12 Technology, Health and Development

I n this chapter, we discuss two different perspectives on development which is implicitly underlying the topics on technology and health discussed in this book.

- The first of these perspectives is linked to the basic human needs of "good health" and may be summed up in the WHO slogan from the Alma Ata declaration on Primary Health Care in 1968: "Health for all".

- The other perspective on development is linked to the basic need for social and economic development, and more precisely, the need for economic growth in poor countries, regions and communities in the world, so as to counteract the otherwise increasing economic divide. This latter perspective on development, in our context, is also directly linked to the topic, although it will need some explanation: New perspectives within economic theory emphasise the role of technology in economic development. The "technology-gap approach to economic growth", sees technological differences as the prime cause for differences in economic growth across countries (Fagerberg, 1994). Further, this perspective now sees technology as rooted in people – knowledge, not things, and technology development being linked to use and learning, by people, and through that, innovation.

Our rationale for bringing in these two different perspectives on development is that by combining them we can formulate the following hypotheses:

- **Hypotheses 1** – IT for a better world: Information systems and related technologies are needed in order to improve health services and health status in a population. While this hypothesis has been argued for, throughout the book and stands well without further arguments, the second hypotheses will need some explanation by way of assumptions. The assumption is that our social system perspective on HIS states that the system is made up of people handling data and tools, procedures and technology that is making up the system, not the artefacts alone. Key parts of technology development are therefore linked to learning through use and implementation of technology in context.

- **Hypothesis 2** – Empower communities' learning through use. Development and use of HIS following the IHIA approach in developing countries and with emphasis on the use at local and district levels will at the same time lead to technology learning though use, knowledge and innovations. Considering the "technology growth" perspectives, investments in IHIA will contribute to economic growth, and consequently empowerment. Further, by focusing on implementation and

use at local levels, learning, development and empowerment will include poor and deprived communities. We will further explore these two perspectives in the chapter.

12.1   Technology for Development

Geoff Walsham (2001) posed a pertinent question to information systems researchers, whether they are directing the use of ICTs to "create a better world?" Walsham's vision of a better world was not about more automated systems with greater efficiencies or less paper and better surveillance and control mechanisms. Rather it was for a world characterised by more relevant and humane development which transcended concerns of economic development measured by indicators such as Gross Domestic Product. Our own answer to this question posed by Walsham, within our context of health, has been to explore approaches whereby information can be managed and used to improve health services delivery at health facility level, to strengthen management at facility and district levels, and policy making at higher level. In short, how information and technology can be used for shaping a better world, through better health. In this book, we have tried to develop and discuss principles and guidelines for developing systems within an integrated framework which may best serve this purpose.

12.2   What Does it Mean to Use Information for Better Health?

Poor quality data and little use of it are typical characteristics for HIS in developing countries. While this may be largely true, it might also be that much data use for managing health services are not really identified as being "good data use", because it is part of the normal routine work. Let's look at some "fresh" examples from Liberia where we, both the authors, are currently located and doing fieldwork, while at the same time finalising this chapter.

- **Example 1** – "Routine" use of data at facility level. While visiting the Unification city Health Centre, just outside Monrovia, the capital of Liberia, and discussing with the in-charge who took us around to all departments, we were struck by how well data was supporting the activities. All patients and clients coming to the health centre were registered in a book used to make a total head-count for the month, which again was used to calculate workload (patients per health workers). In various departments, such as – Outpatients, Inpatients, Mother & Child Health including Maternity, and EPI – patients were registered in specific ledgers, which again were used to make the monthly summaries. By the end of each month, the in-charge circulated the integrated reporting form, where each health programme had their section or sheet(s). Data was then compiled for reporting, but also for local use. Target populations for immunisation and ante natal care were displayed on the wall and used for calculating coverage of these services, which again, were displayed graphically on the wall – updated till the last reported month. Our impression was that the facility was well run, the importance of data was well understood and data was used to support services delivery in different departments. Data quality seemed to be good, both because data was actively used at the source, and because our limited checks on the numbers in the ledgers did not reveal any errors.

