of governance, an alternative would be a rights-based approach, given the emergence of rights-based approaches to international development. Over time, rights-based approaches to development have evolved in various directions, including a strong strand rooted in the capability ideas discussed in Chapter 6 (Elliott 2014). But a return to one of the key foundations – the Universal Declaration of Human Rights (UNGA 1948) – shows three particular issues for ICT4D:

- Article 12/Privacy: "No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks". With life activities increasingly mediated by or recorded on ICTs, the potential for invasion of privacy is growing, as is the concern to protect digital privacy (UNHCHR 2014, WB 2016).

- Article 19/Freedom of Expression: "Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers". All states set limits on freedom of expression based on principles of harm to others; for example, banning expression that is racist or blasphemous or relating to child pornography. Governments in some countries go further and set limits on online expression based around perceived threats to the state (Goel 2011). From a

liberal rights-based perspective, such actions represent encroachments on the right to freedom of expression (Hintz 2013).

- Article 27 (2)/Intellectual Property: “Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author”. Problems with protection of ICT-related intellectual property are typically dated from the invention of software piracy in the mid-1970s (Pitre & Loguidice 2014). While piracy in developing countries has been economically redistributive, the value of protecting ICT-related intellectual property likely increases as the local digital economy develops (Charoensukmongkol & Elkassabgi 2011).

Beyond these three basic rights, one currently debated issue – given the growing centrality of ICTs to human life – is whether access to ICTs, for example access to the Internet, should be regarded as a basic human right (UNGA 2011). A few governments worldwide have legislated Internet access as a right, and others have reverse-rights court rulings: in 2010, for example, a constitutional court in Costa Rica ruled that the government should not deny anyone access to the Internet (Barry 2014).

7.4.1. Democratic impacts of ICTs

Digital divides – both technological and social – in developing countries remain a foundational impediment to mass participation in e-democracy initiatives. Not only does this reduce the potential and effectiveness of such initiatives, it can also create the basis for political exclusion (Duruji et al. 2015). But, as these are overcome, digitisation of democratic processes reduces the barriers to participation making it quicker and cheaper for citizens to engage in those processes (Steibel & Estevez 2015). This, in turn, leads to greater and richer data flows, which can improve decisions both inside government and by citizens. In Brazil, for example, e-participatory budgeting has led urban expenditure to become more oriented to the needs of ordinary citizens (Spada et al. 2015), and introduction of e-voting enfranchised millions of illiterate citizens and had a demonstrable impact in shifting state expenditure to be more pro-poor, for

example in relation to health care, with demonstrable positive health impacts (Fujiwara 2015).

Beyond these process-level impacts, are ICTs associated with changes in the nature of democratic governance? We saw above that ICTs can assist any of the different models of governance, and one finding is that ICTs often reflect and reinforce the existing polity in a country. As a further example, analysis of social media content – Twitter specifically – during African elections demonstrated the following polity-based differentiation (Best & Meng 2015)

- Ghana: categorised on the Democracy Index as a "flawed democracy" (EIU 2016). Social media content was overwhelmingly related to policy issues.
- Nigeria: earlier categorised as an "authoritarian regime" "where divisive identity politics feed violence and electoral misconduct" (Best & Meng 2015:1). Election-related content on social media was dominated by "discussion of tribe, region, and religion".
- Kenya: categorised as a "hybrid regime" with serious weaknesses of governance amid attempts to move away from identity-based politics, saw social media contributions equally divided between policy and identity content.

The same can be seen under authoritarian regimes, with evidence that the growing scope and depth of online state surveillance in Africa and Asia is constraining e-participation as citizens fear they will be identified and punished (CIPESA 2015, Gronlund & Wakabi 2015, Hussain & Mostafa 2016). Their online activities therefore focus much more on personal and social gratifications such as entertainment and interaction with friends and family. However, this is not just reproduction of existing politics and the Chinese state is a good example. It coerces (by threatening blog writers or discussion board hosts), it controls (via censorship of online content and blocking of sites), and it intervenes in discourse (via the "50-cent party" discussed above who challenge and seek to refute online content critical of the state) (Jiang 2010, Hassid 2012, King et al. 2014). But it cannot – or chooses not to – stifle all political debate across the diverse spaces that have opened up online. Therefore, a space has been created for alternative

voices and this is not simply status quo: “the Internet has contributed to a more critical and politicized citizenry in China’s cyberspace and shifted the power relationship between the state and the society” (Lei 2011:311). Yet state controls place limits on this shift and Huang (1999:145) sums it up neatly: politically active citizens online in such contexts are “flying freely but in the cage”.

An even greater exception to the idea of ICTs just reproducing existing polities might seem to be the events of the Arab Spring: see Box 7.8. In these and other cases – Mexico in the 1990s, the Philippines in the early 2000s, Iran and Moldova in the late 2000s – ICTs certainly have an effect. They enable:

> [a] global movement to form, permitting the ideas and actions of focal protestors to have a much greater influence than might otherwise be possible. The size, reach and rapidity of formation of this social movement would not have been achieved without ICTs, and they were central to … the creation and dissemination of an identity of protest that came to be shared across the network.
>
> (Heeks & Seo-Zindy 2013:17–18)

Box 7.8

ICTs and the Arab Spring

The Arab Spring was a series of protests that broke out across the Middle East from late 2010 onwards, and which precipitated regime change in Egypt, Tunisia, Libya and Yemen, with major uprisings and protests in many more countries. ICTs – particularly social media – are seen to have played a central role (Howard & Hussain 2013). The initial spark is generally identified as the online diffusion of mobile phone-recorded videos of protests in Sidi Bouzid in Tunisia; those protests triggered by the self-immolation of street trader Mohamed Bouazizi (Mackey 2011). Social media was then used extensively as the protest movement spread, as one Egyptian activist summarised: “We use Facebook to schedule the protests, Twitter to coordinate, and YouTube to tell the world” (Rashed 2011).

During the week before Egyptian president Hosni Mubarak’s resignation, for example, the total rate of tweets from Egypt – and around the world – about political change in that country ballooned from

2,300 a day to 230,000 a day. Videos featuring protest and political commentary went viral – the top 23 videos received nearly 5.5 million views. The amount of content produced online by opposition groups, in Facebook and political blogs, increased dramatically.

(O'Connell 2011)

It is therefore not surprising that there have been – in terms of the Figure 3.11 worldviews model in Chapter 3 – optimistic, technologically determinist interpretations of the Arab Spring; seeing ICTs as having a causal role: "We witnessed how social media drove popular uprisings against long-standing regimes in the Middle East and North Africa (MENA) and resulted in toppling of Hosni Mubarak, Ben Ali and Muammar Gaddafi" (Ahmed & Jaidka 2013:29). But there are also other views: much less-optimistic given social media was blocked by some Arab regimes at critical times (Joseph 2012), and more socially deterministic which argue "politics comes first chronologically" – that social media activity follows rather than precedes protest activity; and "politics comes first analytically" – that the political environment is what determines the outcome of protests (Wolfsfeld et al. 2013).

Given hard evidence that social media content was far more reporting than organising protest activity, and given the actual Arab Spring outcomes, this latter view has some level of credibility. In Egypt, for example, it was not the Tahrir Square protestors who took power after Mubarak's overthrow but the long-standing, powerful and well-organised structure of the Muslim Brotherhood; shortly followed by the long-standing, more powerful and better-organised structure of the armed forces.

But the lessons of the Arab Spring are not a hard-right view on the Figure 3.11 diagram that sidelines social media. The scale and speed of the Arab Spring protests would have been quite different without ICTs, blocking of ICTs may have encouraged street protest, and social media has strong perceptual effects on those involved: offering a narrative, a collective identity, hope and motivation for change, that would have been more difficult to create otherwise (Eltantawy & Wiest 2011, Castells 2012, Halverson et al. 2013). So ICTs may not have been a cause or a driver for the

> Arab Spring, but they were at least a facilitator and more likely an aggregator and accelerator.

If ICTs are not a cause of political change but a facilitator that sits within a wider political context, then it is no surprise that ICTs are most effective when they tie together online and offline activity, rather than trying to work solely online (Harlow 2012). Online democratic activity can build rapidly and broadly but it is shallow and contingent: online, "there is a 'distancing' that limits depth of engagement generally, and a facilitation of multiple identities and interests that limits depth of engagement with any one network and role" (Heeks & Seo-Zindy 2013:18).

This returns us to a prior theme: that a core factor underlying e-democracy and the impact of ICTs on politics is incentives and motivations of those involved. We can therefore move to consider the motivations of each stakeholder in the political ecosystem of e-democracy.

Among citizens, there is evidence that those who make effective use of online forums are those who are most politically motivated and politically active offline (Gronlund & Wakabi 2015). ICTs can change motivations – for example, by reducing barriers to participation, or by presenting political information and issues to citizens – but the impacts tend to be relatively small. As an example, the introduction of online voting in Rio Grande de Sol state in Brazil was associated with an 8.2 per cent increase in turnout, the majority of whom were new participants (Spada et al. 2015); and the Brazilian e-voting case cited above increased turnout by just over 10 per cent (Fujiwara 2015).

Turning to e-democracy application designers, in a generic sense, their motivations matter: who are they and what do they want? Which model of governance are they seeking to achieve? These motivations guide design decisions: login required or not, anonymity of actions or not, moderation of content or not, synchronous or asynchronous communication, etc. All of these have been shown to make some types of governance model work better than others (Freelon 2010).

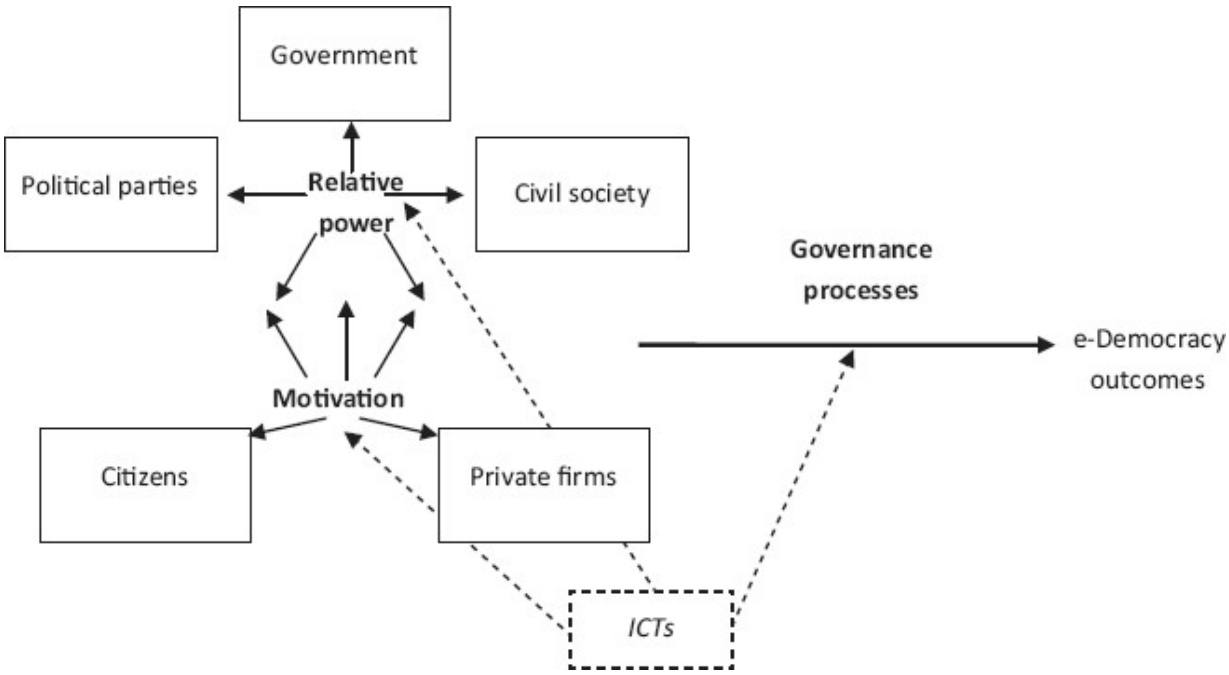
More specifically, we can look at motivations of particular design and implementation stakeholders. Among stakeholders within government,

democratic motivations are often lukewarm at best (Andrade & Urquhart 2012) with the result that there is support for changing the technology of politics (the "D" of DIRT) but not for more substantial changes to political processes or institutions (the "IRT" of DIRT). In part, this may arise because governments believe an appearance of e-democracy will be beneficial in encouraging foreign investment and domestic legitimacy, but that this appearance does not require any fundamental political change (Astrom et al. 2012). The motivations of the private firms that run the telecommunications infrastructure and social media platforms for many e-democracy initiatives are often equivocal: business criteria sometimes make them side with their citizen-customers, and sometimes with the governments that have the power to ban them (ibid.).

Political parties are of course strongly motivated to be involved with politics, though their motivation for internal democratic decision-making, for example of policies, is typically less strong than their motivation for political campaigning (Gibson et al. 2003). ICTs have generally followed these motivational tracks, with most use for competitive-electoral rather than broader democratic purposes in developing countries (Yaacob et al. 2014, Jaidka & Ahmed 2015). However, ICTs have not simply reinforced the power of incumbent parties – they have firstly pushed those parties to be more interactive in their processes, and have also fostered "accelerated pluralism" by lowering the operating costs for more special-interest political groupings, including those with more polarised political views (Curran et al. 2012).

Political motivation is also already strong among organisations of civil society, and there are many examples of their work being strengthened through ICTs, as demonstrated above in the discussion on "e-communitarian" applications. As summarised in Figure 7.5, the overall outcome of any e-democracy initiative will thus be a combination of three main factors: the political motivations of the stakeholders involved; their pre-existing power relative to one another; and the incremental modifications that ICTs make to both motivations and power. We therefore end with another familiar theme: that ICTs are likely to have an incremental but not transformational impact on (political) development.

Figure 7.5 Key factors determining outcomes of e-democracy initiatives



Additional material

Discussion questions

7.1. What do you understand by the term “good governance”?

7.1. Is there more to e-governance than services, accountability and democratic inclusion?

7.1.1. Imagine you are the lead implementer for a planned e-governance system. How would you go about integrating public value into the design of the system?

7.2.1. What are the most important public services impacts associated with new or improved e-services in developing countries?

7.2.2. What do you see as the two main reasons why developing country citizens do not adopt e-services? What can be done about these?

7.3. In what ways is the accountability cycle model similar to, and different from, the information value chain model? What conclusions might you draw

for e-accountability projects?

7.3.1. Imagine you are a designer for an e-accountability project. What actions would you take to try to address issues of motivation among both accountee and accounter groups?

7.4. In small groups, discuss which of the five governance models you feel is best-suited to addressing the problems of the twenty-first century. What are the implications for e-democracy applications?

7.4.1. Do ICTs make developing countries more democratic or less democratic or not make any difference to the level of democracy?

Assignment question

To what extent can ICTs improve governance in developing countries?

Further reading

If you would like to know more about . . .	7.1. good governance as a development goal	. . . then take a look at . . .	7.1. Chapter 5 of Kingsbury, D., McKay, J., Hunt, J., McGillivary, M. & Clarke, M. (2016) *International Development*, 3rd edn, Palgrave, Basingstoke, UK >Discusses a broad set of issues around political development including good governance and democracy
	7.1.1. public value		7.1.1. Stoker, G. (2006) Public value management, *The American Review of Public Administration*, 36(1), 41–57 >Explains the emergence of public value following traditional public administration and then new public management, and its relevance to key public sector issues Samaratunge, R. & Wijewardena, N. (2009) The changing nature of public values in developing countries, *International Journal of Public Administration*, 32(3–4), 313–327 >Also explains the background to public value, but then looks at its relevance specifically to developing countries
	7.2.1. impact of e-services in development		7.2.1. Miyata, M. (2011) Measuring impacts of e-government support in least developed countries, *Information Technology for Development*, 17(2), 133–152 >Covers a small application in a small country, but presents a model of good analysis Kettani, D. & Moulin, B. (2014) *E-Government for Good Governance in Developing Countries*, Anthem Press, London >Detailed – if rather rose-tinted – description of the eFez project in Morocco
	7.2.2. challenges of e-services in developing countries		7.2.2. Lessa, L., Negash, S. & Belachew, M. (2012) *Steering e-Government Projects from Failure to Success*, iGovernment Working Paper 22, IDPM, University of Manchester, UK >Design–reality gap-based analysis of an Ethiopian e-services project

(continued)

			Heeks, R. & Stanforth, C. (2014) Understanding development project implementation: an actor-network perspective, *Public Administration and Development*, 34(1), 14–31 >Actor-network theory-based analysis of a Sri Lankan e-services project
	7.3. e-accountability in developing countries		7.3. Heeks, R. (1998) *Information Systems and Public Sector Accountability*, Information Systems for Public Sector Management Working Paper 1, IDPM, University of Manchester, UK >Foundational set of models and ideas about e-accountability
	7.4./7.4.1. e-democracy and development		7.4./7.4.1. Breuer, A. & Welp. Y. (eds) (2014) *Digital Technologies for Democratic Governance in Latin America*, Routledge, Abingdon, UK >Based on a rich set of field cases, provides broad analysis of a range of experiences with ICTs and democracy Heeks, R. & Seo-Zindy, R. (2013) *ICTs and Social Movements Under Authoritarian Regimes: An Actor-Network Perspective*, Development Informatics Working Paper 51, IDPM, University of Manchester, UK >Analyses different worldviews on the relation between ICTs and political movements, and analyses specifically the example of social media in Iran's "Green Movement" Chadwick, A. (2006) *Internet Politics*, Oxford University Press, New York >No specific developing country focus, but a seminal work analysing ICTs and democracy

8 ICTs and environmental sustainability

In reading this chapter, you will learn to:

- describe the overall relationship between ICTs and environmental sustainability;
- explain the different orders of effects of ICTs on pollution and climate change mitigation including green and smart ICT applications;
- use analytical frameworks to understand environmental monitoring information systems;
- categorise use of ICTs in disaster management;
- interpret analytical models of resilience and e-resilience.

A simplistic view of earlier chapters would say that Chapters 4 and 5 dealt with the relationship between ICTs and economic development, Chapter 6 did the same for social development, and Chapter 7 for political development. In practice, it wasn't quite as simple as that, with broader issues being introduced. There is a similar pattern for Chapter 8. The main focus for the chapter is the relation between ICTs and environmental development. But as explained next, "development" isn't quite the right term for the environment – "sustainability" is. And sustainability, and related ideas like resilience, are cross-cutting goals that matter to more than just the environment.

8.1. Environmental sustainability as a development goal

In Chapter 1, we noted that sustainable development represents a development paradigm, founded on the Brundtland Report definition:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> • the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and
>
> • the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.
>
> (UNWCED 1987:41)

In the post-2015 period, this can be seen as strongly shaping the international development agenda. One can see this in the naming of the SDGs as *Sustainable* Development Goals, and in the presence of at least three "environmental" goals in the list of seventeen (see below) with sustainability incorporated into most of the other goals:

> SDG 13. Take urgent action to combat climate change and its impacts
>
> SDG 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
>
> SDG 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and

halt and reverse land degradation and halt biodiversity loss

Sustainability generally and environmental sustainability specifically – which we can relate particularly to SDGs 13–15 – is therefore a centrepiece of the international development agenda. Alongside this top-down imperative, environmental sustainability is also an immediate pressing issue in practice; particularly climate change. Each succeeding year in the mid-2010s was the hottest on record (Carrington 2016) and for all except a lunatic fringe, man-made climate change is now an accepted fact:

> Human influence on the climate system is clear, and recent anthropogenic emissions of green-house gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems … Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.
>
> (IPCC 2014a:2)

So we have both the high level of the international agenda and the low level of real environmental problems, particularly in developing countries. Action needs to be taken, otherwise the likelihood is of "severe, pervasive and irreversible impacts for people and ecosystems" (ibid.:8). That action will include an important role for ICTs. Yet environmental sustainability represents the development goal for which there is the largest gap between development needs and ICT4D action (Heeks 2014b).

ICTs' role can be understood by means of an overview model. It focuses mainly on ICTs and climate change – by far the most significant of environmental sustainability issues – but also includes other topics. Presented in Figure 8.1 (adapted from Ospina & Heeks 2012a), it divides the relationship into four elements:

- e-Mitigation: the link between ICTs and the pollutants that cause environmental unsustainability.
- e-Monitoring: use of ICTs to track levels of pollutants, other sources of environmental unsustainability, and their impacts.
- e-Strategy: use of ICTs to help make and implement high-level decisions on environmental sustainability.
- e-Adaptation: use of ICTs to help adapt to environmental changes and their wider impacts.

In this chapter, we will now look at each of these in turn.

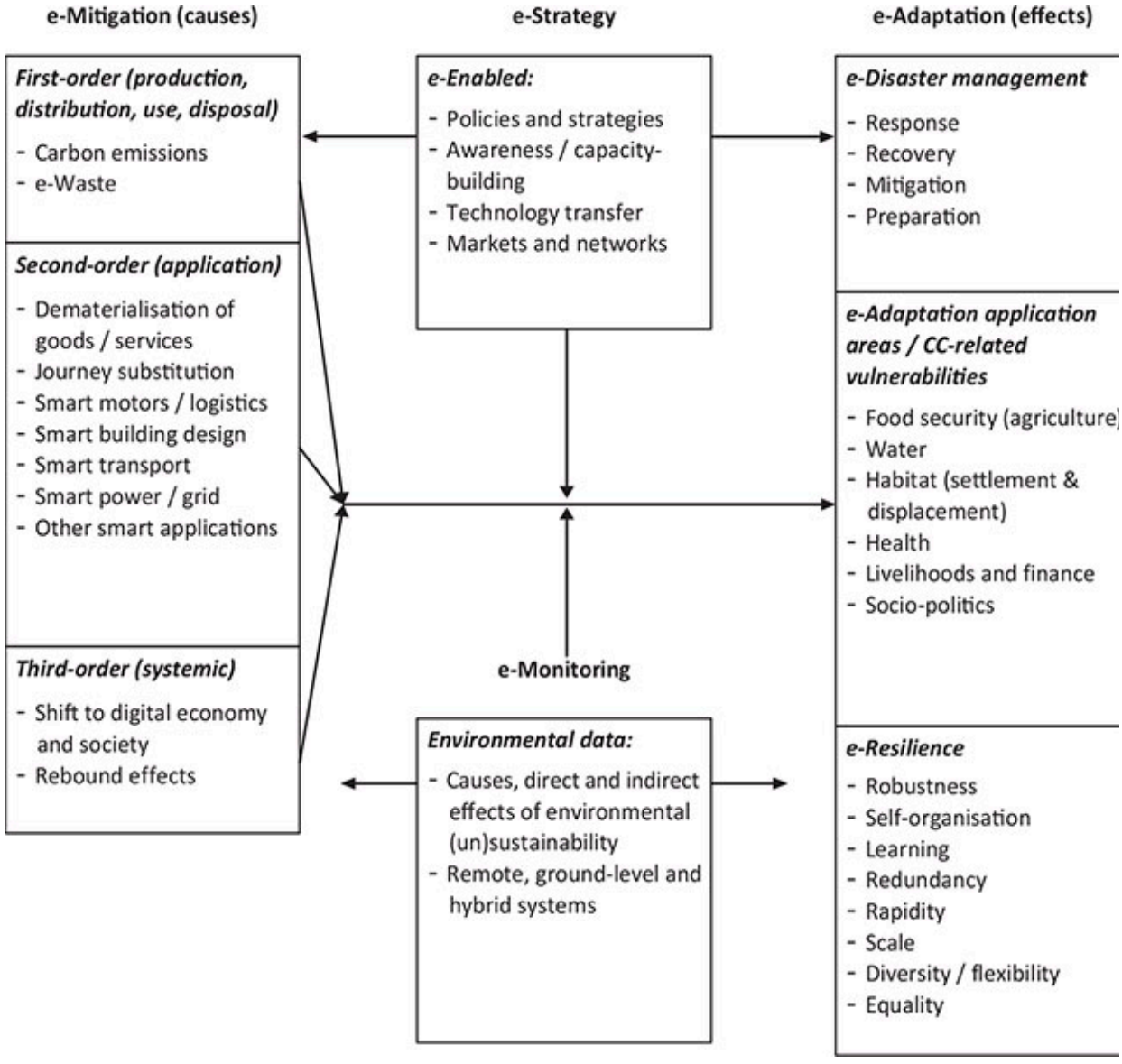
8.2. e-Mitigation and development

Historically, environmental pollution has largely been the fault of the global North: developed countries were by far the major contributors to CO_2 (carbon dioxide) emissions, for example during the twentieth century (Wei et al. 2012). However, this changed during the twenty-first century, particularly due to the actions of China and India. It is estimated that total annual carbon emissions from developing countries have already surpassed those of developed countries (though per capita levels remain well below), and that the total climate impact of developing countries (including historical contributions and other impacts such as land cover use) will exceed that of developed countries by 2030 (Ward & Mahowald 2014). Mitigation of climate impacts remains a low priority for least-developed nations: collectively, they contribute less than 1 per cent of global carbon emissions (Roeth & Wokeck 2012). But mitigation is an increasing issue for the global South overall.

Mitigation and the overall environmental impact of ICTs can be understood as a model of three levels or orders of effect, which were also shown in Figure 8.1 (Hilty & Hercheui 2010, Souter 2015):

- First-order/direct effects: these derive from the ICT product lifecycle – production, distribution, use and disposal of ICTs. An example would be the environmental impact of CO_2 emissions from the production and use of digital hardware.

Figure 8.1 Overview model of ICTs, environmental sustainability and development



- Second-order/indirect effects: these derive from the application of ICTs in other processes and the changes ICTs make to the environmental impact of these other processes. An example would be the environmental impact of reduced carbon emissions from better planning of transport logistics through use of ICTs.

- Third-order/systemic effects: these derive from the cumulative impact of ICTs over time in changing economic and social patterns and structures. An example would be ICTs' support for the changing composition of economies from "dirty" manufacturing to "clean" services. This category also includes "rebound" effects such as ICT-enabled reductions in the cost of producing and purchasing goods, which then lead to more of those goods being consumed, offsetting environmental benefits at the process level.

We will discuss each of these in turn.

8.2.1. Green ICT: first-order effects

The relative expenditure on ICTs between global North and South varies depending on definitions of ICT and of North/South. However, a reasonable conclusion is that total spending on ICT in developing countries is around half that in developed countries, but that expenditure growth rates in the former are up to twice as high, and will overtake developed country spending at some point before mid-century (UNCTAD 2012, Huawei 2016). With annual ICT expenditure in the global South already well in excess of US$1 trillion, with billions of devices in operation, and with around half of ICT hardware manufacture located in the global South (mainly China) (OECD 2013), the developing country first-order effects of ICTs on the environment are significant. We divide them into two main parts – carbon emissions and e-waste – though, as Box 8.1 notes, there are other direct environmental impacts.

Box 8.1

ICT4D's raw materials

One strong but often ignored link between ICTs and developing countries is the sourcing of raw materials. Metals mined to produce ICTs include more common ones such as tin, silver and gold and so-called rare-earth metals such as cobalt, niobium and tantalum (together found as the mineral, coltan), and tungsten (Wager 2011). Key producers in the global South include China, Brazil and the Democratic Republic of Congo (DRC).

Discussion of these raw materials mostly focuses on their human, economic and political impact. There are concerns about the working conditions of miners (Nathan & Sarkar 2011); concerns about the impact on ICT prices as demand for the metals starts to exceed supply (Massari & Ruberti 2013); and – as already mentioned in Chapter 5 – concerns that mining income is finding its way into the hands of armed groups, thus stoking conflict in unstable areas such as the DRC.

But alongside these are the rarely considered environmental impacts of the mining necessary to produce ICTs. These include the direct destruction of natural habitat by mining itself, pollution from the chemicals used for extraction, and indirect destruction of habitat due to the infrastructure required to support mining in rural areas (Edwards et al. 2014). To address this, initiatives such as fair trade, the Extractive Industries Transparency Initiative and local regulation all need to be extended and strengthened.

Carbon emissions

Global estimates are that ICTs consume c.4–5 per cent of all electricity and contribute c.1.5–2.0 per cent of global carbon emissions (Malmodin et al.

2013, Gelenbe & Caseau 2015). The three main contributors are telecom infrastructure, data centres and servers, and PCs and related devices – perhaps contributing about one-third each to the total (ibid.). Given the figures on ICT consumption and production, we can estimate that developing countries contribute around one-third of the global total of ICT-related carbon emissions.

This therefore means the energy-/carbon-saving component of green ICT will be an important part of future ICT4D strategies, which we can categorise in value chain terms:

- There will be "pre-stream" innovations that seek to provide carbon-neutral means of generating electricity specifically for ICT devices. Examples include use of solar power for mobile phone cell towers and other ICT infrastructure, incorporation of solar panels into ICT devices, and use of hand-wound or bicycle-powered chargers for mobile phones (Wyche & Murphy 2013, Ahmad et al. 2015).

- There will be "upstream" innovations that create more carbon-efficient ICT goods and services. Examples include development of directly used ICT components with lower energy requirements, and development of energy-efficient indirectly used ICT such the "green data centre" technologies which can underpin cloud services (Baikie & Hosman 2011, Dodo & Reith 2015). National and international investments can help on the supply side to support such innovation, and legislation can help encourage such innovation.

- To stimulate demand for such innovations, "midstream" actions are needed in relation to procurement. Governments can directly incorporate green criteria into their own ICT procurement decisions, and can legislate or in other ways push other purchasers to do the same (Chen & Chang 2014). Awareness-raising campaigns – including green ICT labelling and certification – will also help get other individual and organisational consumers to build environmental considerations into their procurement (Loo et al. 2014).

- Finally, tools and capacity-building are needed to help organisations at the “downstream” stage to measure and control their ICT carbon footprint (Savita et al. 2015).

Improved power efficiency within devices and changes to devices (such as from desktops to tablets, and from CRT (cathode-ray tube) to flat-screen monitors) have led to significant improvements in per-device energy consumption: laptops have around half the carbon footprint of a desktop PC; flat-screen monitors have around one-third the carbon footprint of a CRT monitor (Dell 2010). There are estimates of a three-fold fall in device-related emissions per user during the 1990s and 2000s (Hakansson & Finnveden 2015). However, these may represent some of the quick wins for green ICT, with future gains in energy efficiency harder to achieve: the three-fold per-user fall during the 1990s and 2000s is likely to be followed by only a 20 per cent further fall in device-related emissions during the 2010s. As device usage becomes more efficient, manufacture – where cutting emissions is more difficult – becomes an increasing part of the overall carbon footprint; for example, rising from around one-quarter of emissions for a desktop to more than 40 per cent for a laptop (Dell 2010). In addition, the growth in data centres serving user devices may well be more than offsetting the falls in device-related emissions: one estimate shows total per-user ICT emissions rising by 10 per cent during the first half of the 2010s as a result (Hintemann & Fichter 2015).

Added to this will be the likelihood of relentless growth in the number of ICT users and in ICT expenditure: annual ICT spending growth in developing countries is typically forecast between 5–10 per cent (Gartner 2015, IDC 2015). Taken together, this suggests that predictions of a decline in first-order carbon emissions from the ICT sector are highly optimistic (GeSI 2015). Much more likely is a growth in emissions, particularly within developing countries (Fehske et al. 2011, Sadorsky 2012, Malmodin et al. 2013).

e-Waste

e-Waste can be defined as “items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intention of re-use” (Step 2014:4–5). An estimated 42m tonnes are produced per year of which roughly one-quarter – about 10m tonnes – is made up from ICT (mobile phones, monitors, PCs, laptops, printers, tablets, servers, etc) (Balde et al. 2015). Globally, the volume of e-waste generated per person is rising by about 4 per cent per year and (given population increase) the total volume of e-waste is growing by about 5 per cent per year. Population and consumption growth partly explain the expansion of e-waste but a key element is forced obsolescence (Spence et al. 2012). This occurs when consumers feel obliged to upgrade to newer ICT and discard their existing ICT even though it is still functional: because producers no longer support the product, because it is no longer compatible with other products, or because of marketing pressure (Remy & Huang 2015).

Countries of the global South contribute about 45 per cent of total e-waste (with China making up one-third of this total) but much less per head of population: Nigeria’s 180m citizens create the same amount of e-waste as Switzerland’s 8m (Balde et al. 2015). Some proportion of the e-waste created in the global North is exported to the global South, particularly to China, West Africa and India. Estimates vary from 5 per cent to 23 per cent of which up to half may be illegal exports despite the presence of the Basel Convention seeking to prevent this, and some exported under the guise of re-use (Breivik et al. 2014, Perkins et al. 2014, Balde et al. 2015). In all cases that would suggest the global South is already having to deal with more than half of all the world’s e-waste.

There are economic opportunities in e-waste: glass, plastics and metals (especially copper, gold and nickel) can be recycled from this waste, with an estimated potential value to developing countries of US$25bn per year – there is as much gold in developing country e-waste as South Africa

produces via mining. Hundreds of thousands of people therefore earn their livelihoods in developing countries, working in formal and informal recycling of e-waste (Breivik et al. 2014). Typical earnings range from c.US$3 per day for those employed in collecting and recycling to c.US$15 per day and US$250 per day for small and larger recycling business owners (Umair et al. 2013).

Only a small proportion – likely less than 10 per cent – of developing country e-waste is recycled through formal channels with the rest being dealt with informally (Oteng-Ababio 2012, Heeks et al. 2015). Informal handling is inefficient in its ability to extract value from e-waste; for example, burning items to extract only the residual copper and extracting only 25 per cent of available gold compared to 95 per cent in a formal system smelter – and much of the material is just dumped (Schluep et al. 2013). As a result, e-waste is currently more of a threat than an opportunity for the global South from the volume of landfill it requires and the toxicity of cadmium, lead, mercury and dioxins (ibid.). The negative health impacts on those working in or living near e-waste recycling and landfill are well-documented (Perkins et al. 2014, Carlson 2016).

Addressing the growing threat of e-waste will require action by all stakeholders (Manhart et al. 2013, Balde et al. 2015, Heeks et al. 2015):

- ICT producers: must take more responsibility for the items they produce including commitments to recycle. This is more difficult in developing countries, with producers often far distant from the site of ICT consumption.
- Consumers: must be encouraged to direct their e-waste into formal recycling channels. As Box 8.2 indicates, this will not be easy.
- Recyclers: more formal recyclers need to be created, and improvements to the handling practices of informal recyclers need to be supported. But the latter are hard to reach and formal recyclers will only emerge in

developing countries if there is strong supply of e-waste – for example via formal "take-back" channels – and strong demand for the outputs of recycling.

- Governments: must introduce legislation that incentivises the other stakeholders to take appropriate actions including regulatory requirements and capacity-building for recycling, plus monitoring and enforcement mechanisms. As yet only a minority of developing countries has formal e-waste legislation.

Box 8.2

Changing consumer behaviour on e-waste in developing countries

It is ICT consumers – both personal users and also bulk consumers in the form of formal organisations – who ultimately decide whether and when an ICT item is waste, and how that e-waste item will be handled.

Those decisions (echoing the ICT4D "prime question" and the central issue of motivation) are shaped by three main forces:

- Financial incentives: whether the consumer can earn any money for their e-waste or whether they may face financial penalties for particular decisions, but also including the (time) costs of particular e-waste channels.

- Cultural norms: what they see peers doing about e-waste and how they themselves feel they may be judged by others on their decisions.

- Government regulations: what laws and rules they may see as compelling them to act in a particular way vis-à-vis e-waste.

Very large and small/medium ICT organisations in India were compared on these three forces.

Very large organisations felt they might suffer financially from overseas clients withdrawing contracts if their e-waste led to environmental damage; felt pressure from staff members and peers to behave in an environmentally responsible manner; and were subject to government regulation. As a result, they adopted proactive e-waste strategies that included auditing of e-waste flows and use of formal recyclers.

Small/medium organisations felt no pressure from peers, staff or (domestic) clients to take any particular action on e-waste, and were exempt from government legislation. They had a financial disincentive to use formal recyclers since the latter would not pay as much as informal scrap dealers, and would not pick up from the organisation whereas the scrap dealers would. As a result, they adopted an "indifferent" e-waste strategy with old equipment just piling up or sold to the scrap dealers.

Source: adapted from Heeks et al. (2015)

8.2.2. Smart applications: second-order effects

A central problem for developing countries is the coupling between economic growth and environmental damage: historically "for every 1% increase in global GDP, CO_2 emissions have risen by approximately 0.5% and resource intensity by 0.4%" (GeSI 2015:9). The promise of smart applications is that they will loosen this coupling, enabling sustainable economic growth. For example, the ICT sector-sponsored Global e-Sustainability Initiative claims that via smart applications, "ICT can enable a 20% reduction of global CO_2 emissions by 2030": 12 giga-tonnes in total (ibid.:8).

The main contributors to carbon emissions and, hence, the main targets for smart applications are energy, buildings, transport, industry and forestry/agriculture. ICTs can help reduce carbon emissions in these sectors

in four main ways i.e. there are four main second-order effects of ICTs (Houghton 2015):

- Physical dematerialisation: replacement of physical goods and services with virtual, digital forms, such as books being replaced by e-books. Production, distribution and use of digital forms are much less energy-intensive than for their physical equivalents.

- Journey substitution: use of ICTs helps replace movement of physical people and items with movement of digital data, thus avoiding the pollution associated with those journeys. Dematerialisation saves distribution-related journeys of goods and, alongside the examples of human journey substitution seen in earlier chapters, we can add videoconferencing and telecommuting as ways to save energy: for instance, a videoconferencing application for the Odisha state government in India was estimated to save 3,000kg of CO_2 per meeting (Mahalik 2012).

- Smart optimisation: ICTs can be used to improve energy efficiency in the design, production, distribution and operation of other products via various "smart" applications. Some examples are provided in Box 8.3.

- Indirect optimisation: ICTs can be used to raise awareness about, and build capacity for use of, smart and other energy-efficient technologies. As an example, participatory radio programmes – combining community radio broadcast plus listener engagement via mobile phone – were used in Zambia to increase usage of more carbon-efficient cookstoves (Jones & Siemering 2012).

Of course, all four applications increase use of ICTs, thus increasing the first-order effects noted above.

Box 8.3

Overview of carbon emission-reducing smart applications

Smart energy (potential to deliver c.20 per cent of total smart savings). Given ever-growing energy needs in developing countries, and energy generation being a core source of carbon emissions, applications are needed including:

- Energy generation: micro and renewable energy sources such as wind, solar and wave all require ICTs for both control and connection.

- Energy transmission and distribution: smart grids allow digital remote monitoring and management of electricity networks, and are particularly valuable in identifying and helping fix sources of transmission loss; a major problem for developing countries.

- Energy consumption: smart meters help consumers monitor, analyse and hopefully reduce their energy-use patterns.

Smart buildings (c.10 per cent of smart savings). Direct emissions from buildings are responsible for c.12 per cent of global CO_2 emissions with indirect emissions via electricity use from systems and appliances in buildings taking the total up to around 25 per cent. With tens of thousands of new housing units needed every day in the global South to cope with population growth and migration, applications are needed including:

- Building design: building information modelling systems to optimise use of energy and materials in the design and construction of

buildings.

- Appliance management: sensor networks connecting and controlling all energy-consuming devices to minimise their carbon footprint.

- Building management: building management systems to control heating, ventilation, air conditioning and lighting according to variables such as occupancy and external climate.

Smart transport (c.25 per cent of smart savings). Transport makes up roughly 20 per cent of direct carbon emissions; a figure projected to double by mid-century in the absence of intervention. Alongside journey substitutions from use of ICTs, needed applications include:

- Infrastructure planning: modelling of transport infrastructures to optimise shifts between transport modes, encouraging walking/cycling, and to make the most efficient use of investments around future journey patterns.

- Traffic management: control of congestion through speed guidelines, road charging and re-routing information, and guidance on available parking.

- Smart vehicles: vehicle navigation and driving assistance systems, engine management and electric/hybrid power systems control.

Smart industry (c.25 per cent of smart savings). Industry accounts for well over one-third of all global carbon emissions with growth in global trade being a particular source of increase. Dematerialisation helps here and other applications needed include:

- Smart logistics: mainly transport-related digital systems including real-time tracking systems in order to optimise vehicle routing and loading.

- Smart manufacturing: automated communication between production machinery, remote monitoring to allow predictive maintenance, and production planning systems to optimise integration of orders and production planning and dispatch.

- Smart motors: to save motor energy requirements and increase motor lifespan.

Smart agriculture (c.20 per cent of smart savings). ICT applications can help to reduce energy costs of farming processes through real-time analytics and access to best-practice information that minimises use of water and fertiliser, boosts farm productivity, and minimises food waste. Savings will also come from smart forestry: ICT-enabled reductions in deforestation.

Source: text adapted from Roeth et al. (2012), IPCC (2014a), Malmodin & Bergmark (2015)

Achieving the potential second-order gains in developing countries will require the following barriers to be addressed (Roeth et al. 2012):

- Knowledge and skills: awareness of smart applications is low in developing countries, as is prevalence of the skills needed to identify, develop, install and operate such applications. Governments have a capacity-building role here.

- Innovation: smart application innovation is being driven from the global North and such innovation designs often mismatch developing country realities. Governments and other development actors will need to support local adaptation and research and development of smart applications.

- Finance: although smart applications can save money through their energy efficiencies, their initial cost can represent a barrier to adoption, while returns may be quite long term. Both of these may encourage governments to step in with subsidies or direct investments.

- Policy: as noted for other e-mitigation issues, policy and institutional capacity is lacking in developing countries, and needs to be developed.

8.2.3. e-Society: third-order effects

If the first-order effects of ICT are largely negative on the environment, and the second-order effects are largely positive; then that still leaves the third-order effects. With first- and second-order effects often being "guesstimates", then forecasts of third-order effects may be little better than putting a finger up into the air. Scenario analysis can improve this to some extent and typically focuses on the relative strengths of four effects summarised in Table 8.1 (Berkhout & Hertin 2001, Moyer & Hughes 2012, Hakansson & Finnveden 2015).

In summary, it may well be that mitigation hopes for ICTs are overblown. They will undoubtedly be an integral and essential part of a sustainable future but at least some calculations suggest "the net positive effect is, however, not large" when we add first-, second- and third-order effects together (Moyer & Hughes 2012:927). That is the global picture. For developing countries, it may be more negative with suggestions of an inverse-U curve relating ICTs, economic growth and environmental impact – that for lower-income countries, ICTs are associated with growth in carbon emissions while only for the higher-income countries of the global North will ICTs be associated with reductions in carbon emissions (Lee & Brahmasrene 2014). One calculation suggests a 1 per cent increase in a country's ICT Development Index is associated with a 0.67 per cent increase in carbon emissions (ibid.). This should not discourage ICT use – since that is essential to the economic growth necessary to move to the downslope part of the curve – but it should encourage greater adoption of green and smart ICT in developing countries.

Table 8.1 Third-order ICT effects

	Positive	*Negative*
Digital society	Dematerialisation and substitution are already incorporated into consideration of second-order effects, but there are other systemic effects such as growth in the lower-energy ICT sector displacing activity in higher-energy traditional sectors.	As ICTs enhance connectivity and globalisation, this can lead to greater transportation of people and goods.
Rebound	Growth in consumption of "cleaner" ICT goods and services leading to less consumption of other "dirtier" goods and services.	ICTs help reduce the price of goods and services, an also reduce the transaction costs of purchase and consumption (e.g. via e-commerce). The consequent induction effect is basic economics: as you reduce the price of something, demand and hence consumption rises. So, for example, if smart grids reduce the cost of electricity, there may not be a fall in carbon emissions but a rise in use of electricity by consumers. ICTs may also facilitate greater identification and extraction of fossil fuel deposits.

8.3. e-Monitoring, e-strategy and development

Monitoring and strategy fit together via the information value chain: monitoring represents the data capture, processing and storage, and the creation of environmental information and knowledge; strategy represents high-level decisions and actions that flow from that monitoring. ICTs are mainly associated with monitoring though there are some strategy-relevant applications. The value of e-monitoring systems actually comes from their use in subsequent environmental decisions and actions.

8.3.1. Environmental e-monitoring systems

ICT-enabled environmental monitoring systems can be categorised in terms of their focus on one or more of three aspects of environmental sustainability:

- Cause-focused systems: monitor the causes of environmental (un)sustainability. With around one-quarter of total global carbon emissions coming from "agriculture, forestry and other land uses" and particularly from deforestation (IPCC 2014b), this has been a main focus for digital monitoring.

- Direct impact-focused systems: monitor the immediate indicators of environmental (un)sustainability. This covers systems monitoring weather, climate and air/water/soil quality.

- Indirect impact-focused systems: monitor the indirect indicators of environmental (un)sustainability. Examples would include systems to monitor desertification, changes in animal and plant species, sea-level rise and glacial shrinkage. We could also include disaster monitoring systems, though we will discuss these instead in the following section.

We can also categorise environmental e-monitoring systems in terms of three different data capture options:

- Remote systems: gather data above the ground through satellites and aircraft including (see Box 8.4) drones.

- Ground-level systems: gather data on the ground through digital sensors or through "human sensors". For example, electronic sensors have been used in Bangladesh to monitor levels of arsenic in groundwater (Ramanathan et al. 2006); and citizens and other volunteers have been used to monitor the growth and health of coral reefs in Jamaica (Crabbe 2012).

- Hybrid systems: use a mix of remote and ground-level data-gathering. For example, satellite-based images of forest areas in Ethiopia have been complemented by community-based monitoring of deforestation to produce a more accurate overall picture (Pratihast et al. 2014).

Box 8.4

Drone applications in ICT4D

Unmanned aerial vehicles (UAVs) such as drones play an increasing role within the ICT4D field. A principal use, identified in Chapter 2, is to provide short-term telecommunications coverage: for remote regions or for disaster-struck areas where ground-based infrastructure has been degraded. A second and much more controversial use, identified in Chapter 5, is as a weapon for military operations. A third use is as a delivery mechanism; for example, delivering medicines in the wake of a disaster (Martini et al. 2016).

Most relevant to this chapter is use of drones for remote mapping and monitoring. Once again, these have been applied in post-disaster situations: counting populations in camps for displaced persons in Haiti following the 2010 earthquake, or assessing infrastructure damage following typhoon Haiyan in the Philippines in 2013 (ibid.). But they have also been applied for environmental purposes such as cause-focused systems to track deforestation. So-called "conservation drones" have been used by NGOs and community groups to monitor localised forest cover and legal/illegal logging in a number of Asian countries (Paneque-Galvez et al. 2014).