This routine ubiquitous analysis and use of information is part of the day-to-day running of many health facilities. It is done because it is helping the health workers to do their job. Since such use of data is buried in routine work and not seen as extraordinary, it may to a large extent go un-noticed with relation to the debate on data use and non-use. To contrast this good example, it must be noted that we also visited facilities where we detected many errors in summing up data and where there was very less commitment to data use. These errors will of course have implications on how the health of the catchment population is managed.

- **Example 2** – Data used for county management and raising awareness. In Margibi County, Kakata town, we met with the county team including the county health officer. An interesting fact here is that there is a County Board of fifteen members from the health services, other government structures and the community that is meeting every quarter. To these meetings, a county report with data and key indicators from the HMIS is presented. The board is then used to create awareness on important health issues, such as the very high level of maternal deaths in the county. Various traditional beliefs are preventing pregnant women to deliver at facilities with skilled birth attendants. "When your mother delivered you at home, and your grandmother delivered your mother at home, why should you go to a health facility to deliver?" is a common attitude. To get more women to attend ANC services and to deliver in a facility has been a key issue were the board has been used to create awareness and mobilise communities. These efforts have been successful, as in 2010, twenty-one maternal deaths were reported and in 2011 this was reduced to eleven. This is of course still an extremely high figure in a population with an annual estimate of 8,000 deliveries, and it only includes maternal deaths which are reported. Four ANC visits is the policy in Liberia and it is seen as being important in ensuring that women come to the facilities to deliver. It has therefore been a main target also in Margibi county where awareness raising has been pursued through the board, health facilities and also outreach services in the communities. As a result of these efforts, the ANC fourth visit coverage has increased from 24 per cent to 48 per cent, as reported in the report from the fourth quarter 2011 to the board meeting in January 2012. All data in this example are from the county HMIS, where they use DHIS to capture and manage data and where facility level data management and reporting is paper based.

  The point we are making through this case is that this is a noteworthy example of active use of data from the HMIS. Data is used to set targets, raise awareness, deliver services and to monitor achievements of the targets – which will all contribute to "better health". Furthermore, also this practice of information use was regarded, by those involved, as only being part of the normal routine – or ubiquitous data use. It was not something that was explained to us when we asked "how do you use data?" The story had to be derived through several rounds of discussion.

These two examples illustrate how data management and use may contribute to "a better world", contributing to reducing maternal mortality by 50 per cent. Of course, numbers are small and we only have data for two years, so whether the data represent a trend or not we are not yet sure. The trend is encouraging though.

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12.3   What is "Appropriate" IT for Better Health and Community Empowerment?

What about technology, its role in strengthening data use and empowering communities? While the first example above was from a fully paper based system at the facility level, in the latter example, data was derived from the county database.

Due to poor infrastructure and relative poverty, the aim of empowering communities by bringing information and tools for its proper handling close to the people and local users, has traditionally been difficult to achieve. The typical setting so far has been that most health facilities and community health workers in developing countries have had limited access to appropriate computer based tools and the internet. Local and primary level data management has basically been paper based, and even at the district level, availability of appropriate computer based database applications have been limited.

Looking at the history of empowering the community level through capacity building and developing useful computer based applications, it is necessary to start with the term "appropriate" technology. In the seventies and even later the term appropriate technology was used in development aid circles to denote technology "simple" enough to be used in developing countries – a rather patronising attitude. Here we will revisit the term and see whether the term "appropriate" can be given a new meaning in the age of internet and cloud computing.