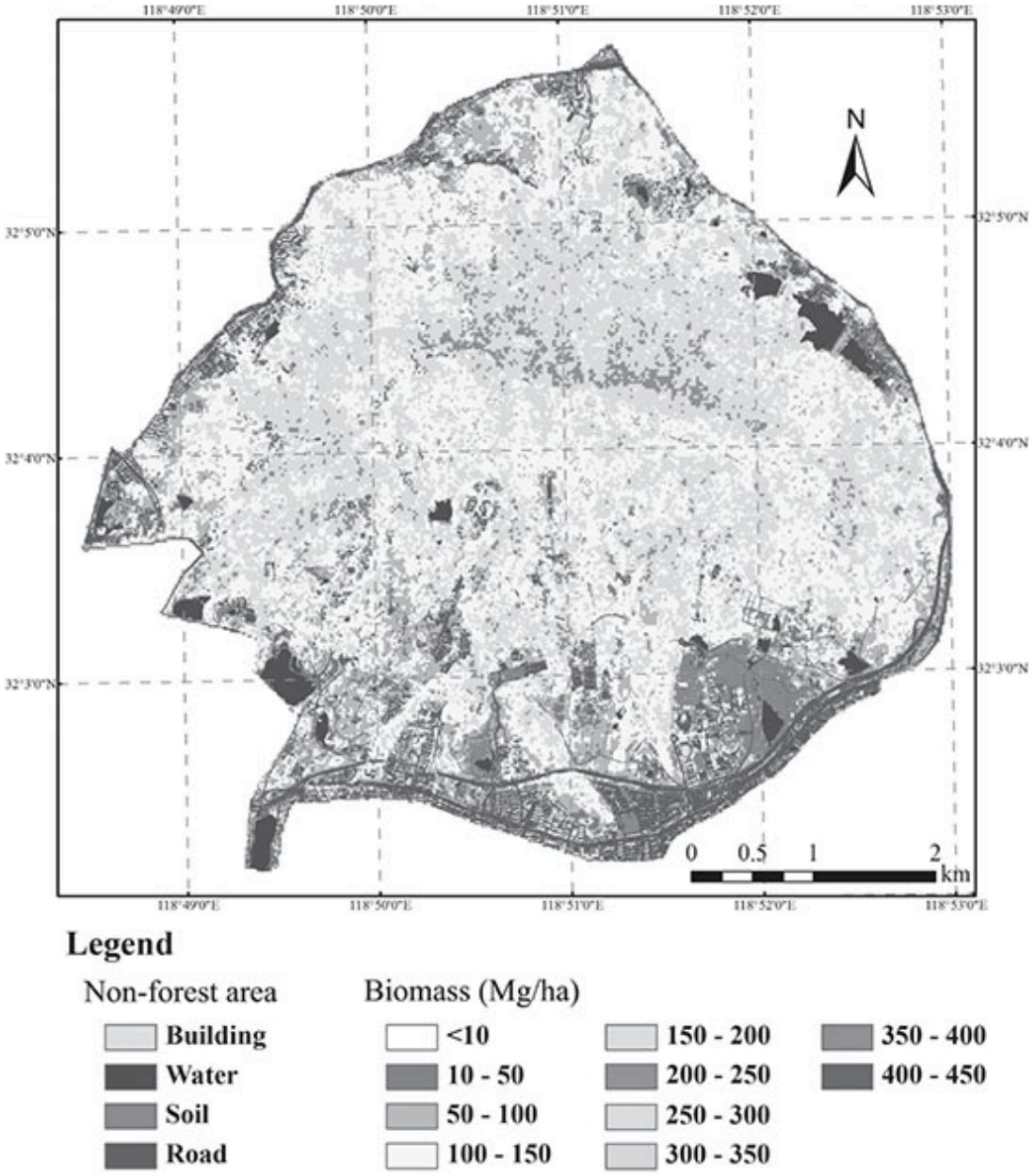
Like many ICTs, drones offer technical and financial benefits: for example, delivering new data at low cost. While in some ways the embodiment of an ICT free from earthly concerns, in practice, drones are always embedded in local realities and they bring new informational, political and ethical challenges (ibid., Smart et al. 2016).

Whichever way environmental monitoring data is captured, in almost all cases it is then input to, processed by, and output to create information and knowledge by, a geographic information system (GIS): "a computer system capable of holding and using data describing places on the earth's surface"

(Shamsi 2002:2). At root, a GIS has a digitised map of an area that forms the base layer of data, on top of which various other layers of geographically referenced data can be superimposed: topography, forest cover, land use, water flows, etc. Figure 8.2 shows an example of output from a cause-focused, remote environmental monitoring system: a GIS mapping forest density in a protected area of south-eastern China (Deng et al. 2014).

As noted above, "smart forestry" applications sit at the intersection of mitigation and monitoring, and are of particular relevance to developing countries given the role of forests as carbon stores and the role of deforestation in carbon emissions. Given that "one third of total emissions of developing countries is caused by land-use change and forestry – primarily deforestation" (Roeth et al. 2012:6) then reducing or preventing deforestation in developing countries is seen as having the most immediate and largest potential impact on carbon emissions in the short term. A major initiative here has been the UN's Reducing Emissions from Deforestation and forest Degradation (REDD) programme which was later expanded to "REDD+" to include forest conservation, sustainable management and reforestation. ICTs have been essential to the functioning of REDD, with an example given in Box 8.5.

Figure 8.2 Example of GIS usage to monitor deforestation in China



Box 8.5

ICT-enabled monitoring of deforestation in Brazil

The Amazon forest is the world's single largest living carbon store yet deforestation accounts for at least two-thirds of Brazil's annual carbon emissions and nearly 5 per cent of all global carbon emissions.

Initiatives to monitor and reduce deforestation are therefore of critical national and global importance. Deforestation is identified using satellite imagery that is mapped onto a GIS run by INPE, Brazil's Institute for Space Research. Data from the system has been made publicly available since the mid-2000s to provide greater transparency.

Figure 8.3 Forest ranger using GIS output and GPS device to identify and prosecute illegal deforestation in the Amazon



Data from the GIS was central to policy changes in Brazil such as legislation to control deforestation, and declaration of an increasing number of protected areas. Implementation of the new laws is the responsibility of forest rangers who use GPS devices to locate satellite/GIS-identified areas of deforestation, and then take action (see Figure 8.3). However, the relatively low resolution of the GIS, limited capacity of the ranger services and dangers of violence mean the remote

sensing data is not used in real-time, but merely for an initial rough identification of location. Rangers will then monitor areas on the ground until deforestation has built up to a certain level, then send in a team to issue fines and prosecute or remove farmers. Deforestation rates have fallen by about two-thirds following introduction of the system.

Critical success factors for the system include:

- Continuous political support for the system from central government, and protection of INPE from political interference so that it is trusted by both government and non-government groups.

- Adaptive design that listened to criticism of earlier systems from the scientific and NGO communities, and redesigned based on those criticisms.

- Data transparency that increased trust in INPE's system and also allowed other groups to perform their own analysis.

One problem has been exclusion of forest rangers from system design processes despite the rangers being clear about redesign needs including higher resolution images, and better integration of the GIS with other systems from the land registry and national mapping agency.

Four lessons emerge from the case:

- Ensure the full information value chain runs: environmental monitoring data is, on its own, of little use – the success of the INPE system comes because the information it produces is used by a set of actors inside and outside government for decisions and actions that bring results of environmental value. Design and operation of e-monitoring systems "must therefore incorporate a clear understanding

of how the information produced by those systems will be utilised, and by whom" (Rajao 2012:6). This is very similar to the lessons for e-accountability systems in Chapter 7: that monitoring alone is of limited value unless it can also be linked to environmental control.

- Separate out information value chain responsibilities: INPE's system is trusted because it only has responsibilities for information provision, separate from responsibilities for use of that information to make and implement policy decisions (by the Ministry of the Environment) and tactical decisions (by forest rangers).

- Make data freely available online: environmental monitors are then trusted as others can double-check information and can re-use the data.

- Find ways to close design–reality gaps: the current design assumptions and requirements of the system do not match on-the-ground realities of the forest rangers. This covers not just the technical issues noted above but gaps in terms of required competencies and complementary resourcing. Those who use the outputs of e-monitoring systems should therefore participate in system design processes.

Source: adapted from Rajao (2012)

8.3.2. ICTs to support environmental strategy

Probably the most important example of a strategy for environmental sustainability is the national-level environmental policies that a country creates, such as its National Adaptation Programme of Action. Policy activities can be broken into three main stages (Ospina & Heeks 2011):

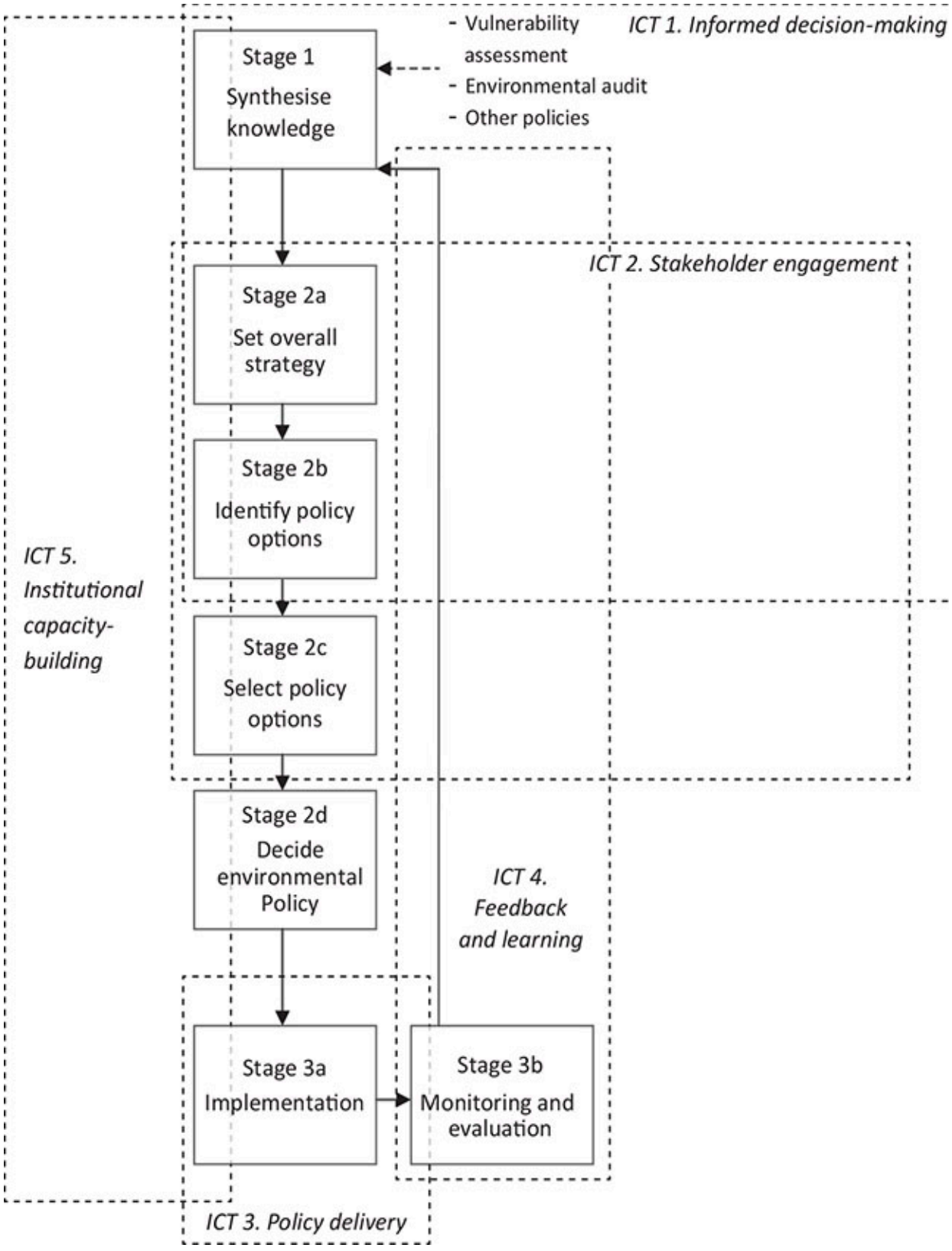
1. Gathering of information and synthesising available knowledge about the current and future state of the environment.

2. Design of the environmental policy, including making decisions about what specific measures to undertake.

3. Implementation of the environmental policy, including evaluation of the impact of that policy.

These three stages can then be broken down into more detail to help identify five different ways in which ICTs can support this policy process (this can be seen as a specific example of "e-policy" which, as noted in Chapter 7, is part of e-governance that falls under the heading of "effective governance") (see Figure 8.4, adapted from ibid.):

Figure 8.4 ICTs and formulation of environmental policy


ICT 1. Informed decision-making
- Vulnerability assessment
- Environmental audit
- Other policies
Stage 1
Synthesise knowledge
ICT 2. Stakeholder engagement
Stage 2a
Set overall strategy
Stage 2b
Identify policy options
Stage 2c
Select policy options
Stage 2d
Decide environmental Policy
ICT 5. Institutional capacity-building
ICT 4. Feedback and learning
Stage 3a
Implementation
Stage 3b
Monitoring and evaluation
ICT 3. Policy delivery

- Informed decision-making: e.g. use of digital environmental information systems to monitor current and model future environmental scenarios.

- Stakeholder engagement: e.g. awareness-raising and informing of stakeholders via digital communications, engaging stakeholders via social media and online discussion forums, use of group decision-support systems.

- Policy delivery: e.g. use of ICTs to support adaptation actions, use of ICTs to support transfer of environmental technologies, ICT-enabled environmental pricing and trading systems such as carbon markets.

- Feedback and learning: e.g. ongoing environmental monitoring via ICTs, e-governance systems to provide transparency and accountability of the resources being invested in sustainability initiatives (see Chapter 7), digital knowledge and learning systems (see Chapter 6). An example is given in Box 8.6 of front-line feedback on progress with policy implementation.

- Institutional capacity-building: e.g. use of ICTs for intra/inter-institutional networking, environmental modelling applications, e-learning systems. Making use of ICTs for environmental strategy itself requires the typical ICT4D building blocks from Chapter 2 to be in place: technology (accessible by all institutional stakeholders), data (ensuring high-quality environmental data is available), skills and knowledge (capacity-building around use of ICTs for strategic environmental purposes), etc (Ospina & Heeks 2012c).

Box 8.6

Front-line feedback on disaster risk reduction policy

Disaster management is intimately linked to environmental sustainability given the link between climate change and the increase in number and severity of climate-related disasters. Almost all countries are committed – through agreements from the ongoing UN World Conferences on Disaster Risk Reduction (DRR) – to national DRR policies. While country governments provide reports on progress with implementation of such policies, the Global Network of Civil Society Organisations for Disaster Reduction wanted to cross-check these top-down reports with on-the-ground reports on progress with DRR at a local level.

It therefore undertook the "Views from the Frontline" process, which gathered survey responses through a mix of video, email-, Web- and SMS-based questionnaires. In all there were 20,000 interviews involving 500 organisations in 69 countries, and nearly 40,000 SMS-triggered responses in 36 developing countries. A key finding was that the majority of respondents reported local disaster-related losses were increasing, and these and other findings were fed into national and UN-level processes.

The mobile-based survey system did not quite work as intended: because of the cost of texting, 99 per cent of those who were sent a text message request actually responded via the Web survey with strong skews towards older, male, urban respondents. A second phase survey using Universal Cellular Messaging Protocol, which is free to the user, was able to generate thousands of responses: the gender bias was not improved but the proportion of young and rural respondents was much higher.

The Views from the Frontline experience demonstrates that mass surveys can bring local voices and perspectives into strategic decision-making on climate change, and that ICTs are a cost-effective part of this strategy. Language, sampling strategy and wording of questions must all be carefully planned when using mobiles, and a hybrid strategy that mixes face-to-face and e-surveys seems best "with face to face work

providing reach, engagement and qualitative data; and with mobile-based eSurveys providing a low-cost broader base of more quantitative data".

Source: Gibson & Scott (2012)

8.4. e-Adaptation, e-resilience and development

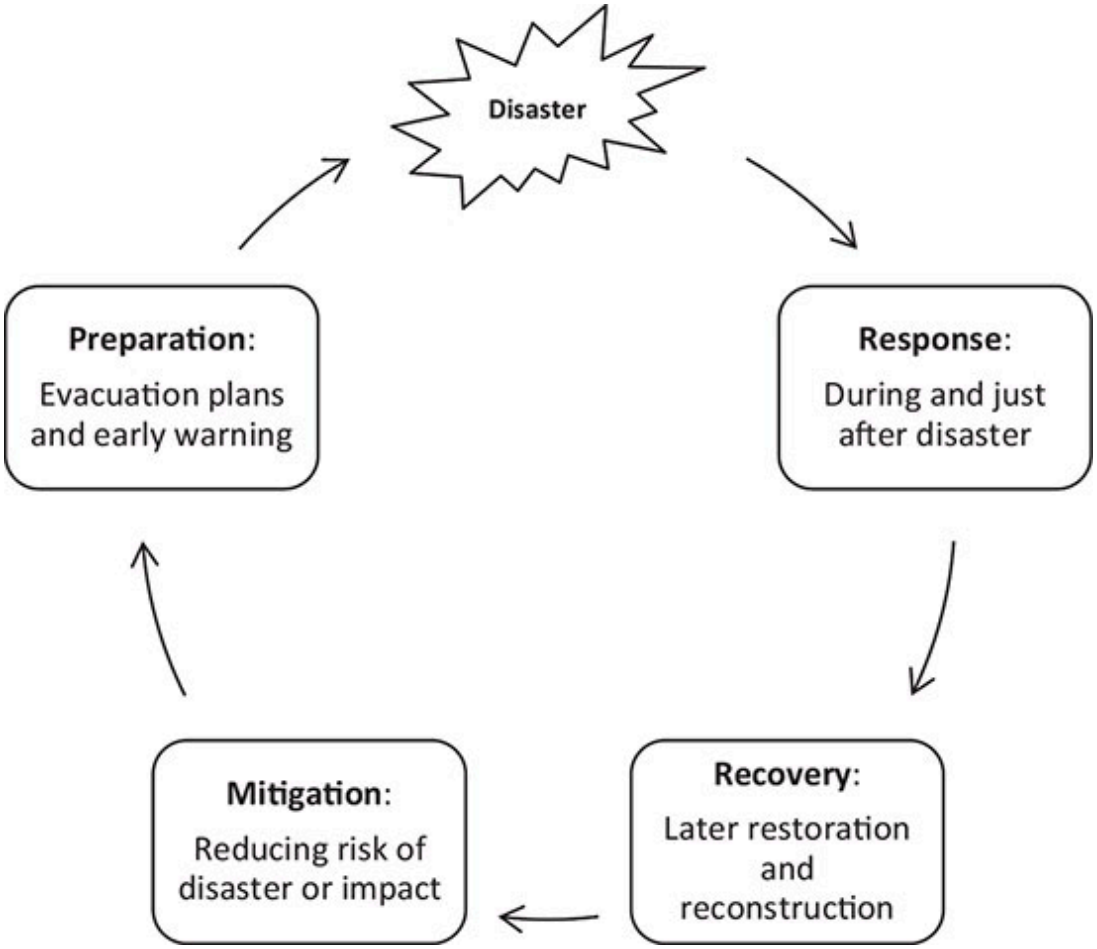
Developing countries need to adapt to two environmental factors: short-term shocks such as climate-related disasters, and longer-term trends such as climate change or growing pollution levels. We will look at the role of ICTs in each of these in turn before turning to a broader view on ICTs and adaptation through the concept of "e-resilience".

8.4.1. ICTs and disaster management

A disaster is "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (UNISDR 2009:9). Not all disasters relate to environmental sustainability. Some are human-made such as transport accidents and building collapses. And some natural disasters are unrelated to the state of the environment such as earthquakes and tsunami. Some – landslides, floods, wildfires – have some climate-relation, and others – drought, heatwaves, storms – are directly climate-related. While climate change cannot be solely blamed for particular disasters, the extent and severity of climate-related disasters has already increased as a result of climate change, and will do so further in future (Banholzer et al. 2014, IPCC 2014a).

A typical understanding of disaster management sees it as a cycle (see Figure 8.5, adapted from Chatfield & Brajawidagda 2013). We will look at the role of ICTs in each of the phases of the cycle in turn (Coppola 2007, Karanasios 2012, Yap 2012):

Figure 8.5 The disaster management cycle



Response

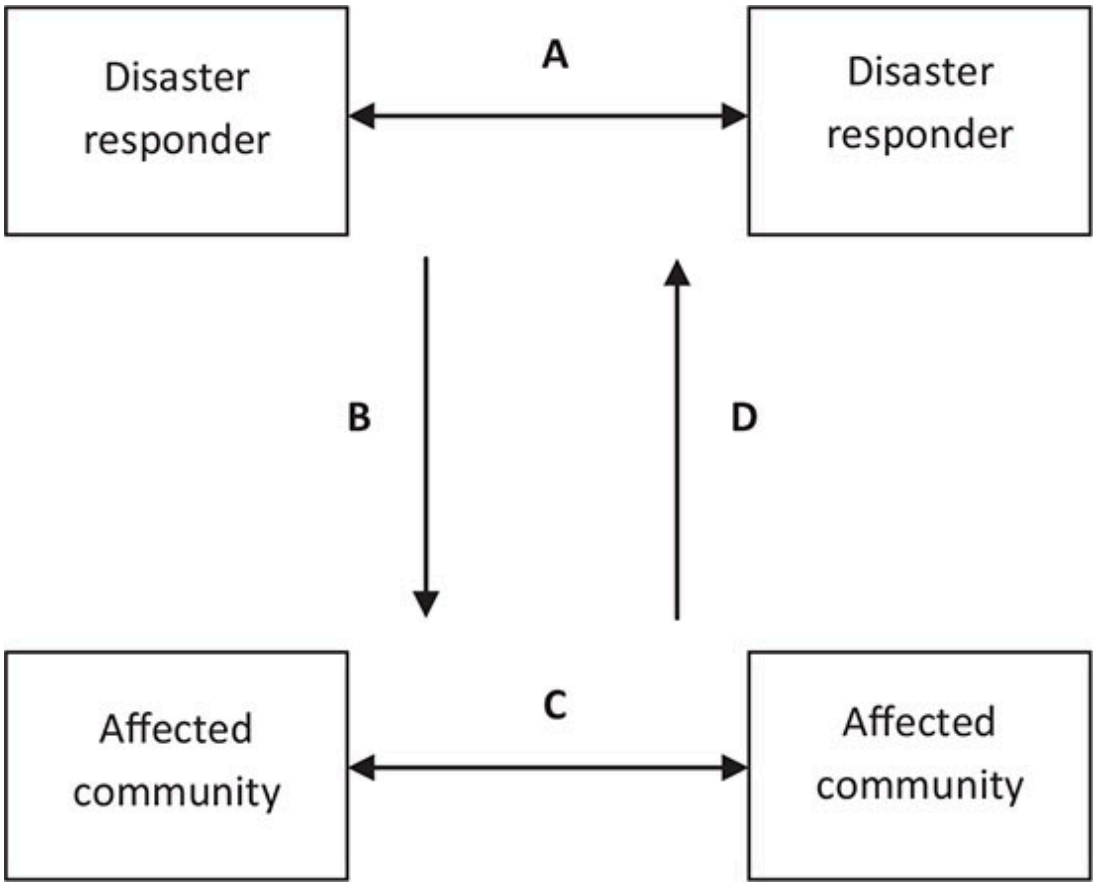
This represents the "actions taken in the immediate aftermath of a disaster, to save and protect life, property, and infrastructure. It encompasses dissemination of disaster alerts, and subsequent search, rescue and care of casualties and survivors" (Yap 2012:148). This is the phase when there is greatest and most urgent need for functioning digital communications infrastructure, but also the phase when it is most likely to be either damaged or overloaded. The advent of mobile telephony and other wireless digital infrastructure has greatly helped, and rapid-deployment wireless systems –

such as the drone-based systems mentioned earlier – are becoming an integral part of disaster response. Redundancy of communication channels is important including use of conventional broadcast channels such as radio and TV, and satellite-based communication.

Four main information flows are required during the response phase, as summarised in Figure 8.6.

A. Disaster responders need to coordinate between themselves. While email and mobile telephony can help, a shared GIS will have far greater value but can be hard to operationalise unless developed and trialled during the preparation phase. Common data and technological standards are a pre-requisite but human, organisational and political barriers often get in the way of inter-agency coordination even if the ICT infrastructure could be used. Where they do exist, remote sensing data can provide guidance on the extent and locations of floods, destruction of roads and housing, etc.

Figure 8.6 Disaster response information flows



B. Those on the ground need guidance from central response organisations. Again, email and mobile telephony are a mainstay but GIS can be much more valuable.

C. Those in affected communities often want to connect out to find nearby family and friends, or also to connect out to more distant relations to give reassurance or seek help. Sources of power for recharging mobile phones can be a basic requirement. Peer-to-peer or centrally coordinated applications – including those based around social media – to try to reconnect family members in the aftermath of a disaster have proven much more effective than previous methods.