When initiating the project in Sierra Leone, described earlier, sustainability of hardware and software was a major concern. At that time, there were those arguing that computer technology was not appropriate for rural Sierra Leone. An initial survey showed that literally all computers where seriously affected by viruses. In order to address this problem, a Linux based infrastructure was implemented in the districts; a computer without screen was used as a dedicated "no touch" Linux server running the DHIS software and accessed by users in the district headquarters through the wireless network by using their browser. This infrastructure turned out to be very successful, and indeed appropriate. Despite limited initial Linux knowledge, the trade-off was a running system without viruses. Early in the process, an additional smart technology was also tried; low powered twelve volt computers running on batteries and, the plan was, solar power. This experiment, however, turned out to be not so "appropriate" because the low-powered server did not have sufficient capacity and speed, and users were not happy with screens, performance, and various technical problems put that pilot effort to a standstill.

In Sierra Leone, the internet is not universally available across the country, a situation which is still similar in most parts of Africa. The norm when implementing country HIS in Africa has therefore been, as in Sierra Leone, until today (2012), to capture the data in stand-alone databases implemented in districts, hospitals and health facilities around the country, and to report data electronically by e-mail attachments or physically on a memory stick to the next level. It is complicated to maintain numerous standalone database applications with fragile flows of data between them. Building a web-based data warehouse on a central server, as is the norm in industrialised countries, and even using a cloud infrastructure, is much simpler technically and in terms of human capacity and needed support structures, for hardware, software and data and database management. Ironically, however, as discussed earlier in the book, Africa would need more human capacity for support and maintenance when implementing a "traditional"

country HIS than would, say for example Norway, when implementing a similar system. In Africa, they would need to maintain numerous standalone implementations and complicated flows of data, whereas in Norway only one central implementation would have to be maintained. Cloud based infrastructure using a central server with universal access would therefore be a very appropriate infrastructure in Africa. Based on the rapid increase in mobile coverage and new cables for internet, in both the East and the West coasts of Africa, the situation regarding internet infrastructure is about to change. So, the more modern cloud based technology is markedly "appropriate" for developing countries which runs contrary to the "appropriate is simple" argument of the seventies.

The semi-online solutions developed in DHIS enabled by the new HTML5 standard which is allowing for offline data storage in the browser, is, as described earlier, been successfully implemented in Kenya. During a field visit in the remote western parts of Kenya, the most interesting finding was that the users in districts and health facilities said they had now easier access to their own data, as well as data from the rest of the country, than they had had any time before, including the paper based system. The argument was that they could access their data regardless of power-cuts (when they used their laptop), viruses or computer problems, because the data was, as one user said, "up there", always available, "in the internet"; "While before it was difficult to find the data you needed, now everything is there." Furthermore, they really appreciated the dynamic updates of data, both their own and from around the country. The messaging system in the DHIS was also greatly appreciated as it allowed for instant communication between users across Kenya, as well as serving as a direct "open" line for feedback, reporting bugs and to get help from the system support team when having problems. "Just like Facebook" as one user said. Manuel Castells (1996) in his treatise on the Network Society has interestingly argued the same point: if marginalised people and areas do not become active members of "network society," they will continue to be systematically excluded and marginalised.

We see that the rapid spread and improvement of the mobile network and improved internet are factors that are greatly improving the potential of communities to enter the network society – both through the ability of health services to carry out data management at local and community levels, and these make health problems visible, which previously remained invisible. Only when problems become visible, can they be acted upon and this will lead to better health and development. These examples of new and cutting edge technologies, including the local wireless network running on a dedicated Linux server in the districts in Sierra Leone, are all characterised by – firstly, being very appropriate for even rural communities in Africa, and secondly being very modern and even cutting edge. Therefore, the term appropriate technology for developing countries needs to be given a new and different meaning in the age of the internet and cloud computing. To exaggerate a bit, the more "modern" and "cutting edge", the more appropriate is the technology for Africa and other developing countries. Furthermore, the current rapid development of mobile network and internet infrastructure in developing countries is significantly contributing to the closing of the "digital divide". Of course, the issue of poverty and poor economic development remain key issues maintaining the combined economic and digital divide. We now turn to our second hypothesis stating that implementation and use of HIS may contribute to economic uplifting of deprived communities.