D. A major problem in disasters is getting good quality information from the ground: remote sensing data has its limitations and is not relevant in some types of disaster. Mobile phones have helped increase

the flow of upward data but this can be overwhelming if not coordinated. Box 8.7 illustrates one way in which this can be managed.

Box 8.7

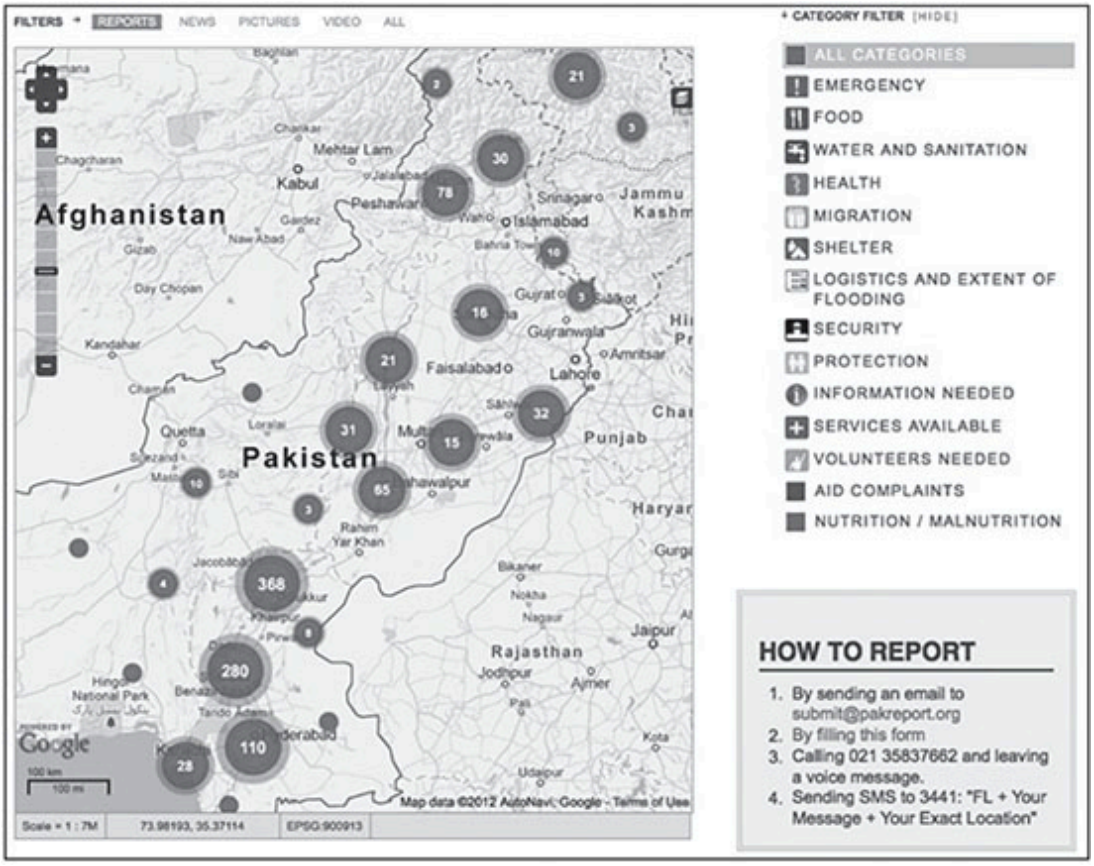
Crowdsourcing disaster reports in Pakistan

During disasters, there is an urgent need for ground-level information about which areas are affected and how. During the 2010 floods in Pakistan, "Pakreport" was deployed: a customised version of the Ushahidi software that used two forms of crowdsourcing: one for sending data and one for inputting that data. Any mobile phone owner on the ground could send an SMS message to short code 3441, prefixed "FL", giving details of flooding at their location (email and voice options were also available though little used). Then, a group of global volunteers would translate, categorise and geolocate the message. The results were then displayed online (see overview example in Figure 8.7; from Eng 2012).

Specific versions of the map – a GIS system – were made available to the various relief agencies working in Pakistan. In all, 1,500 real-time reports were received, largely about the floods themselves and related issues such as migration, shelter, water and sanitation.

Pakreport demonstrated the value of crowdsourcing during disasters as an effective means of both gathering and analysing data. It also demonstrated the value of mobile-plus-Internet-plus-server systems to combine reach and power:

Figure 8.7 Pakreport output



p.306

Mobile provided the reach down to the "bottom of the pyramid" populations who are on the front line of disasters and other climate change-related vulnerabilities. The Internet provided the reach and power to help coordinate volunteers across the world, and disseminate results to relief agencies. As the foundation, servers provided the power to collect, analyse, store and display the processed information.

(Chohan et al. 2011:8)

And Pakreport also demonstrated the importance of the information value chain. Because it was deployed during rather than before the disaster, the initial focus was on the data end of the value chain, with little time at first "to make relief agencies aware of the application, and to help ensure the information produced was being used to guide field decisions and actions" (ibid.:7). The design of disaster response

information systems must therefore consider the whole chain, so that the value of information produced is realised through decisions, actions and results on the ground.

Source: Chohan et al. (2011)

Recovery

This is typically understood as a rehabilitation phase that restores basic services and functions (electricity, water) to the system (community, region, etc), and a reconstruction phase that fully restores the system back to its former functioning in terms of housing, hospitals, schools, roads, factories and all other structures of social and economic development. This becomes very similar to general development activities and we have therefore covered this role of ICTs in earlier chapters.

Mitigation

This phase seeks to either reduce the likelihood that the disaster will occur or to reduce its consequences. This is typically done by mapping potential hazards (the root cause of disasters) and vulnerabilities (which exacerbate the impact of disasters) and then taking relevant action. ICTs can support the mapping process – quite literally in the case of GISs – and can also provide support to decision-making and implementation of hazard mitigation actions. A number of examples of this have occurred in urban areas, for example using local volunteers and open source GIS such as OpenStreetMaps (WB 2016), but Box 8.8 gives an example from a rural area. Box 8.6 above gave an example of front-line monitoring of disaster mitigation and preparation plans.

Box 8.8

Hazard mitigation through PPGIS in Vietnam

Upland areas in Vietnam have seen greater numbers and intensity of rainstorms over time, and an increased incidence of landslides which cause loss of life and agricultural land, and damage to property and transport links. A public-participation geographic information system (PPGIS) project was undertaken in an effort to reduce the incidence and severity of landslides in A Luoi district in Vietnam's mountainous Central Highlands. The project involved four steps:

- Step 1: Hazard mapping. As a top-down action, topographic, land use and climate data were loaded onto a GIS. As a bottom-up action, meetings were held with commune members to identify on a GIS-based map the most problematic areas for landslides. Site visits combined with GIS risk calculations produced a set of priority locations for action.

- Step 2: Option testing. Construction of physical barriers was rejected by both local government and communities, and instead the development of bamboo plantations was identified as the most locally acceptable hazard mitigation option.

- Step 3: Location selection. Based on their local knowledge, farmers were asked to choose those hazard priority locations which would be most suitable for bamboo planting. The four identified locations were then cross-checked with GIS calculations using data on issues such as topology, land use and housing. A final physical cross-check of each site was then undertaken.

- Step 4: Action plan. With location selection data input onto the GIS, a plantation planning map was produced and shared at a stakeholder workshop. The bamboo planting was adopted as a combined local government and community priority action.

Source: Huu et al. (2012)

Preparation

This includes evacuation plans, training of front-line responders, and early warning systems. ICTs play an increasing role in early warning of disasters and are involved at the three main stages of the information value chain: information-gathering, decision and action. Monitoring systems gather information about hazards: for example, remote satellites monitor storm systems and fires, and on-the-ground sensors monitor water levels and earthquakes. As in other phases, GIS will be a key tool. The decision to trigger a warning is usually taken by humans, but can increasingly be automated if certain pre-determined conditions are met. Action to disseminate the warning is generally multi-channel with ICTs being added to traditional radio, TV and public address/alarm systems. Automated SMS and phone calls are integrated into early warning systems, as is use of social media to maximise the chance that the warning message is received in time. In more remote areas, human phone calls can still be effective, as Box 8.9 indicates.

Box 8.9

Phone-based flood early warning in Nepal

Floods are an increasing problem in rural areas of Nepal, but ICT infrastructure is often limited to mobile phone communication only. To help reduce the damage to property and livestock, a project by NGO Practical Action sought to connect upstream villages, which became aware of river flooding at an early stage but were not badly affected by it, and downstream villages where floods caused most damage.

The project provided a phone list of key contacts in both upstream and downstream communities. When there is continuous heavy rain, those in the upstream areas phone and warn those in the downstream communities, who are then able to prepare and evacuate livestock, property, family, etc. They also warn about landslides that may block planned transport routes.

> In return, those in the downstream – more populated, better connected and more commercial – areas, provide information on markets, agricultural practice and development opportunities. … Downstream communities now have a lead time of one-two hours in warning against floods, which has enabled households to save not just valuable documents, belongings, animals, etc but also – and most importantly – lives.
>
> (Giri & Malakar 2011:2–3)

Key to the project's success have been two things. First, simplicity: it worked with a technology that was already in use – mobile phone calls – rather than trying to introduce a new technology. Second, it answered the ICT4D prime question – "Why should I do this?" – by ensuring both upstream and downstream communities were motivated to continue. Upstream contacts get valuable agricultural information, downstream contacts get flood warnings, and both sets build "bridging" social capital with each other (see Chapter 5).

Source: Giri & Malakar (2011)

8.4.2. ICTs and climate adaptation

Although there are other environmental trends to which developing country populations must adapt, climate change is far and away the dominant one. This includes changes to key climate markers such as temperature and precipitation, changes to climate events such as the intense hazard events described above that can trigger disasters, and change to trends such as seasonality (Ospina & Heeks 2012b). Direct physical effects, alongside those just listed include rising sea levels, melting glaciers, and rising acidity of seas and other water sources. The role of climate change in these outcomes is scientifically supported though the specific contribution of climate change to any individual outcome is harder to identify (IPCC 2014a).

The impact of climate change is widespread across the globe, but the hardest hit are the poor in the global South who face a double whammy. They are least able to access the resources necessary to cope with climate change. And they are already the most vulnerable populations, but climate change exacerbates those existing vulnerabilities in various ways (WB 2003, Ospina & Heeks 2012a, Leichenko & Silva 2014):

- Food security (agriculture): climate changes and associated effects such as desertification impact crop yields and livestock productivity and food prices, and thus diminish food security.
- Habitat (settlement and displacement): coastal settlements are under particular threat and migration from climate-threatened areas will place additional loads, especially on urban settlements.
- Water: changes in precipitation, salinisation and loss of glaciers adversely affect water supply.
- Health: climate change is related to heat- and cold-related illness, and to changing incidence of vector-borne and infectious diseases.

These, in turn, will impact two other areas of potential vulnerability:

- Livelihoods and finance: for example, reducing incomes and the sustainability of rural livelihoods.
- Socio-politics: in impacting livelihoods, resource shortages and large-scale migration, climate change may also worsen fragile socio-political contexts in developing countries.

Not all impacts of climate change are negative – for example, new crops may become viable where previously they were not – but the poor are least able to take advantage of any opportunities climate change offers. For them, climate change almost entirely represents a threat to their future livelihood.

Climate change is not isolatable by science as an environmental phenomenon, and the impacts of climate change are mediated through existing vulnerabilities. Thus the poor would rarely identify themselves as specifically adapting to climate change. Instead, they adapt to various contextual vulnerabilities as they arise. Because of this, it is very hard to build a clear boundary around e-adaptation applications and processes. Typical examples of ICT application would be (Ospina & Heeks 2012b):

- Food security (agriculture): ICT-enabled assistance to improve agricultural productivity or obtain better prices for outputs.
- Habitat (settlement and displacement): ICT-enabled planning of more resilient housing designs and location.
- Water: use of ICTs to disseminate messages about better water conservation.
- Health: use of ICTs to disseminate information on prevention and treatment of new diseases.
- Livelihoods and finance: ICT-enabled methods of getting or making more money.
- Socio-politics: ICT-enabled improvements in political participation.

In general, then, these applications look very similar to those discussed in earlier chapters, making it hard to distinguish ICT4CCA (climate change adaptation) applications from ICT4D applications. An example of this rule – and also an exception – are illustrated in Box 8.10, but the general application of the rule has at least two implications.

Box 8.10

ICT4CCA as ICT4D: an example and an exception

As noted in the main text, most current e-adaptation applications are actually general ICT4D applications that also include support for adaptation. Bangladesh's ICT-enabled "plant clinics", based in the coastal area in the south-west of the country, are an example (Haq et al. 2011). Farmers call in via mobile to community-based extension workers – so-called "plant doctors" – with any plant-related query around seed varieties, pests, fertiliser dosage, etc. The plant doctors also undertake field visits armed with laptops and digital cameras. Plant doctors respond via their own local knowledge, an online database of typical solutions, or via email contact with agricultural scientists in the capital, Dhaka. The plant clinics will address any issue, but this has included dealing with climate change-related issues including increasing salinity in the soil due to sea-level rise, and more frequent flooding, delays to onset of monsoon rains, and crop failures due to erratic weather patterns.

The lessons from this and similar projects (Braun & Islam 2012) are that climate change adaptation support needs to be integrated into broader agricultural information systems; that climate change adaptation information must be locally relevant and action-oriented; and that community-based intermediaries (such as the plant doctors) are vital to e-adaptation systems since they add value by "translating external information into locally relevant messages; integrating global and local knowledge; bridging the power gap between farmers and supply chain institutions; bridging the digital gap between farmers and the global ICT infrastructure; and so on" (ibid.:8).

There are adaptation-specific uses of ICTs – and these may grow in future – but they are rare. One genre would be ICT-enabled networks dedicated to sharing information on climate change adaptation. The AfricaAdapt network is an example: a Web portal supported by email,

> Skype, wikis and other ICT applications which helps members across the continent from government, NGO and academic institutions to share knowledge related to climate change adaptation (Harvey & Mitchell 2011).

First, one would neither recommend nor expect to see separate e-adaptation applications. Instead, one would look to understand how climate change was impacting a particular area and then prioritise use of ICTs according to those impacts. Because of the local specificity of not just climate effects but also their interaction with existing vulnerabilities, top-down and mass-scale e-adaptation seems a less appropriate model than more localised support that builds the capacity to recognise and adapt to emergent climate change impacts (Pant & Heeks 2012). This notion of using ICTs to build local adaptive capacity is akin to the arguments behind e-resilience (see next section). Such systems, though, must not be isolated but link to higher-level information systems at regional and national level: those links help to draw in external resources including ideas and knowledge for better adaptation, and to feed into higher-level strategy-making as demonstrated in Box 8.6.

Second, and because of a perceived lack of clarity and lack of novelty around e-adaptation, it can be given a low priority by consultants, researchers, ICT innovators and others. This despite the fact that adaptation to climate change is such a necessity for those at the base of the pyramid. One impact has been a greater focus on e-mitigation. For the ICT sector, for example, green and smart ICT provide a much better basis for innovation and sales than e-adaptation. So there is a danger of a mismatch between top-down and bottom-up e-environment priorities: the former prioritising e-mitigation, the latter prioritising e-adaptation. Added to the challenge of dealing with climate change sceptics and deniers, this also helps explain why application of ICTs in disasters and resilience may take more of the limelight than use in climate change adaptation.

8.4.3. e-Resilience

Developing countries must not only deal with environmental shocks and trends but other shocks (such as economic crises and health epidemics) and other trends (such as migration and economic restructuring) (text here and below adapted from Heeks & Ospina 2016). Encompassing this broader scope, the solution is well-known, which is that countries must become more resilient. That is because resilience is defined as the ability of vulnerable systems – countries, regions, communities, supply chains, organisations – to withstand, recover from, adapt to, and potentially transform amid change and uncertainty. Resilience will therefore play a crucial role in the achievement of development outcomes.

Using the University of Manchester's RABIT (Resilience Assessment Benchmarking and Impact Toolkit) model, resilience can be understood through its nine attributes. Three are primary foundations of resilience: robustness, self-organisation, learning. Six are secondary enablers of resilience: redundancy, rapidity, scale, diversity, flexibility, equality. The stronger these are, the more resilient a system will be, and ICTs can strengthen resilience – building "e-resilience" – through improvements in each of the resilience attributes.

Table 8.2 (adapted from Ospina 2013 and Heeks & Ospina 2015) provides more detail. It defines each of the attributes of resilience using the example of an individual community (combining diversity and flexibility due to their overlap). And it gives an illustrative example of e-resilience: a way in which ICTs can increase resilience in a developing country setting.

Table 8.2 The RABIT model of resilience and e-resilience

Resilience attribute	*Definition*	*e-Resilience example*
FOUNDATIONAL ATTRIBUTES OF COMMUNITY RESILIENCE		
Robustness	• Ability of the community to maintain its characteristics and performance in the face of environmental shocks and fluctuations.	• Use of GIS to help plan the location of physical defences such as storm drains or dykes.
Self-organisation	• Ability of the community to independently re-arrange its functions and processes in the face of an external disturbance, without being forced by external influences.	• Use of mobile phones as outlined in Chapter 5 to strengthen social networks within local communities.
Learning	• Capacity of the community to generate feedback with which to gain or create knowledge, and strengthen skills and capacities. Closely linked to the community's ability to experiment, discover and innovate.	• Use of data visualisation and decision-support tools to support learning and knowledge-building around environmental risks.
ENABLING ATTRIBUTES OF COMMUNITY RESILIENCE		
Redundancy	• Extent to which community resources and institutions are substitutable; for example, in the event of disruption or degradation.	• Use of mobiles and other ICTs as outlined in Chapter 5, to deliver additional financial resources.
Rapidity	• Speed at which assets can be accessed or mobilised by community stakeholders to achieve goals in an efficient manner.	• Use of mobiles as outlined in Chapter 5 to speed up access to, and mobilisation of, financial assets
Scale	• Breadth of assets and structures a community can access in order to effectively overcome or bounce back from or adapt to the effects of disturbances.	• Use of mobiles as outlined in Chapter 4 to improve access to higher-level economic structures such as markets and supply chains.
Diversity and flexibility	• Ability of the community to undertake different courses of actions with the resources at its disposal, while enabling them to innovate and utilise the opportunities that may arise from change.	• Use of social media to bring a more diverse range of views into decision-making, and the way in which ICTs are multi-purpose and thus able to increase the flexibility of social and economic processes.
Equality	• Extent to which the community provides equal access to rights, resources and opportunities to its members.	• Use of mobile and Internet applications as outlined in Chapter 7 to provide more equal and consisten access to public services.

However, alongside this strengthening role, ICTs can also weaken resilience (ibid.). For example, greater integration into and dependence upon external

institutions through digital connections can cause self-organisation to diminish. And any growth in digital divides can reduce equality within a system. Any intervention therefore needs to target those attributes of resilience that most need strengthening, and then identify pro-resilience applications of ICTs, as the example in Box 8.11 outlines.

Box 8.11

Building e-resilience in Ugandan coffee communities

Agricultural communities in developing countries are at risk from climate change, shifts in demand and price, crop/livestock disease, conflict and other stressors. They therefore need to become more resilient, and ICTs can assist this process. As an example, e-resilience priorities were identified in the coffee-growing communities around Mount Elgon in eastern Uganda; an area in which climate change is starting to impact farmers' lives.

Those priorities were identified by combining two rankings:

- First, a ranking of community resilience attributes in general, to find which were strongest and which were weakest. By analysing community interviews about resilience, for example, rapidity was seen as currently the weakest part of resilience within the community while redundancy was seen as the strongest.

- Second, a ranking of e-resilience: the existing contribution levels of ICTs in relation to each of the resilience attributes. From the results of a community survey, for example, robustness was found to be the attribute with greatest potential for more use of ICTs while self-organisation had least potential.

The two rankings were presented to, and discussed with key stakeholders, including use of data visualisations such as that shown in Figure 8.8, which summarises e-resilience within the community.

By combining the two rankings, a prioritisation was obtained. High-priority attributes (i.e. those which were relatively weak overall in the community but also to which ICTs were not yet contributing much) were then discussed further to identify actions that could be taken to improve coffee farmers' e-resilience in the Mount Elgon region. For example, scale was identified as the highest priority attribute, and actions identified included:

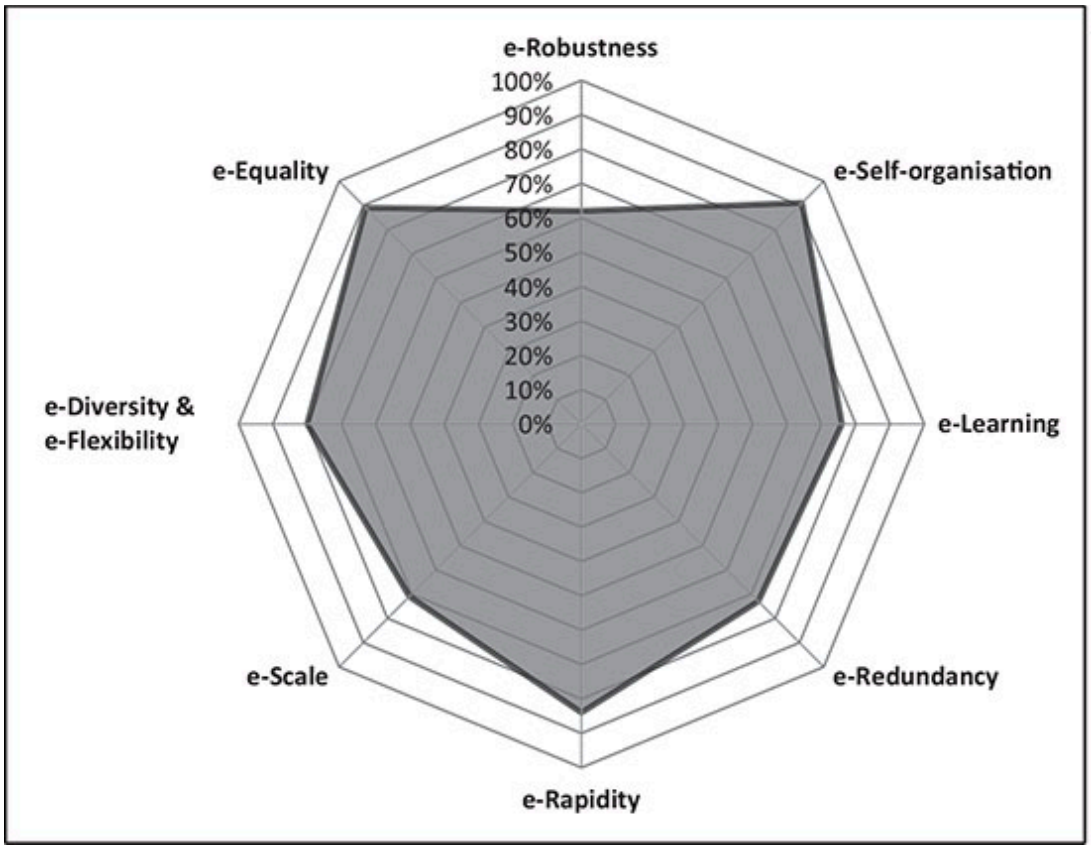
- Fostering farmers' ability to make use of external weather information from national-scale organisations such as FEWS NET (a well-established food security system that provides seasonal forecasts and makes the information available online (see Chapter 6 for an example)).

- Use of ICTs to facilitate multi-stakeholder dialogue and information sharing on climate change-related projects/issues in the Mount Elgon region (e.g. sharing project information and local activities through Facebook, mailing lists, Twitter, WhatsApp, etc).

- Use of ICTs to raise farmers' awareness about financial services that are available at various levels (e.g. local, regional).

Source: Ospina et al. (2016)

Figure 8.8 Contribution of ICTs to community resilience attributes



We have only had time to scrape the surface of the connections between ICTs and resilience, and there is much to be done in terms of both research and practice on this topic. However, with resilience likely to form a core component of future development plans, e-resilience looks to be an area of growing interest in international development.

Additional material

Discussion questions

8.1. Why is it important for development to be sustainable?

8.1. Which of the four application areas of the overview model do you think is most important to environmental sustainability, and why?

8.2.1. What more could your national government be doing in relation to green ICT and reducing the carbon footprint of ICTs?

8.2.1. What more could your national government be doing to help reduce e-waste, including greater recycling?

8.2.2. Which of the four second-order effects – physical dematerialisation, journey substitution, smart optimisation, indirect optimisation – do you think could make the biggest contribution to mitigation, and why?

8.2.3. Combining first-, second- and third-order effects of ICTs, what is the overall effect of ICTs on carbon-equivalent emissions likely to be over the next 20 or so years?

8.3.1. Which type of environmental e-monitoring system – cause-focused, direct impact-focused, indirect impact-focused – would you recommend prioritising, and why?

8.3.2. If you could select only one of the five ways in which ICTs can support environmental policy making, which one would it be, and why?

8.4.1. If you could work on only one of the four areas of ICT support for disaster management – response, recovery, mitigation, preparation – which would it be, and why?

8.4.2. Why are adaptation-specific applications of ICTs rare, and what should be done to address this?

8.4.3. Is resilience a sufficiently important development issue to warrant making ICT4D investments?

Assignment question

Are ICTs part of the problem or part of the solution vis-à-vis climate change?

Further reading

If you would like to know more about . . .	8.1. sustainable development as a development goal	. . . then take a look at . . .	8.1. Elliott, J. (2013) *An Introduction to Sustainable Development*, Routledge, London >Provides an overview of sustainable development UNWCED (1987) *Our Common Future*, UN World Commission on Environment and Development, Geneva >Mostly referred-to in terms of its one-line definition, the Foreword and Overview still provide a valuable basis for understanding sustainable development
	8.1. ICTs and environmental sustainability		8.1. Hilty, L.M. & Hercheui, M.D. (2010) ICT and sustainable development, in: *Proceedings of HCC9/CIP2010*, J. Berleur, M.D. Hercheui & L.M. Hilty (eds), Springer, Heidelberg, Germany, 227–235 >An overview of ways to conceptualise the connection between ICTs and (mainly environmental) sustainability Souter, D. (2015) *Advancing a Sustainable Information Society for All*, UN Department of Economic and Social Affairs, New York >More detailed overview of the relation between ICTs and (mainly environmental) sustainability Ospina, A.V. & Heeks, R. (2012a) Unveiling the links between ICTs and climate change in developing countries, in: *ICTs, Climate Change and Development*, R. Heeks & A.V. Ospina (eds), Centre for Development Informatics, University of Manchester, UK, 6–38 >Reviews the relation between ICTs and climate change in terms of debate, research, and future research agendas
	8.2.1. green ICT and development		8.2.1. Hanne, F.Z. (2011) GREEN-IT: why developing countries should care, *International Journal of Computer Science Issues*, 8(4), 424–427 >Brief overview of the issues Balde, C.P., Wang, F., Kuehr, R. & Huisman, J. (2015) *The Global e-Waste Monitor 2014*, IAS – SCYCLE, United Nations University, Bonn, Germany >Comprehensive overview of e-waste globally, but therefore including developing countries
	8.2.2. smart ICT and development		8.2.2. Roeth, H. & Wokeck, L. (2012) ICTs and climate change mitigation in emerging economies, in: *ICTs, Climate Change and Development*, R. Heeks & A.V. Ospina (eds), Centre for Development Informatics, University of Manchester, UK, 78–115 >Alongside discussion of climate change emissions and mitigation more generally, looks at the various different smart ICT applications

	8.2.3. third-order effects and development		8.2.3. Berkhout, F. & Hertin, J. (2001) *Impacts of Information and Communication Technologies on Environmental Sustainability*, SPRU, University of Sussex, UK >Early overview of all three orders of effect, including third-order but without a specific developing country focus
	8.3.1. environmental e-monitoring systems		8.3.1. Pratihast, A.K., DeVries, B., Avitabile, V., de Bruin, S., Kooistra, L., Tekle, M. & Herold, M. (2014) Combining satellite data and community-based observations for forest monitoring, *Forests*, 5(10), 2464–2489 >A case example of combining remote and ground-level monitoring data to support REDD+ and to monitor deforestation
	8.3.2. ICTs and environmental strategy		8.3.2. Ospina, A.V. & Heeks, R. (2011) *ICTs and Climate Change Adaptation*, Strategy Brief 1, Centre for Development Informatics, University of Manchester, UK >Overview model as per main text, with a few more illustrations of ICT usage
	8.4.1. ICTs and disaster management		8.4.1. Yap, N.T. (2012) Disaster management, developing country communities & climate change: the role of ICTs, in: *ICTs, Climate Change and Development*, R. Heeks & A.V. Ospina (eds), Centre for Development Informatics, University of Manchester, UK, 140–179 >Model and illustration of application areas of ICTs to disaster management, plus discussion of issues and recommendations
	8.4.2. ICTs and climate change adaptation		8.4.2. Pant, L.P. & Heeks, R. (2012) ICT-enabled development of capacity for climate change adaptation, in: *ICTs, Climate Change and Development*, R. Heeks & A.V. Ospina (eds), Centre for Development Informatics, University of Manchester, UK, 116–139 >Reviews nature of climate change adaptation processes, use of ICTs to build adaptation capacity, issues and an overview model
	8.4.3. e-Resilience		8.4.3. Heeks, R. & Ospina, A.V. (2015) Analysing urban community informatics from a resilience perspective, *Journal of Community Informatics*, 11(1) >Slightly more detailed explanation of RABIT model and application to urban communities Heeks, R. & Ospina, A.V. (2016) *Benchmarking, Visualising and Strengthening ICTs' Impact on Urban Community Resilience: A Costa Rica Case Study*, Centre for Development Informatics, University of Manchester, UK >An alternative application of the RABIT model, in an urban community

9 The future of ICT4D

In reading this chapter, you will learn to:

- identify key technological trends of relevance to the future of ICT4D;
- explain the technologies, innovations and challenges of Development 2.0;
- explain the technologies, innovations and challenges of data-intensive development;
- explain the technologies, innovations and challenges of open development;
- consider the terminology of ICT4D's future.

The previous chapters – whether discussing the background to ICT4D, or ICTs' contribution to specific development goals – have largely focused on the past and current state-of-play. Chapter 9 reorients to look at the future of ICT4D. Of course this introduces more uncertainty and recalls Niels Bohr's famous phrase, "Prediction is very difficult, especially about the future". But there are opportunities and challenges ahead that we should try to consider.

9.1. Future directions in ICT4D

If we break down ICT4D, then the future of "D" has to some extent been identified in Chapter 1. The traditional development system – dominated by

the UN, the "Bretton Woods" institutions of the World Bank and International Monetary Fund, and donors from the global North – is in relative decline in the face of growing South-South development activity driven notably by emerging economies in Asia, the growing role of the private sector in development, and economic growth in low-income countries. And we know from the experience of the Millennium Development Goals that the influence of UN goals has its limits; being stronger on discourse and resourcing of international development than on policy and practice (Heeks 2014a). Nevertheless, the Sustainable Development Goals will be the single main shaper of the international development agenda up to 2030.

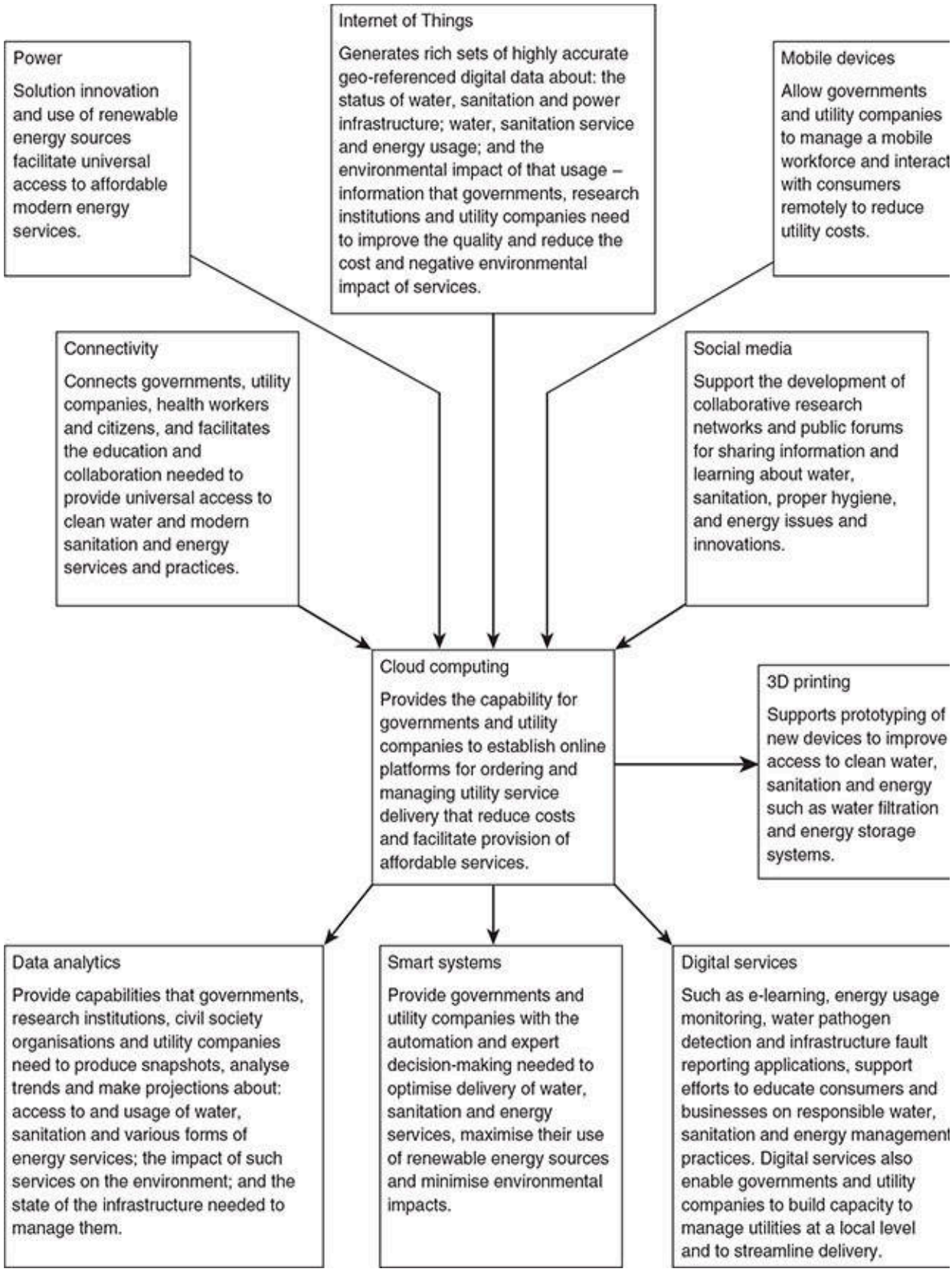
Predicting trends in the "ICT" component is tricky if we look to the longer term but in the short term, we can base our understanding on technologies already emerging (NetHope 2015):

- Power: nano-, micro- and mini-grid systems including use of renewables producing power for a small area – from individual homes up to a local community.
- Mobile devices: growing prevalence of smartphones with greater functionality and more natural interfaces.
- Connectivity: growing prevalence of broadband including mobile broadband, and fewer unconnected spaces due to innovations in satellite, drone, wi-fi and "white space" technologies.
- Internet of Things: "the internetworking of physical devices, vehicles . . . buildings, and other items [things] – embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data" (WP 2017c). It is estimated that up to 100 billion devices will be connected by 2025, enabled by the roll-out of Internet protocol version 6 (IPv6) (ISOC 2015). (IPv6 is a protocol for identifying Internet-connected devices

which expands connectivity potential beyond a few billion Internet addresses possible under IPv4 to allow an almost infinite number of devices to be connected.)

- Cloud computing: "the practice of using a network of remote servers hosted on the Internet to store, manage and process data" (NetHope 2015:35) with growing use of cloud as it becomes ever-cheaper.
- Data analytics: growing availability of digital data combined with growing ability to analyse and visualise that data.
- Social media: "interactive platforms via which individuals and communities share, co-create, discuss, and modify user-generated content" (Kietzmann et al. 2011:241).
- Digital services: especially growth in m-services in domains such as m-agriculture, m-health, m-learning, m-government and m-finance.
- Smart systems: which automate not only data gathering and analysis but also linked decisions and actions. Smart devices embed all this within a single object; smart systems link together multiple components; intelligent systems can learn from past decisions.
- 3D printing: "allows production of physical objects . . . from a design using any of a number of different materials" including metals and plastics (NetHope 2015:50).

Figure 9.1 Application of emerging ICTs to water, sanitation and energy sector development


Power
Solution innovation and use of renewable energy sources facilitate universal access to affordable modern energy services.
Internet of Things
Generates rich sets of highly accurate geo-referenced digital data about: the status of water, sanitation and power infrastructure; water, sanitation service and energy usage; and the environmental impact of that usage – information that governments, research institutions and utility companies need to improve the quality and reduce the cost and negative environmental impact of services.
Mobile devices
Allow governments and utility companies to manage a mobile workforce and interact with consumers remotely to reduce utility costs.
Connectivity
Connects governments, utility companies, health workers and citizens, and facilitates the education and collaboration needed to provide universal access to clean water and modern sanitation and energy services and practices.
Social media
Support the development of collaborative research networks and public forums for sharing information and learning about water, sanitation, proper hygiene, and energy issues and innovations.
Cloud computing
Provides the capability for governments and utility companies to establish online platforms for ordering and managing utility service delivery that reduce costs and facilitate provision of affordable services.
3D printing
Supports prototyping of new devices to improve access to clean water, sanitation and energy such as water filtration and energy storage systems.
Data analytics
Provide capabilities that governments, research institutions, civil society organisations and utility companies need to produce snapshots, analyse trends and make projections about: access to and usage of water, sanitation and various forms of energy services; the impact of such services on the environment; and the state of the infrastructure needed to manage them.
Smart systems
Provide governments and utility companies with the automation and expert decision-making needed to optimise delivery of water, sanitation and energy services, maximise their use of renewable energy sources and minimise environmental impacts.
Digital services
Such as e-learning, energy usage monitoring, water pathogen detection and infrastructure fault reporting applications, support efforts to educate consumers and businesses on responsible water, sanitation and energy management practices. Digital services also enable governments and utility companies to build capacity to manage utilities at a local level and to streamline delivery.

The “D” and the “ICT” can be put together as ICT4D by understanding how all emerging ICTs can be applied to specific development sectors, with an example given in Figure 9.1 (adapted from NetHope 2015).

Alongside this generic application of all emerging technologies to particular development sectors, we can also look for emerging ICT4D models. This chapter will discuss three such models: Development 2.0, data-intensive development and open development.

9.2. Development 2.0

“Development 2.0” has been used in three different ways:

- As a generic idea of a new phase in international development, without any particular connection to ICTs (Brainard & Chollet 2008).
- As a generic ICT4D concept of “new ICT-enabled models that can transform the processes and structures of development” (Heeks 2010b:1) – the definition here rests on the extent and definition of transformation.
- As a specific ICT4D concept meaning the application of Web 2.0 technologies and models to international development (Thompson 2008). This is the meaning used in the section that follows.

If Development 2.0 is the application of Web 2.0 to development, then we must understand Web 2.0 which can be defined as “openly available online technologies that allow creation, editing and sharing between (often large) groups of people via a web-browser” (Bower 2016:765). “Web 2.0 harnesses the Web in a more interactive and collaborative manner, emphasizing peers’ social interaction and collective intelligence” and consists of both technologies and the models for using those technologies (Murugesan

2007:34). This might also suggest "Development 0.0" was pre-Digital Development, and "Development 1.0" was a model associated with Web 1.0.

9.2.1. The technologies of Development 2.0

Web 2.0 is based upon a set of technical architectures and programming tools that enable the simplicity and interoperability of its user applications. These can be broken down into four categories (Cook 2008) which can be understood as "affordances" of Web 2.0 in the terminology explained in Chapter 1.

> *Communication*: "Communication platforms allow people to converse with others, either by text, image, voice or video" (ibid.:13). For example:
>
>
>
> • Blogs: "A blog, short for Web log, is a powerful two-way Web-based communication tool. A blog is a Web site where people can enter their thoughts, ideas, suggestions, and comments. Blog entries, also known as blog posts, are made in journal style and . . . might contain text, images, or links to other blogs and Web pages" (Murugesan 2007:35). Key characteristics of blogs include the simplicity of creating entries that appear online, the ready link to related material online, and the ability of readers to post comments.
>
> • Microblogs: "a form of blogging where users publish very short text updates" (IIED 2009:108), with the best-known example being Twitter. Microblogging allows real-time updates on issues, (brief) interactions on topics, and ease of following other microbloggers.
>
> Examples of my ICT4D-related blog (upper half) and microblog (lower half) sites are shown in Figure 9.2.

Figure 9.2 ICT4D blog and microblog examples



Figure 9.3 Example of ICT4D-related wiki entry



Cooperation: "Sharing software enables people to share content with others in structured and unstructured ways" (Cook 2008:13). This includes technologies for sharing particular types of content: video files, audio files/podcasts, images, with YouTube being an example of the former. It also includes social bookmarking which allows users to save and share links to content of interest online.

Collaboration: "Collaboration tools encourage people to collaborate with each other on particular problems, directly and indirectly in both central and distributed ways" (Cook 2008:13). For example:

- Wikis: "A wiki is a simple yet powerful Web-based collaborative-authoring . . . system for creating and editing content. It lets anyone add a new article or revise an existing article through a Web browser" (Murugesan 2007:35). Wikipedia is the best-known example, and Figure 9.3 shows the entry on ICT4D (and, no, I didn't write it).

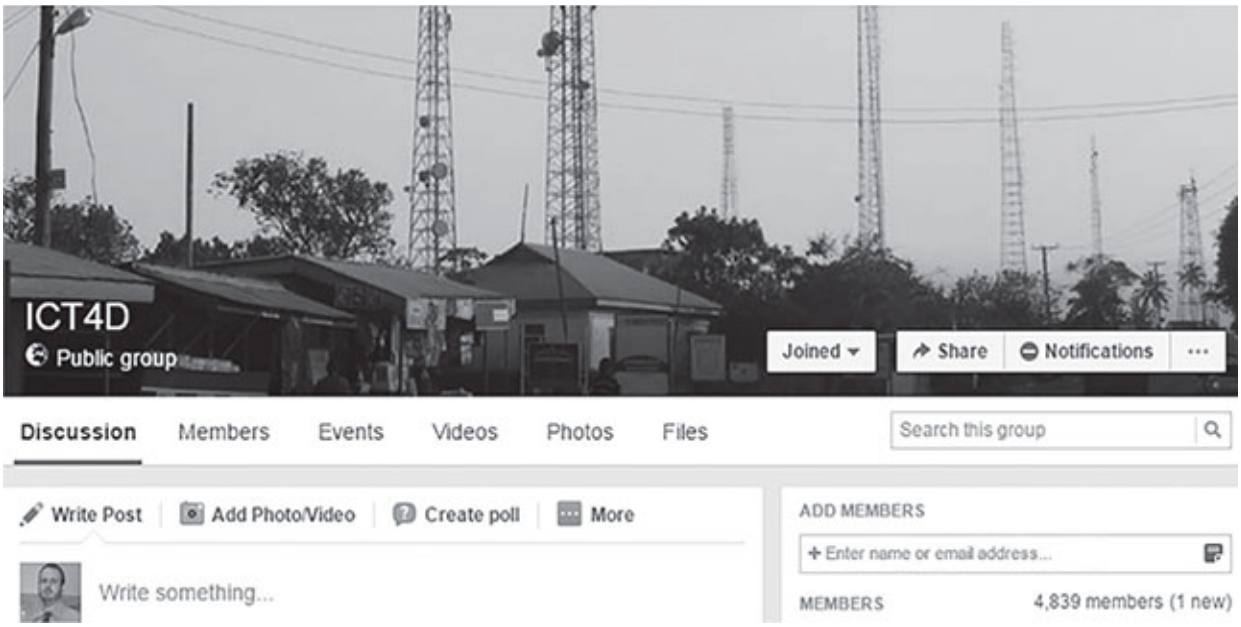
Connection: "Networking technologies make it possible for people to make connections with and between both content and other people" (Cook 2008:13). They include: mashups which allow data from multiple online sources to be combined; syndication which allows Web content, particularly content updates, to be automatically distributed to other websites or subscribers; and tagging which associates keywords

(metadata) with Web content and thus allows it to be identified much more easily during searches (IIED 2009).

In practice, Web 2.0 applications overlap across the categories described above, and so we can add a fifth categorisation – *combination* – this particularly being true of a final technology:

- Social networking sites: these are "online community platforms which . . . enable users to establish and make visible relationships, discuss topics of interest, access material, find contacts and encourage the growth of networks of people [and] . . . provide a variety of ways for users to interact, such as messaging and instant messaging, membership profiles . . . online discussion forums, blogs, photo- and videosharing, and other digital resources" (ibid.:112). With a main focus on communication and cooperation, they therefore also allow some aspects of collaboration and connection, and help create communities of interest around specific topics. Probably the best-known platforms are LinkedIn and Facebook, with Figure 9.4 showing the main ICT4D group on Facebook.

Figure 9.4 Example of ICT4D-related social networking group



9.2.2. Development 2.0 innovations

Development 2.0 can be seen as underpinned by six forces that shape the novelty of Web 2.0 (Anderson 2012). Two of these – large-scale data and openness – will be discussed in subsequent sections, and that leaves four that can form the specific basis for Development 2.0 innovations. In some ways, these are the equivalent of the "broader changes" which, as identified in Chapter 1, create the value that derives from the affordances of Web 2.0.

> *Users as digital producers*. A central change in Development 2.0 is that it allows ordinary citizens in the global South to take on the digital production roles outlined in Chapter 2: creator, enabler, producer, innovator. We have already seen an example in Chapter 5 of "IT impact sourcing" creating new livelihoods for the poor when they become digital creators. More typical digital creator roles (merging into the "active user" role) would be assigned to those who contribute on social media: blogs, sharing sites, social networking sites, etc. As per the 95:5 hypothesis outlined in Chapter 5, these intensive roles have much less

impact than extensive roles working in the ICT sector. However, there are still impacts of – at least perceived – empowerment through online self-expression. For example, urban migrant workers in China have used social media to discuss both labour rights issues and personal problems. This has "become an important space for the migrant workers to voice themselves when they are faced with actual problems . . . making them and their lives more visible" (Zhou 2015:279).

The power of the crowd. The essence here is that online connectivity allows large numbers of people to be brought to bear on a development process or problem in a way that would not previously have been feasible. Chapter 8 illustrated this with Pakreport, which allowed hundreds of people to provide ground-level, real-time reports on the status of flooding in their local area. Pakreport and many similar applications derive from the original application of Ushahidi – an open source platform for crowdsourcing and mapping crisis-related information – to report and map violence after the 2008 Kenyan elections, and then to support relief actors during the 2010 Haiti earthquake (Bott & Young 2012).

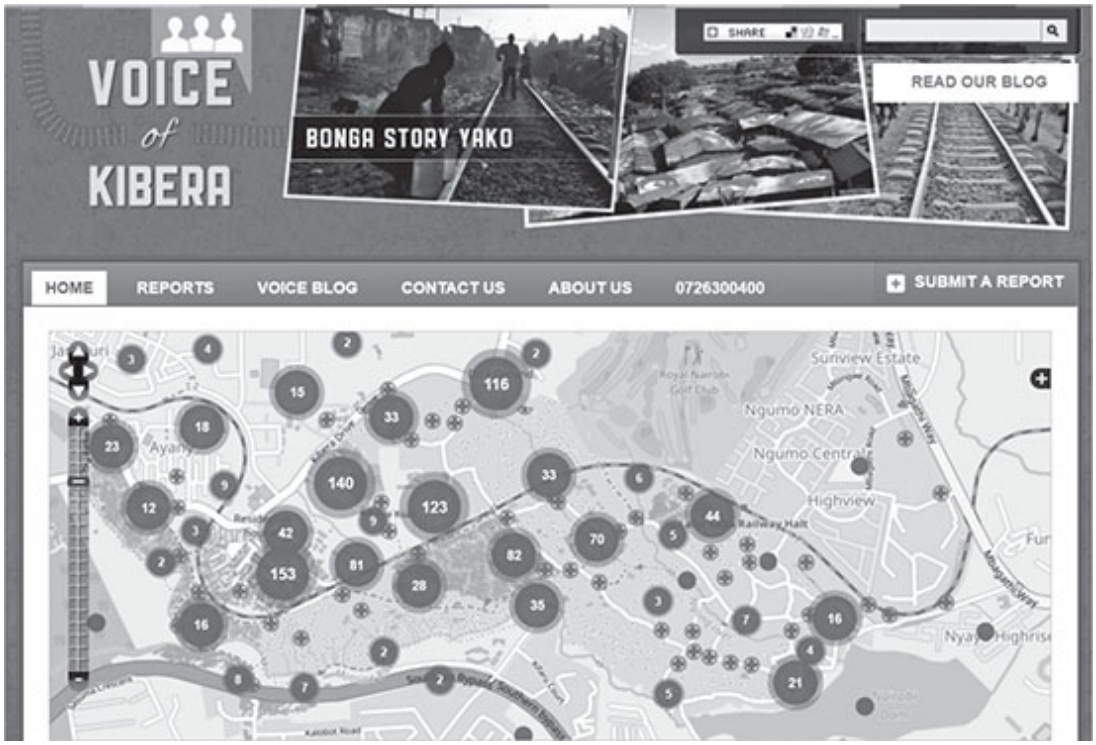
Other crowd-based models include:

- Micro-work: small digital tasks which collectively make up some larger project, outsourced to individuals. This combines crowd and digital production models, with organisations like Samasource outsourcing computer-based tasks such as data transcription and image tagging to workers in Africa and Asia, and Jana outsourcing mobile-based translation and transcription micro-tasks in East Africa (Mtsweni & Burge 2014).

- Crowdfunding: use of online portals to gather funding for a project from a large number of individuals. There are already dozens of crowdfunding sites across the developing world. Some are social development-oriented such as GlobalGiving which crowdfunds NGO development project proposals (WB 2016). Others are more economic development-oriented. For example, Catarse – the largest crowdfunding site in Brazil – had provided, up to 2017, more than US$15m in funding from 350,000 people for over 2,500 projects from technical innovations to music and film production (Catarse 2017).

Digital participation. Where the first two innovations look at the role and number of those involved, this one focuses on who is involved, and sees Development 2.0 as enabling inclusion in development processes of those who were previously excluded. We saw an illustration of this in Chapter 7 with e-participatory budgeting, which enabled citizens – including those from the poorer neighbourhoods – to participate for the first time in decisions about public spending. Public participation geographic information systems (there was a non-Web-based example in Chapter 8) are being used for community mapping and decision-making. "Map Kibera" is an example, which has enabled community members to both participate in the mapping process – recorded via OpenStreetMaps (see Figure 9.5 (MKT 2017)) – and to participate in related decisions and actions, some recorded via the sister "Voice of Kibera" website (Panek & Sobotova 2015).

Figure 9.5 Example of Web-enabled community mapping in Kenya



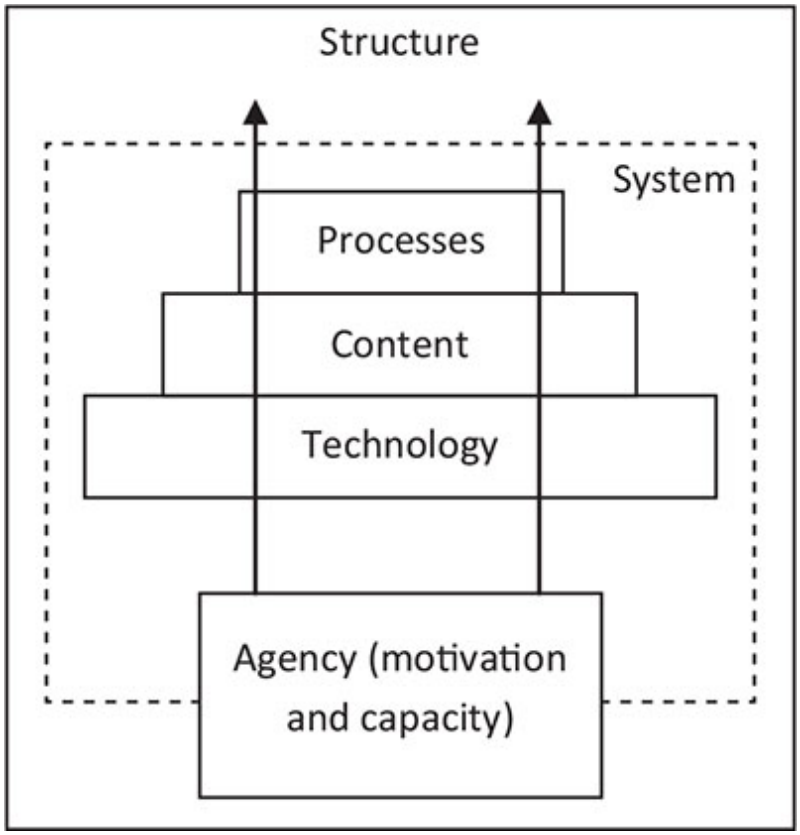
Network structures. The final innovation of Web 2.0 is structural and means that Development 2.0 models are based around network structures. In particular, flat network structures provide an alternative to hierarchical structures in which there is some central control point. Where the former replaces the latter then it can involve the disintermediation noted in Chapter 1 – the removal of some previous intermediary. Chapter 4 showed how the Esoko system in Ghana (an eBay-type application for agricultural producers and wholesalers) saved transaction costs by removing middlemen, and Chapter 7 showed how e-government could eliminate public servants in India as gatekeepers to public services and thus reduce the necessity of paying bribes.

Flat network structures like Esoko are peer-to-peer networks that allow individuals – such as consumers and producers – to interact directly with one another. As noted, digitisation and disintermediation reduce costs but they do so to such an extent as to make possible connections and development processes that previously were not feasible. This can be read as development's instance of the "long tail" notion: that niche transactions which were previously very high cost and/or infeasible become possible. An example could be Web-based, peer-to-peer micro-lending such as found on platforms like Zidisha and Kiva (which is only quasi peer-to-peer as local microfinance intermediaries are involved). These provide both investors/donors and entrepreneurs with financial opportunities they would not otherwise have (Laemmermann 2012).

9.2.3. The challenges of Development 2.0

To interrogate progress with Development 2.0, we can return to the overview model first introduced in Chapter 4, and shown on its own in Figure 9.6.

Figure 9.6 ICT4D overview model



Identified challenges for Development 2.0 include:

- Foundational motivational shortfalls: Development 2.0 initiatives have sometimes struggled with the ICT4D prime question (first introduced in Chapter 3) because they have not been able to provide a sustainable incentive for people to share and participate. “Dead Ushahidi” is a website that demonstrates this by identifying Ushahidi crowdsourced maps that did not take off or which failed to sustain (DU 2012). As a fitting illustration of motivational problems, Dead Ushahidi has itself been dead since 2012.

- Digital motivational shortfalls: motivation to engage in Development 2.0 is also hampered by online-specific problems. There is the challenge of trust – the cues and experience humans use to build trust via face-to-face

relations are often absent online – and thus there is a lower capacity to trust in, and commit to, online collaboration and cooperation (NetHope 2015). This is reinforced by concerns about privacy and security when sharing online. And there is the challenge of engagement: our use of Web 2.0 can be characterised as "playful engagement" that mixes leisure, entertainment, economic and socio-political usage (Tully & Ekdale 2014) but which can also undermine the ability for sustained engagement. Thus, for example, initial enthusiasm for involvement in online political change initiatives in the global South can quite rapidly fade (Breuer & Welp 2014).

- Social divides: the human capacity requirements for participation in Development 2.0 are greater than those for earlier ICT4D models. As such the familiar developing country barriers identified in Chapter 2 – that some people may lack awareness and knowledge, may lack skills, may lack confidence – will apply particularly here (Kreutz 2009, Wyche et al. 2013).

- Technological divides: by typically requiring reliable Internet access and Web-enabled devices, Development 2.0 raises barriers to inclusion. For example, use of social media in rural Kenya has been difficult because of lack of reliable electrical and Internet infrastructure, reliance on phones that are not Web-enabled and which cannot take photos or video of sufficient quality to upload at local cybercafés, and overall cost (ibid.). Like the social divides, these will fade with time but they remain an important constraint on Development 2.0.

- Data/content quality: where the barriers above can be overcome in order to provide data content for Development 2.0 processes, that data may sometimes be of poor quality: skewed to an elite group able to overcome agency and technological divides, or chaotic in nature, or inaccurate or otherwise untrustworthy (Bott & Young 2012). Hence – as for example in Chapter 8's Pakreport case – the use of data moderators.

As the examples above show there are many Development 2.0 initiatives in operation, but one outcome of the overview model challenges is that the transformational potential of ICTs has not often been realised. Three patterns can be divined which, while not universal, are notable, and which represent the broadest level of development impact enabled by Web 2.0's affordances:

- Reproduction: a tendency of Development 2.0 activities to reproduce rather than change wider systems and social structures. Social media output from a UN summit "reproduced global development rituals and thus failed to catalyse alternative priorities for and approaches to international development" (Denskus & Esser 2013). Social media in Kenya is dominated by "prominent, well-connected elites" (Tully & Ekdale 2014:78). Level and location of crowdfunding in Brazil seems connected with an entrepreneur's existing social networks (Mendes-Da-Silva et al. 2016). This has been a recurrent message of the book: that ICTs are not (yet) transformative in development and, at best, are making an incremental difference.

- Amplification: that Development 2.0 activities tend to magnify rather than change existing human agency. Where Development 2.0 does create a change, it often arises from amplification of human agency: of the existing motivations and capacities of those involved (Toyama 2015). Hence, as noted in Chapter 7, Web technologies were an enabler and amplifier of people's motivations during the Arab Spring, but they were not the cause or driver of change.

- Reintermediation: while Development 2.0 may remove traditional individual and organisational intermediaries from some development systems, it inserts new intermediaries. In particular, the Web platforms on which Development 2.0 activities occur – Facebook, Twitter, etc – become new intermediaries. These intermediaries are powerful. We can understand that in terms of network effects – the value of belonging to a network increases as more people belong to the network – which mean social media platforms have a tendency towards monopoly (Fuchs 2014). And these digital platforms are powerful in terms of the Section 2.6.2 political model shown in Figure 2.27: they control important institutions,

knowledge, resources and practices, and are structurally in a dominant position. This limits empowerment of citizens in developing countries: while they may use the tools of mainstream social media, they cannot fully appropriate them let alone appropriate the platforms and companies that provide them.

9.3. Data-intensive development

The information value chain has run throughout the history of development, so data has always been the foundation for information then decisions then actions then development results. However, the advent of digital ICTs – including but not limited to Web 2.0 – has greatly increased the production of data and also the ability to store, process and output that data. Thus we see claims that we will continuously produce more data in the next 18 months than in all of previous human history (Huawei 2013), and estimates that we will be producing 180 zettabytes per year in the world by 2025 (Kanellos 2016).

Whatever the exact figures, the broad trends are clear and pushed data to the forefront of business management trends in the early 2010s and, from there, into international development. It rapidly became a bandwagon onto which – often reinventing themselves in mid-air – leapt consultants, academics, practitioners and others. The bandwagon inserted itself into the process of creating the Sustainable Development Goals; seeing greater data intensity – indeed, a "data revolution" – as a requirement both to achieve the goals and to measure their achievement (HLP 2013). One result was the creation in 2015 of the Global Partnership for Sustainable Development Data, aiming for a more "data-driven" approach to international development (a terminology we will return to below) (GPSDD 2015).

9.3.1. The technologies of data-intensive development

Data-intensive development can be associated with four "V"s (adapted from Dumbill 2012):

- Volume: the greatly increased amount of data that is available. This is "big data" (though most commentators also associate big data with velocity and variety).
- Velocity: the greatly increased speed with which data is available, reducing the lag between event and data about that event to such an extent that we can call this "real-time data".

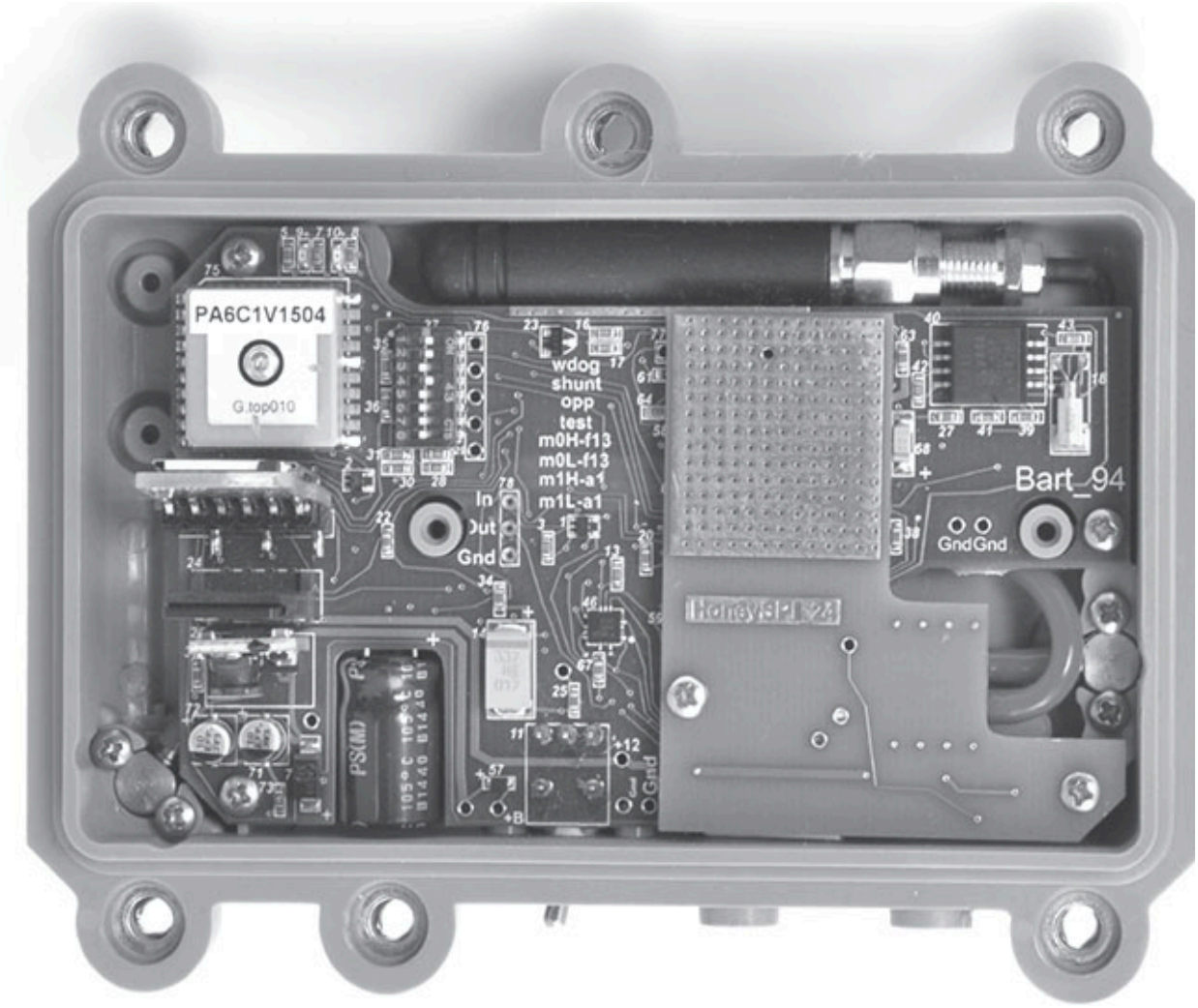
- Variety: the greatly increased number of forms and types of data. This is "diverse data".
- Visibility: the greatly increased availability and accessibility of data. This is "open data".

The technological foundations of the four Vs can be understood by running through the CIPSO elements of the information value chain from Chapter 1 (though technologies are increasingly available to run through all of CIPSODA, as Box 9.1 explains):

- Source/capture/input: the growing number of digital devices in developing countries, their connectivity, and the increasing amount of human activity that takes place on or via those devices provide the foundation for the growing data intensity of development. All activity – actions including transactions, and natural events – produces data. As more of that activity is digitally mediated, so the data it produces is digital and can readily be captured and input to digital systems. This is accelerating with growth in the Internet of Things including use of sensors (see example in Figure 9.7 used in water and energy applications (SWEETLab 2017)). And proliferation of more types of devices and

more software applications in more places, helps boost the variety of data form and content.

Figure 9.7 Example sensor used in development applications



- Processing: technologies for data processing are improving with Hadoop – “an open source software framework for storage and large scale processing of data-sets on clusters of commodity hardware” (Thakur & Ramzan 2016:354) – often cited as an example of an enabler. Data

analytics techniques are also improving, for example, to cope with the variety of data now being generated.

- Storage: digital storage capacity is growing as fast as data production, and cloud computing in the global South has made this more readily accessible and scalable, so data volume expansion can be handled.

- Output: as with data processing there is continuous improvement in both the technologies and the techniques of data output including data visualisation. Geographic information systems are an example already cited, as in Chapter 8.

- Communication: data communication between each one of the CIPSO processes is becoming easier through rising digital connectivity in the global South, and faster and more voluminous as bandwidth increases. This also helps data become more open as it can be disseminated more quickly and more easily.

All these support and are supported by an expanding ecosystem for data-intensive development of innovators, product vendors, service providers, practitioners and researchers.

Box 9.1

"Smart development": autonomous decision-making within international development

"Dumb" information systems handle some or all parts of CIPSO, "semi-smart" systems handle CIPSOD, and "smart" systems handle CIPSODA. Let's take an agricultural irrigation example:

- Dumb system: gathers data on soil moisture and provides information on this to the farmer. From this information, the farmer works out whether and when irrigation is needed.

- Semi-smart system: as above but the system alerts the farmer when irrigation is needed.

- Smart system: as above but the ICT controls the irrigation system and turns it on and off when needed. No farmer input is required.

- Intelligent system: as noted above, this covers the functionalities of the smart system but also learns as it goes along, thus incorporating the "knowledge"/learning aspect of the information value chain alongside CIPSODA.

The intended pros of smart systems include faster and better quality decision-making and action, and avoidance of human error and costs. The potential cons include system cost, problems if the underlying decision-making algorithm is faulty, and growing dependency on technology. Whatever the pros and cons, use of semi-smart and smart systems with autonomous decision-making is growing in development (Martinez et al. 2014, Di Santo et al. 2015). Potential examples were given in discussing climate change mitigation in Chapter 8 (though some of these systems at present may just have "smart" as a label rather than actually being smart as per the definition above).

9.3.2. Data-intensive development innovations

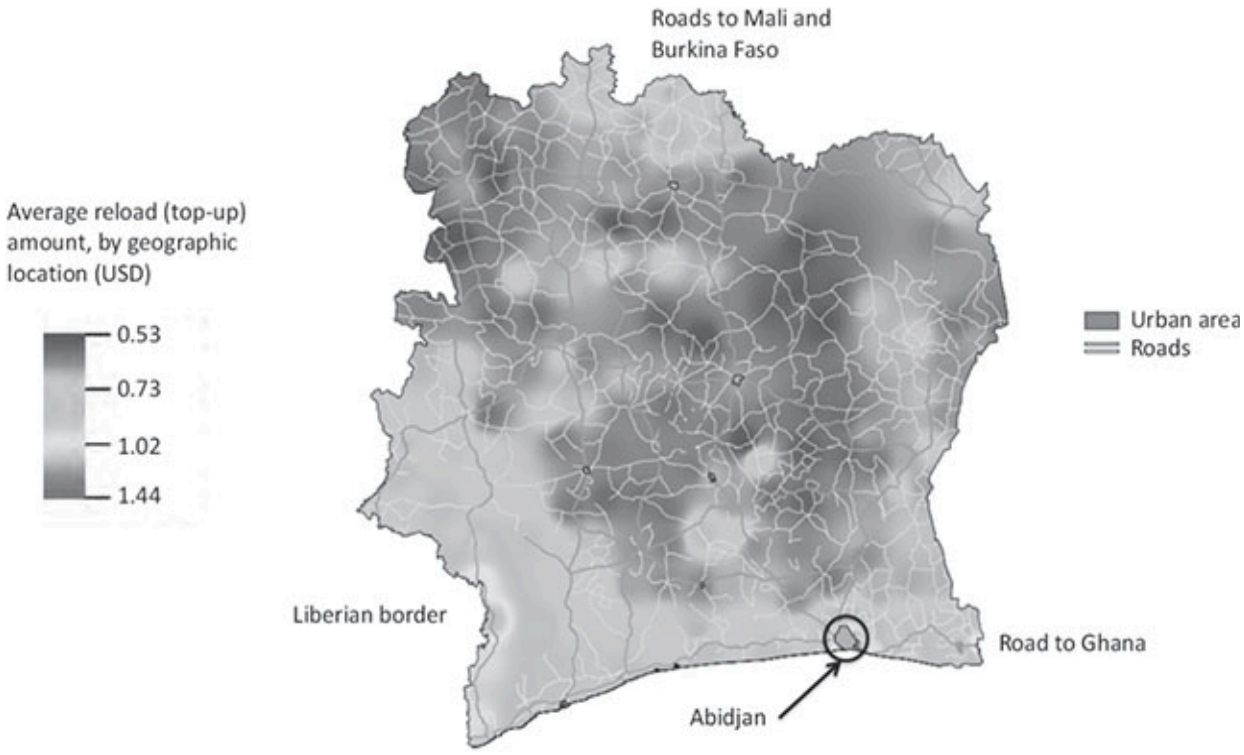
Building from the 4Vs, four data-related innovations for development can be identified.

Big data for development: the emergence of very large datasets relating to phenomena within developing countries. Main sources have been mobile phone call and social media records, but there are growing numbers of survey-based, transactional and other large datasets that can offer new insights into development. Mobile phone data is of particular interest due to the near ubiquity of phones, thus offering the ability to

move beyond sampling to near universal data gathering: this underlies the – very questionable – notion that theory and causation in development can be discarded in favour of simply following correlations (Press 2013, Cowls & Schroeder 2015).

Mobile phone data has some inherent development value but is valued much more because other development indicators can be inferred from it (Hilbert 2015, UNGP 2015a). Call duration and frequency plus level of credit top-ups have been used as proxies for levels of poverty and related measures such as food security (see, for example, Figure 9.8, which shows use of mobile top-up data to partly proxy income levels in Ivory Coast) (Gutierrez et al. 2013, adapted in ITU 2014). Population movement can also be tracked and, for example, linked to transportation planning, national and international migration, or to health epidemics and other natural disasters.

Figure 9.8 Identifying income levels across Ivory Coast using mobile phone data

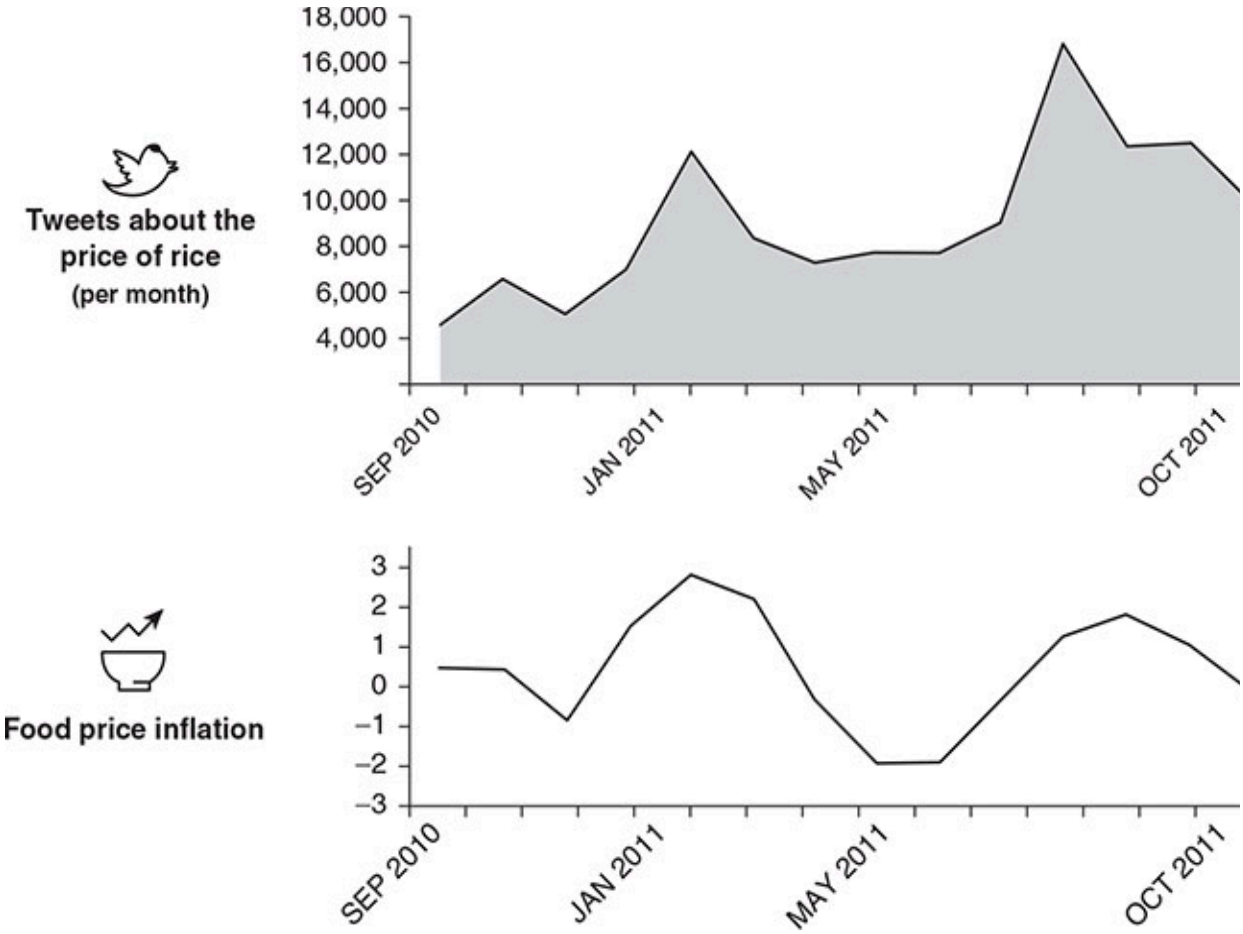


Real-time data for development: development data being available at or immediately after the event that created it where, historically, it has taken some time to capture, input and process data when something happens. Three identifiable models of real-time data provision are:

- Auto sensing: real-time data automatically produced by sensors without human intervention.

Previous examples relate to public service provision: sensors in water pumps that report when they are broken (Chapter 7), and to environmental monitoring: sensors that monitor levels of arsenic in groundwater (Chapter 8). Other applications will be found in agriculture for example in relation to irrigation management (Haule & Michael 2014), and in health for example in relation to management of the vaccine cold chain (Chaudhuri et al. 2012).

Figure 9.9 Using real-time social media data to monitor food prices in Indonesia



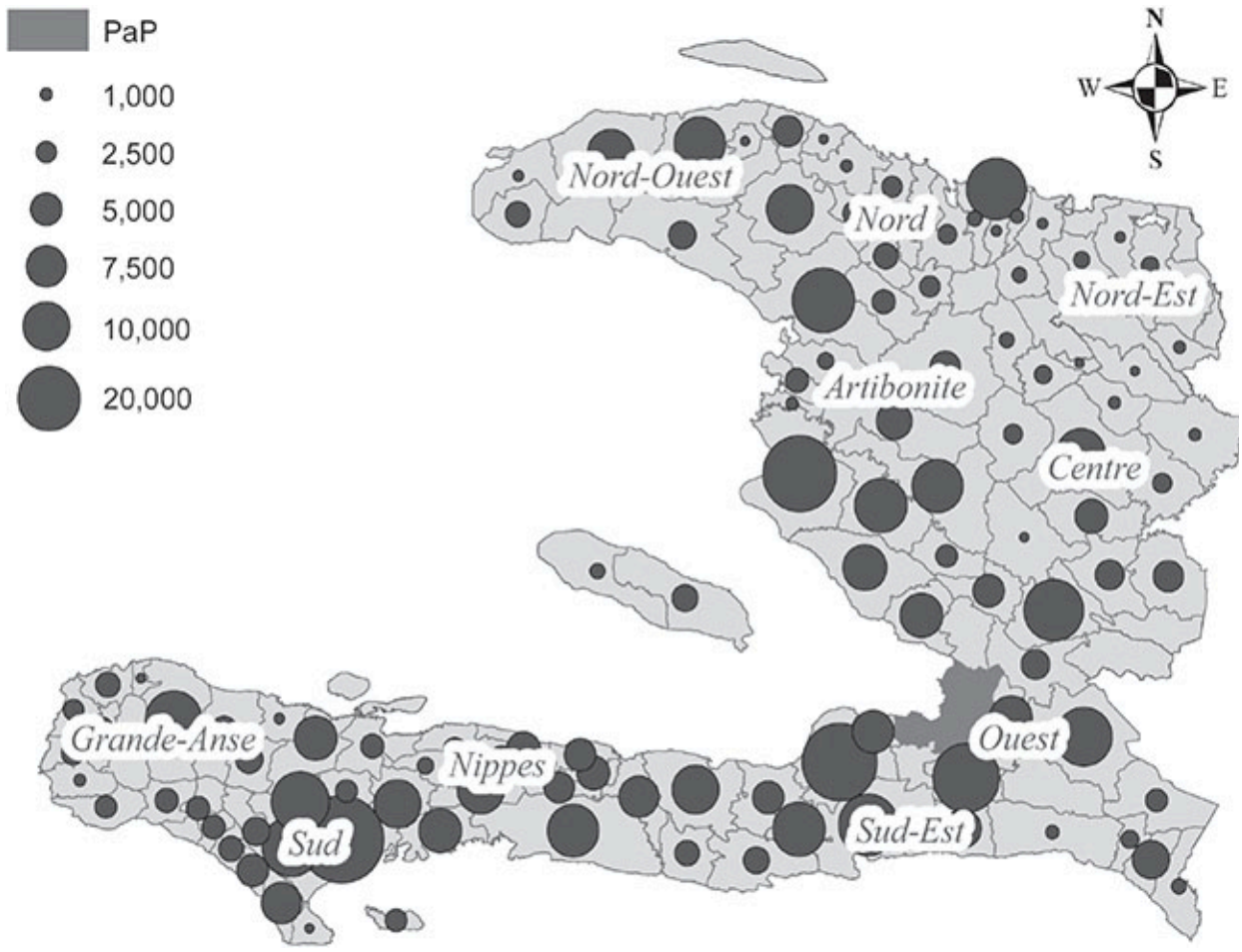
• Participatory sensing: real-time data produced by deliberate human action. This can be very specific with users regularly recording health symptoms via a mobile phone app (Yoneki & Crowcroft 2014), the status of local water supplies via SMS (Tsega et al. 2015), and household income and other indicators via SMS (Khan 2015). Or this can be generic, often overlapping with big data to form what can be called crowdsensing: use of mobile phone records has been noted above, and there are also real-time applications analysing social media feeds. For example, using online news, discussion groups and Twitter for early identification of a cholera outbreak in Haiti (Chunara et al. 2012), and using Twitter to monitor food price inflation in Indonesia (see Figure 9.9 which shows volume of tweets about rice prices as a reasonable proxy for food price inflation, suggesting tweets could be a low-cost substitute for food price surveys; UNGP 2011).

• Opportunistic sensing: real-time data produced as a by-product of human action. Typically, this uses in-built apps in mobile devices; for example, to record speed of movement, distances travelled, noise levels, health data such as heart rate, etc (Khan et al. 2013). Like participatory

sensing, this can be specific to an individual: a jogger tracking their route or an elderly person being monitoring in case they fall; or generic crowdsensing: aggregating acceleration sensor data from collective mobile phones to identify potential potholes, or using audio input to identify noise pollution hot-spots.

Diverse data for development: the growing variety of development data that is available. There are many categories of data one could identify here, often overlapping with the other categories of big, real-time and open. The hope of "predictive data" is often drawn from analysis of social media data, with health and economic examples given earlier. "Small data" is discussed later. A number of examples have already been given of "geo-locatable data" such as the GIS-associated examples in Chapter 8. Many of the mobile phone-related examples also rely on the geo-locatable-ness of phones so that poverty, food security, migration, traffic, etc can all be located. Figure 9.10 shows numbers of people displaced from the capital of Haiti, Port-au-Prince (shown as PaP) to other regions of the country following the 2010 earthquake; measured by mobile phone records of those who were in the capital prior to the earthquake, and then were somewhere else nineteen days later (Bengtsson et al. 2011). This could provide quick, accurate data for humanitarian relief decisions.

Figure 9.10 Tracking earthquake-displaced persons via mobile phone records in Haiti



One other emergent category is "sentiment data" that measures public attitudes towards particular issues, mainly based around analysis of social media data given that feelings are frequently expressed in such data. Examples of Twitter feed analysis include tracking levels and type of demand for new m-money products in Kenya (Grosser 2014), and analysis of sentiment towards immunisation in Indonesia to help identify some key concerns – such as religious issues and perceived side effects – when planning a vaccination campaign (UNGP 2015b).

Open data for development: the greater availability of development-related datasets for general use. By far the biggest growth area has been open government data, which is particularly linked to improvements in

transparency, accountability and service delivery. These have already been discussed in Chapter 7, but a further open government data example comes from Indonesia where the tabulations of voting results from all levels in elections – polling stations through district to province to national – have been placed online by the Election Commission (Brajawidagda & Chatfield 2014). The polling station results were only scanned forms, so social media initiatives crowdsourced the digitisation of the form content, and the checking of tabulations. Where errors were identified, these were reported and the Election Commission responded with some clarifications. Open data can apply equally to private sector firms, markets, NGOs and other development actors and systems where, again, the focus has been transparency and accountability, as noted in Chapter 7.

Alongside accountability, however, there are two other development roles of open data (Davies et al. 2013):

- Empowerment: open availability of data can empower decision-makers at various levels of development – from individuals and communities to civil society organisations – to make better decisions. For example, Chapter 8 showed open availability of remote sensing data helping communities in Vietnam become more resilient to climate change. As another example, education performance data from Kenya's Open Data Portal is being used to help parents make better decisions about schooling for their children (Mutuku & Mahihu 2014).

- Enterprise: open availability of data can create opportunities for the private sector – forming part of the emerging "data economy" – in identifying additional value to be extracted from datasets (for example, via mashups between different datasets), and in stimulating service innovations within governments. One role of these enterprises is to act as open data intermediaries between sources and citizens. For example, Indian firm Gramener takes open government data – census data, electoral data, development programme data, etc – and converts it into visualisations that can be readily understood (Gramener 2017).

9.3.3. The challenges of data-intensive development

The challenges of data-intensive development can be categorised using the information value chain shown in earlier chapters.

> *Data*. Despite the advances in technology and technique noted above, digital data quantity and quality in developing countries is lacking (Jasper 2015); for example, "advocates of open data policies run the risk of glorifying government data that is frequently inaccurate or incomplete, often in ways that are biased against the poor" (Raman 2012). Data may need to be checked, cleaned and rendered into interoperable formats even to make use of it – requiring skills that are likely to be in short supply. There are dangers of data exclusion if digital data is assumed to represent everyone when only an elite minority use social media, or when men use digital technologies more than women (see Box 9.2 for further examples of gender bias in data), or when the poorest do not have mobile phones. Private sector ownership of many of the digital platforms and channels through which development is mediated means data accessibility may be constrained; volume and velocity defeated by lack of visibility. There will also be concerns about privacy and security: of "unaccountable governments tracking citizens, or corporations illegally discriminating between customers" (ibid.).

Box 9.2

Making women visible in data-intensive development

As data becomes increasingly important within international development, what current datasets reveal and hide becomes increasingly important. One key concern is the lack of a gender

dimension in datasets that particularly acts to the developmental disadvantage of women. This is not merely a moral issue but also a practical one: gendered data leads to demonstrably better development decisions and outcomes, for example in health and education projects (Temin & Roca 2016).

Three main problems and solutions are identified (Badiee & Melamed 2014, Buvinic et al. 2014, Temin & Roca 2016):

- Data content: the lack of gender disaggregation – the ability to separately identify data for men and women. In part, there needs to be more use of gender as an analytical lens for those datasets that are already gender-disaggregated: this is true for health, employment and education data in most developing countries. In part, gender needs to be added as a data element to surveys and other data-gathering initiatives where it does not yet exist.

- Data coverage: no data or too little data being available on issues of particular relevance to women's development. More data needs to be gathered on topics such as mental health, domestic violence and unpaid work.

- Data usage: women are much less likely than men to have or use datasets. Open accessibility of data will help here, but active training in data literacy is also required alongside actions to reduce technological aspects of the gender digital divide.

Big data is seen as having positive potential. For example, some countries include a gender identifier in the national IDs attached to mobile phone accounts, and in other locations researchers are working to infer the sex of phone users from their call detail and airtime purchase patterns (Vaitla 2014, Reed et al. 2016). Given that phone data can proxy indicators such as mobility and poverty, this could provide an

important new source of gender data. Phone-based surveys and social media could also provide big data insights into issues around women's personal security, sentiment and expectations that can be hard or costly to obtain from conventional sources (Buvinic et al. 2014).

However, there is a flipside. Big data can drive out other data sources and, by making some issues more visible, it makes others less visible. For example, the sources of power – such as those outlined in Section 2.6.2 including structural relations and control over institutions, knowledge and resources – are typically ignored in big datasets (Crawford & Finn 2015). Yet these are the source of gender inequalities which must be illuminated and changed if gender development goals are to be achieved.

Information/knowledge. There are still many technical challenges in turning development data into information: development of appropriate CIPSO architectures that are scalable and sustainable, development of appropriate data-mining algorithms, use of data perturbation or encryption to protect privacy, etc (Ganti et al. 2011).

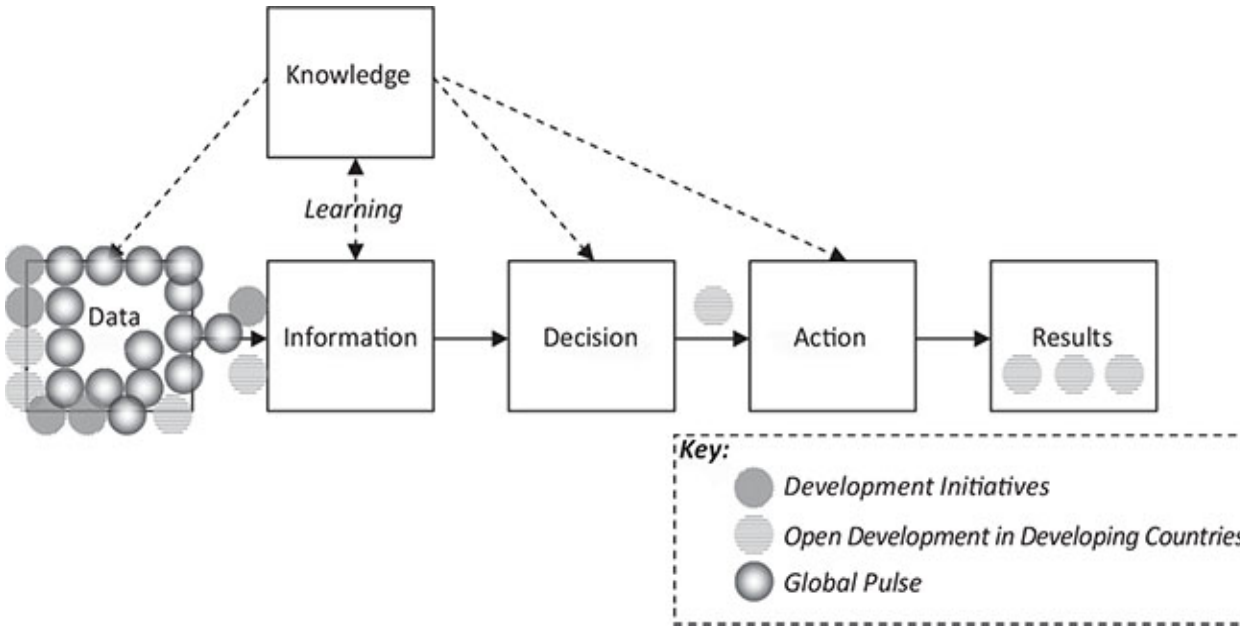
Working with development decision-makers is challenging because they want to understand not just the information being presented but also the means by which it was sourced and processed, and the levels of confidence it comes with; yet they often lack knowledge of the underlying techniques. So, while simple and compelling visualisation of data helps turn it into information for decision-making, so also does creation of a clear and simple but also transparent and truthful narrative summarising the CIPSO journey (Essam et al. 2015). Yet growth in smart development systems, where some programmed algorithm determines decisions and actions will further reduce the ability of development actors to understand the information value chain (Morozov 2014).

The disempowering potential of big data – removing any role in the information value chain from those who lack knowledge and other capacities necessary to understand and act on big data – has led to a

"small data" counter-movement (RD 2015, UNU-CS 2017). Small data uses ICTs for CIPSO, but at the micro-level of households and communities, so those involved in generating the data are also those who receive and use it. Hybrid systems that mix small and big data – the data-intensive development equivalent of combining top-down and bottom-up – are also being developed (Quaggiotto 2014).

Decisions/actions/results. Many data-intensive development initiatives focus on the upstream stages of the value chain, and give little or no attention to the downstream stages. One analysis of such initiatives within three data-intensive development programmes (see Figure 9.11, adapted from Heeks 2014e) found that 23 of the 27 initiatives focused on gathering and processing new data without a clear sense of how that data was going to be used for decisions and actions in order to deliver development results. Similarly, a number of open government data initiatives have struggled to move beyond making data available (Gonzalez-Zapata & Heeks 2015). And many of the examples reported above are proof-of-concept rather than live applications.

Figure 9.11 Heatmap of focus for key data-for-development initiatives



In part this happens because of the worldview of those involved, which ranges from being mildly data-centric to strongly data-deterministic, and which incorrectly assumes that there is some guaranteed link from data to results. The terminology of "data-driven development" reflects this problematic worldview; wrongly believing that data alone can somehow lead to better development. There are plenty of examples of this having negative repercussions: the information value chain breaking at an early stage as analysts try and fail to persuade development decision-makers that some new data set or visualisation is of value (Essam et al. 2015). Their mistake is to think that the information value chain is driven forwards from data to results. Instead, it is more driven and certainly designed backwards – starting with the development results that are sought and working back through the actions and decisions necessary to deliver those results before finally identifying the data needed.

A second challenge is that development organisations and systems evolved under situations of data scarcity and lag (Khan 2015). In development projects, for example, pre-planning and monitoring are time-consuming and slow because data has been hard to obtain; rigid, LogFrame-based approaches are used which follow a pre-set course of action for much of the project; and measurement focuses more on the things about which there is data – processes and outputs – rather than those about which data is hard to obtain – development impacts. Data intensity allows a more agile, iterative and experimental approach. But this struggles to take hold because data-impoverishment is so well-institutionalised: development project financing systems, monitoring and evaluation systems, culture and capacities are all attuned to it (WB 2016). Simply changing data availability will make little or no difference, unless these wider incentives, processes, systems and structures can be altered.

9.4. Open development

"Open development" is a concept that has been particularly highlighted by Canada's International Development Research Centre (Smith & Reilly 2013). Open development is often defined in a rather circular manner as the application of open models to international development: "an emerging set of possibilities to catalyze positive change through 'open' information-networked activities in international development" (Smith et al. 2011:iii).

Open models, as noted above, have been associated with the advent of Web 2.0, though they derive from a much wider set of trends. They come in many varieties such as those defined by sector – open government, open business, open learning – or those defined by value chain stage – open sourcing, open production, open distribution. The framework for open models offered here uses two dimensions (developed from West & O'Mahony 2008, Reilly & Smith 2013) and is summarised in Table 9.1:

Table 9.1 Open development matrix

Degree of openness	***Open participation***	E.g. development of open source software	E.g. production of open educational resources	E.g. e-participation i governance
	Open access	E.g. use of open source software	E.g. use of open educational resources	E.g. e-accountability of government
		Open technologies	***Open content***	***Open processes***
			Source entity	

a) Degree of openness: we can distinguish between open access which means the recipient can make use of the source entity, and open participation which means the recipient can engage in the creation of the source entity. Another way to understand this is in terms of the roles outlined in Chapter 2: in accessibility, the recipient is a digital consumer; in participation, the recipient is a digital producer. Both of

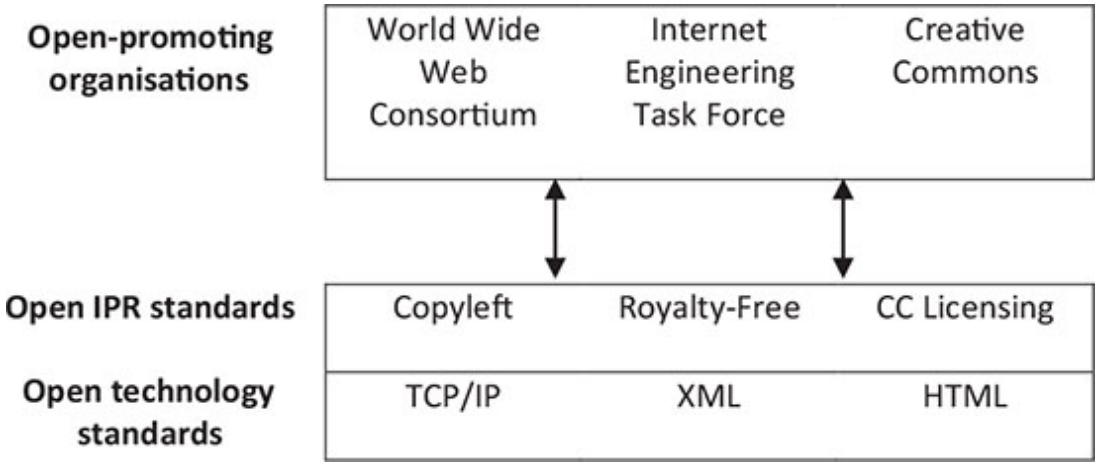
these would be contrasted with “closed” development in which entities would be inaccessible or only accessible to a select few. Dividing openness into just these two categories is highly simplified, and we could readily identify many more steps on the “ladder” of openness: for example, contrasting theoretical availability with practical accessibility, or introducing notions of level of ownership and control including the distribution of benefits from open access and open participation. However, the simple categorisation will be used here.

b) Source entity: we can distinguish between three different types of entity that can be open, drawing on the ideas of layers from earlier chapters as summarised in the Figure 9.6 overview model. Open technologies are the foundational hardware and software; open content is the digital data and knowledge that resides on those technologies; and open processes are the decisions, actions and transactions undertaken on the basis of the technology and content. It is feasible to have different degrees of openness within the different layers such as open content hosted on a proprietary technology platform, though arguably the latter would constrain the degree to which the former was truly open.

9.4.1. The technologies of open development

Specific technologies such as particular open source software initiatives will be discussed in the section below, but the basis for open development relies on a set of open protocols or standards that are mutually supportive (see Figure 9.12). For example, one reason the Internet is able to support open development is its foundation in open standards such as TCP/IP (transmission control protocol/Internet protocol) for connectivity and communication, XML (eXtensible Markup Language) for data structuring, and HTML (HyperText Markup Language) for data display (Hoe 2006). These are universally and freely available, do not discriminate or enable predatory practices, and they therefore enable the interoperability and openness of technologies and data content and, hence, openness of processes.

Figure 9.12 "Ecosystem" of open technical and social technologies



Alongside these are what could be called "social technologies" underpinning open development. An example would be open licences for intellectual property rights (IPR) such as "copyleft" or Creative Commons (CC) licencing (Reilly & Smith 2013). We could even include here the organisations or networks that help promote or maintain open protocols and standards such as the World Wide Web Consortium, the Internet Engineering Task Force and Creative Commons.

9.4.2. Open development innovations

Following the Table 9.1 framework above, the innovative aspects of open development can be understood under three categories of innovation, as discussed next.

> **Open technologies for development**. *Open source hardware* – "hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based

on that design" (OSHWA 2012) – has not had anything like the profile of its noisier cousin, software. However, a number of ICT4D projects are based on open source hardware; for example, urban environmental monitoring systems in India (Abraham & Pandian 2013) or digital laboratories for secondary schools in Brazil (Simao et al. 2014). The main advantages of open source – as opposed to proprietary – hardware are seen to be the relatively low cost, the ready availability of existing hardware "building blocks" so designs do not need to start from scratch, lower barriers to participation in innovation, and the potential to get feedback on designs from a wider community.

As just mentioned, *open source software* (OSS) has had a much higher profile within development. In relation to open access, there has been a particular drive within some countries for adoption of OSS for e-government (Tella & Tella 2014). Key benefits compared to proprietary solutions have been reduced costs, greater interoperability through use of open standards, and easier ability to customise to local needs such as local language interfaces.

Moving to open participation via the development of open source software, the health sector has seen a number of OSS initiatives. iDart in South Africa is a smaller-scale example, developed by Cell-Life and used in pharmacies to help manage the dispensing of anti-retroviral drugs (Loudon & Rivett 2013). Its development followed many of the ICT4D Project Implementation Principles outlined in Chapter 3: an action research approach involving "use of iterative and incremental methods, evolutionary prototyping, and participatory design" (ibid.:64). This allowed participation of users – pharmacists – in the production process through their feedback on prototypes. However, beyond this, the open approach allowed organisations other than Cell-Life to participate: for instance, a group within the University of Witwatersrand developed a patient data capture module that was then integrated into iDart.

A similar pattern can also be seen on a larger-scale with the Health Information Systems Programme (HISP) and its District Health

Information Software v2 (DHIS2) discussed in Chapters 3 and 6. Though coordinated from the University of Oslo, its open source approach has enabled software development to be distributed across teams in many developing countries (Braa & Sahay 2013): South Africa, Kenya, Tanzania, India and others (see Figure 9.13 (HISP 2017)). This has had two advantages (Titlestad et al. 2009). First, that in-country teams could localise the software to their particular needs; more readily closing local design–reality gaps. Second, that local innovations of wider value could be fed into the next global release of the main version of DHIS2: for example, a capability to break down reporting data by multiple dimensions such as sex, age and status originated in Ethiopia and was then tested in Tajikistan and Sierra Leone before being more generally adopted.

Figure 9.13 HISP network locations



A major benefit of open source technologies is therefore that they can pool ideas – from minor improvements to more significant innovations

– from a larger number of stakeholders than would be possible with proprietary technologies. Openness enables access to a wide range of stakeholders but, as summarised in Figure 9.6, it is agency – combining capacity and motivation – that drives their participation. The stakeholders must have the skills and knowledge necessary to amend or develop the technologies, and they must be motivated. Two main motivators for participation in open technology development are relatively altruistic: a desire to share and collaborate, and a desire to help meet needs of a particular user group (Subramanyam & Xia 2008). But other motivators are less altruistic including desires to build new skills and knowledge, enhance personal reputation, and advance career and earnings prospects. Even sharing may be enlightened self-interest: recognising that "the whole is greater than the sum of the parts" and that participation in open projects allows access to ideas and technologies that no individual or small group could itself have the resources to develop.

Open content for development. Open data for development was discussed earlier, including pointers to examples in previous chapters, but two other types of open content can be highlighted here:

- *Open educational resources* (OER): "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others" (Smith & Casserly 2006:10). Reports of OER in developing countries tend to be dominated by experiences of creating OER repositories or starting OER initiatives, with much less research on use of OER (Inamorato et al. 2012, Smith 2013). Where they are used in higher education, there is a sense that OER supplement the core teaching process rather than forming the foundation for it. For example, at Durban University of Technology, OER were used to provide additional sources or online exercises and quizzes rather than full courses (Van Der Merwe 2013). Where they are used more at the core of the curriculum, then OER have been shown to potentially improve the quality of resources and nature of teaching but to require significant adaptation and support for teachers if that outcome is to be realised (Hodgkinson-Williams & Paskevicius 2013, Murphy & Wolfenden 2013).

- *Open access research*: "online research outputs that are free of all restrictions on access (e.g. access tolls) and free of many restrictions on use (e.g. certain copyright and license restrictions)" (WP 2017d). Even more than with OER, the focus of research on open access to research publications has been on the creation of open access repositories or on participation of developing country researchers in open access publications such as peer-reviewed journals; looking especially at the type of challenges (cost, quality, etc) discussed later (Chan & Costa 2005, Chan & Gray 2013). Despite its name, very little research has been undertaken to investigate the impact of open access to research publications, though all initiatives are undertaken on the assumption this will benefit developing country researchers. What research there is reports rather mixed results, with any positive impact being less than anticipated (Davis & Walters 2011).

Open processes for development. We have already discussed some open processes – the participation in creation of open technologies and open content – which are examples of digitally enabled *open innovation*. The potential positive impacts of open innovation were also reflected, from personal benefits to participants (such as altruism and competency development) to systemic benefits that could assist those who access the outputs of open innovation (such as lower cost and greater speed of innovation, or greater scope or improved quality of outputs) (see also Masum et al. 2013).

Similar benefits can be identified for the related process of *open science*: "science carried out and communicated in a manner which allows others to contribute, collaborate and add to the research effort, with all kinds of data, results and protocols made freely available at different stages of the research process" (Currier 2011:4). An example is The Synaptic Leap (TSL), "a web-based environment designed to generate collaborative research in biomedical science . . . focused on synthesizing or identifying affordable treatments for tropical diseases in developing countries" (Parker et al. 2014: 193). Supported by electronic lab notebooks, shared databases, blogs, online discussion forums and other social media, TSL's first success was improvement to the anti-schistosomiasis drug, praziquantel; a project that took three years to complete using inputs from dozens of researchers in

Africa, Europe, Oceania and North America (Ardal & Rottingen 2012, Robertson et al. 2014).

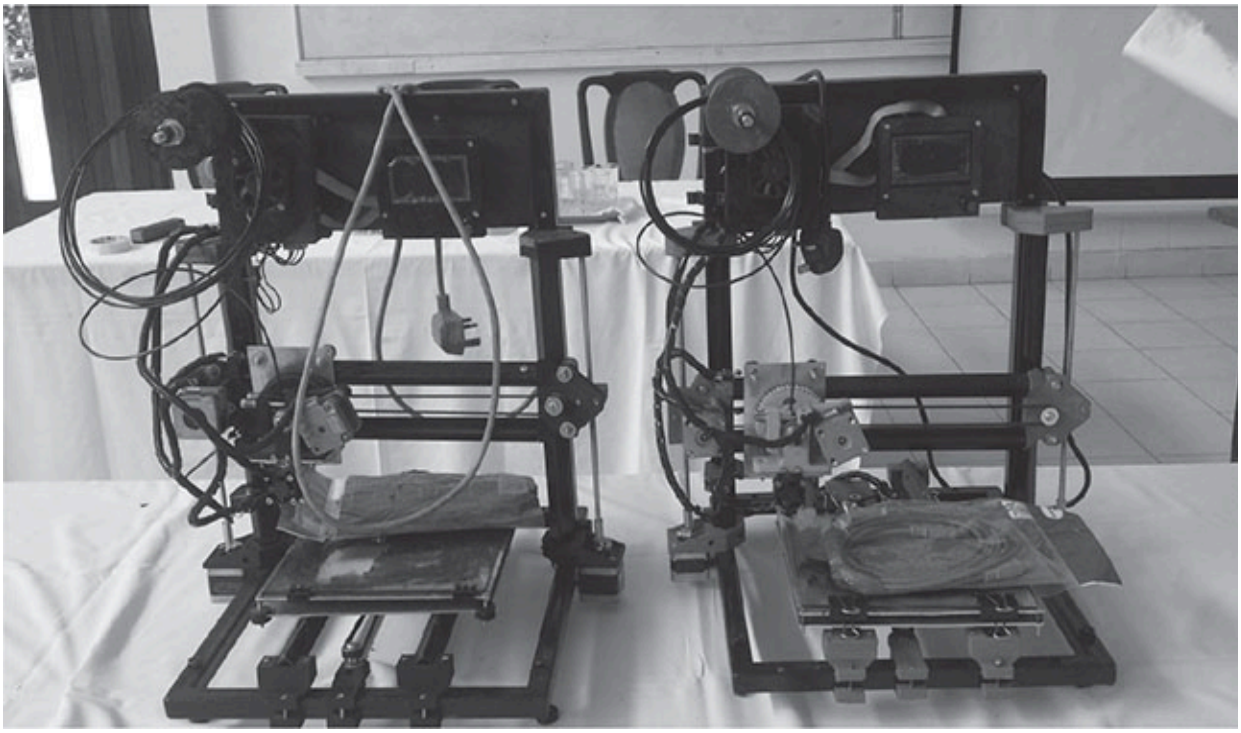
Open government was discussed in Chapter 7 and briefly above in relation to open government data. Open government processes can be understood as a ladder covering the elements from the earlier chapter, each of which is ICT-enabled: basic open access allows citizens to access the outputs of government processes i.e. public services; more advanced open access allows citizens to monitor and then control those processes through transparency and accountability; and open participation in government processes runs from citizen consultation through to citizen decision-making.

Open education seeks to remove traditional barriers to education, particularly higher education. The main model of digitally enabled open education is MOOCs (massive open online courses), which were discussed in Chapter 6. They do deliver learning though they also face challenges of high drop-out and sustainability. The degree to which they are open varies. Relatively few seem to be based on OER and a growing number are run on a for-profit basis (Smith 2013). Fees, digital divides and skill/knowledge pre-requisites restrict access in developing countries. While participation in the process of learning is integral to MOOCs, participation in the process of teaching let alone modification of the curriculum is much more limited.

Open production is a more emergent concept than the others here, but can be seen reflected in the opportunities for developing countries created by the advent of low-cost 3D printing, and the emergence of digital fabrication as a production model (Pearce et al. 2010). Though neither 3D printing nor digital fabrication are necessarily open, there has been significant availability of open technologies – open source 3D printers run with OSS – and open content in the form of freely accessible designs. For example, Figure 9.14 (courtesy of Roy Ombatti; see also Goodier 2016) shows open source 3D printers built in Kenya using recycled parts. These are placing the capacities for production of a growing range of items – examples include tools, prosthetics, medical implements, prototypes and 3D printers

themselves – within reach of a far greater number of small and medium-sized organisations in developing countries (Ishengoma & Mtaho 2014).

Figure 9.14 Open source 3D printers in Kenya



9.4.3. The challenges of open development

Four particular challenges to open development can be identified.

Lower quality and higher cost. Centralised ownership and control can impose quality controls and efficiencies that are lacking in open approaches, partly because these are worth imposing since investment returns will accrue to the owning/controlling party. There is no necessary connection here. In terms of efficiency, approaches such as crowdsourcing or open innovation can reduce the required time if not the required effort (Lichtenthaler 2011). And opening up processes to

more people can lead to fewer errors slipping through (Masum et al. 2013).

Nonetheless there are concerns that open technologies and open content could be of lower quality than more proprietary alternatives (Smith 2015). Of the promise of free and open source software for development (FOSS), Heeks (2009a:9) notes:

> This promise has been threatened by the resemblance of parts of the FOSS community to a religious cult. Some have adopted a "with us or against us" mentality bordering on paranoia that has produced a welter of self-justification, but very little independent analysis … Niceties like robust business models, rigorous total cost of ownership calculations, or user-friendliness can get forgotten.

Beyond concerns, there are examples of complaints about quality such as poor "OCARA" (see Chapter 2) quality of aid transparency open data (Bhushan & Bond 2013), or of open government data in Ghana (Ohemeng & Ofosu-Adarkwa 2015); and complaints about poor quality of some MOOCs and OER (Bonk et al. 2015). The extent to which problems derive specifically from the open nature of these initiatives is unclear, but they do mean that both planning and evaluation of open development must make both quality and cost a central concern.

Incomplete chains. Previous reference has been made to the challenges for open development of not completing information value chains. This is a problem for open content; that it is made accessible but then not translated into actions and results because of all the other chain barriers: such as lack of technology, skills and motivation to access the data; and/or lack of power, knowledge and money to implement decisions made on the basis of open content (Gonzalez-Zapata & Heeks 2015). Similarly, there is the problem noted in Chapter 6 of open education not achieving much learning for the high proportion of drop-outs, and in Chapter 7 of open government not running through the cycle to transparency and accountability. Sustaining cycles of action can be hard given the sometimes lower clarity of incentives for participation in open

processes, thus creating a need to institutionalise capacities, practices and incentives (Braa & Sahay 2012).

Institutions of ownership. There are many institutional forces that support the notion of private ownership and returns on investment: the market system overall, IPR regimes and laws, organisational cultures that reward personal not shared achievement (Smith & Reilly 2013). Overcoming these to enable open, collaborative models to succeed is difficult. One can see this as a clash between two institutional logics, an idea first introduced in Chapter 6. On the one hand are the often powerful network of organisations, institutions and individuals who adhere to "closed logic": proprietary ownership, competition and control. An example would be universities and publishers whose business models currently rely on closed educational resources, closed access and closed education (Smith 2013). On the other hand, are the generally less powerful network of organisations, institutions and individuals who adhere to "open logic": freedom of access and ownership, participation and collaboration.

For open development initiatives to flourish, the open logic network must find space to predominate over the closed logic network, or at least find some accommodation with it. An example is the iDart project mentioned earlier (Loudon & Rivett 2013). It was not able to change the general closed logic of the university, which believed ICT innovations should be patented and channelled into for-profit spin-offs, but created a project-specific space for compromise, with Cell-Life being spun-off but as a non-profit organisation based around open source licensing for its software products.

Too much openness? What was your instant reaction to the idea of openness and open development? One reaction is to assume that open is good and closed is bad. But not everyone thinks that way and that can lead to resistance to the elements of open development. A particular difficulty for open development is that openness can be a counter to two different types of "closed" development models: either closed

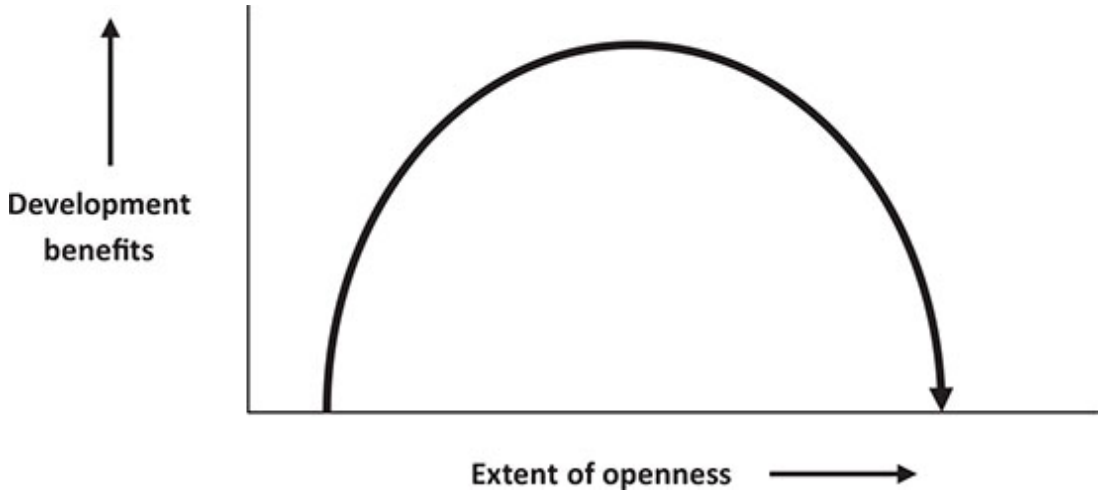
development via the authoritarian power of the state, or closed development via the proprietary and monopolistic tendencies of the market. Open development can claim to be a counter to both at once (Benkler 2013), but it will then face brickbats from two sides since those who view the state as the problem typically see markets as the solution, and those who see markets as the problem typically see the state as the solution (Singh & Gurumurthy 2013). At open development workshops, I have seen North Americans criticise open development as anti-competitive, and East Asians criticise it as potentially leading to selfishness and chaos.

We might also advance less ideological concerns about openness, trying to avoid the simple idea that more openness is always better. A more likely relationship, at least in terms of open processes, is an inverse-U curve as illustrated in Figure 9.15. What this argues is that increasing openness in "corrupt, opaque, self-serving environments" will bring development benefits (Heeks 2015). But ever-greater transparency of processes will at some point start to bring more disbenefits than benefits, with "hyper-transparency" having negative impacts on motivation and privacy, and undermining trust in all institutions.

9.5. ICT4D 3.0, Development 2.0 or Digital Development?

Having reviewed key elements of its content, what should we call the future of ICT4D?

Figure 9.15 Potential relationship between process openness and development benefits



If I hadn't already jumped the gun in 2009, then "ICT4D 2.0" would have been a good candidate. But, as Chapter 1 explained, a transition has already been identified from ICT4D 1.0 to ICT4D 2.0. This was associated with technological change, for instance from telecentres to mobile phones, being part of that transition. With a further technological transition – from feature phones to smartphones; from partial to ubiquitous connectivity; from dumb to smart devices; from 2D to 3D printing, etc – should we identify "ICT4D 3.0" as a next stage?

Arguably not, because ICT4D 2.0 was not just about technological change but also about changes in the role of the poor, in development goals, in key issues and actors, and in development models. Some of these could be linked to other post-2015 changes, such as the emergence of the Sustainable Development Goals. But others will continue as per their ICT4D 2.0 specifications – there is no further step beyond considering the poor as producers and innovators, beyond ICT impact being a key issue, beyond all sectors being involved in development. If some elements of ICT4D 2.0 are changing and others are not, maybe the best that could be argued is "ICT4D 2.5".

However, that feels clumsy, so perhaps "Development 2.0" should be the terminology. As noted above, there is a rationale for collecting all six of the main ICT4D future components – users as digital producers, the power of the crowd, digital participation, network structures, data-intensive

development, and open development – under the Development 2.0 heading. But there are difficulties with this term. Development 2.0 can readily refer to new non-ICT-related development models. And there is a sense of 2.0-fatigue because the notion has been rather over-used, and any usage always leads to some smart-alec leaping ahead to claim sight of 3.0, 4.0, etc.

An alternative is "Digital Development", a term which gained some momentum in the mid-2010s in UN and donor circles (Heeks 2016a, 2016b). It is ambiguous because it means things other than use of digital technologies for international development. It lacks the purpose of the "4D" element of ICT4D, and it does not offer the clear tag that helps to signal events and material online. So we should beware of ever letting go of the ICT4D label. However, one can imagine incorporating ICT4D 2.0 as the innovation worldview of Digital Development, and Development 2.0 as examples of some of the new development models of a Digital Development era.

At present, Digital Development is not much more than a set of idea-sweepings brushed into a single box. It would mean more if it reflected a paradigmatic shift in our view of development. Bon and Akkermans (2015) make a case that this shift should be towards understanding development via the lens of complexity science (see also Ramalingam 2013). Seeing development ecosystems and social systems and information systems as complex adaptive systems may not only offer new insights, but also be a particularly appropriate way to reflect the growing interconnections fuelled by ICTs and the growing role of networks in development. It may therefore be able to gather together in one paradigm other trends identified here, including the growing role of social networks, of smart devices and systems, and of data flows.

But this is just one suggestion and only the beginnings of an idea. It needs someone to undertake further evidence-gathering, thinking and conceptualisation if Digital Development is to more fully emerge.

Perhaps that someone will be you.

Additional material

Discussion questions

9.1. Which digital technologies do you think will be most important to the future of ICT4D, and why?

9.2.1. For a woman living in a rural, low-income household in the global South, which one of the four main Web 2.0 technologies would be most powerful, and why?

9.2.2. What are the development benefits and disbenefits of the Development 2.0 innovations?

9.2.2. Are data-intensive development and open development separate from, overlapping with, or sub-elements of Development 2.0?

9.2.3. Are the three Development 2.0 patterns positive or negative for international development?

9.3.1. Which of the four Vs is the most significant departure from the traditional role of data in international development?

9.3.2. What are the development benefits and disbenefits of the data-intensive development innovations?

9.3.3. As a government policy-maker, how would you intervene to address the challenges of data-intensive development?

9.4. What is open development?

9.4.2. Which do you think should be given highest priority in international development – and why – open technologies, open content or open processes?

9.4.2/9.4.3. What are the development benefits and disbenefits of the open development innovations?

9.5. What should we call the future of ICT4D?

Assignment question

What future direction will ICT4D take?

Further reading

If you would like to know more about . . .	9.1. future directions in ICT4D	. . . then take a look at . . .	9.1. Heeks, R. (2014) *ICT4D 2016*, Development Informatics Working Paper 59, IDPM, University of Manchester, UK >Looks at emerging areas of ICT4D applications that should be priorities in future NetHope (2015) *SDG ICT Playbook*, NetHope, Fairfax, VA >A number of sections look at the future of ICT4D, particularly in terms of ICTs
	9.2. Development 2.0		9.2. IIED (2009) *Change at Hand: Web 2.0 for Development*, International Institute for Environment and Development, London >Applications of Web 2.0 to development with review of issues and good practices

(continued)

			Heeks, R. (2010) *Development 2.0: Transformative ICT-Enabled Development Models and Impacts*, Development Informatics Short Paper no.11, Centre for Development Informatics, University of Manchester, UK >An ICT-enabled-models view of Development 2.0 Thompson, M. (2008) ICT and development studies: towards development 2.0, *Journal of International Development*, 20, 821–835 >Analyses Development 2.0 in terms of key development issues
	9.2.2. Development 2.0 innovations		9.2.2. Anderson, P. (2007) *What is Web 2.0? Ideas, Technologies and Implications for Education*, JISC, Bristol, UK >Earlier basis for cited 2012 source, providing key ideas about constitution of Web 2.0 O'Reilly, T. (2005) *What is Web 2.0*, O'Reilly Media, Sebastopol, CA >Foundational source of ideas on Web 2.0
	9.3. data-intensive development		9.3. Global Pulse (2012) *Big Data for Development: Challenges and Opportunities*, UN Global Pulse, New York >An overview of big data-related opportunities and challenges Hilbert, M. (2016) Big data for development, *Development Policy Review*, 34(1), 135–174 >Further overview of big data applications, issues and policy Davies, T., Perini, F. & Alonso, J.M. (2013) *Researching the Emerging Impacts of Open Data*, Open Data Research Network >Overview of open data for development including impacts and research priorities
	9.4. open development		9.4. Smith, M.L., Elder, L. & Emdon, H. (2011) Open development: a new theory for ICT4D, *Information Technologies & International Development*, 7(1), iii–ix >Foundational paper on open development Smith, M.L. & Reilly, K.M.A. (eds) (2013) *Open Development*, MIT Press, Cambridge, MA >Edited collection that further develops the idea of open development
	9.5. Digital Development		9.5. Heeks, R. (2016) *Examining "Digital Development": The Shape of Things to Come?*, Development Informatics Working Paper 64, GDI, University of Manchester, UK >Initial thoughts about the future of ICT4D

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