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12.4   Technology, Health and Development

The current state of the world is that differences between the rich and the poor are huge and increasing. We now turn to the role of technology in uplifting deprived communities by applying perspectives within economic theory which emphasize the role of technology in economic development. The "technology-gap approach to economic growth", sees technological differences as the prime cause for differences in economic growth across countries (Fagerberg, 1994).

"Technology is central to regional change, positive and negative, and to economic change, job-creating and job-destroying. It is the most obvious cause and effect of cumulative wealth of rich nations. Technology also promises, more than any other phenomenon, to bring poor nations out of poverty." (Malecki, 1991, pp. 6-7).

The important assumption behind these perspectives is that technology is regarded as rooted in people – knowledge – and not in things. Technology is basically not an exogenous factor, but rather an endogenous one; related to the behaviour of people and the accumulation of knowledge – learning. Technology then is seen as being embedded in people in the institutional and cultural context, and therefore "more often than not difficult and costly to transfer from one setting to another" (Fagerberg, 1994).

"Much of what we call technological change is the process of learning by people and, through them, by organisations and nations. The skills embodied in people result in some companies – and some regions and nations – being more prosperous and successful than others." (Malecki, 1991, p. xi).

Information technology is linked to economic development and therefore tends to be concentrated in the most modern sectors of the economy and regions of a country – and of the world. For this reason, a side effect of IT might be a worsening of the gap in development between sectors and regions within a country, and between countries. Sectors and areas where IT is poorly applied will tend to lag increasingly behind sectors where IT is highly (and more effectively) applied. This is where development of the HIS, IHIA and related infrastructure may play a significant role. Contrary to general technology development, targeting the most developed areas in a country, development of health services, HIS and IHIA are equally targeting disadvantageous communities and thereby directing technology development and learning to these areas.

12.5   Health Sector as an Arena for Technology Learning

The perspectives on economics emphasising technological learning as captured in the policy labelled "National innovation systems" which was also endorsed by the OECD in 1996 (Lundvall, 1992), is based on the following assumptions:

- **First,** it is assumed that the most fundamental resource in modern economy is knowledge and, accordingly, that the most important process is learning.
- **Second,** it is assumed that learning is predominantly an interactive and, therefore, a social embedded process, which cannot be understood without taking into consideration its institutional and cultural context.
- **Third,** when 'knowledge' is used in the production process it is called technology, and new, recombined or rediscovered knowledge, introduced into the economy, is called innovation.

Central issues in the policy of National Innovation Systems include the fact that national policies on technological learning are seen as important in economic and technological development. Innovation is not seen as 'products', or discrete events uniquely localised in space and time, but as processes. It is seen as a ubiquitous phenomenon resulting from on-going processes of learning in all parts of a modern economy. Learning and innovation are emanating from routine activities in the prevailing economic structure. The areas where technical advances will take place will then primarily be where the national economy is engaged in routine activities, oriented towards addressing intrinsic problems.

Learning is used in a broad sense, including both processes leading to new knowledge or new combinations of old knowledge, and processes putting old knowledge into new heads. Key to these processes are *Learning-by-doing* (improving efficiencies in production), *Learning-by-using* (creating new practices in use of technology), and *Learning-by-interacting* (addressing linkages between users and producers). All these processes take place in context, and country-specific factors influence the process of learning and innovations. Thus technological change unfolds in systems of innovation, covering a country at all levels from national to village. Countries that are rich today sheltered their national economy and markets while they were developing their economies and technologies. They created de facto national innovation systems. During the current reign of globalism, however, poor countries are expected to develop their economy and knowledge in an open global market economy. Haiti and Burkina Faso are expected to compete with the US and Europe in an open global market on equal terms. In chapter six, the ecosystem of innovation which we have described, provides a suggested policy framework in which countries like Haiti and Burkina Faso can engage in the context of technology, health and development. They can learn about technology while at the same time engage in solving their health problems.

12.6   Mobile Network in Kenya – Example of Endogenous Learning and Innovation

M-Pesa developed in Kenya represents one of the first systems for mobile transfer of money in the world. Its development and spread to about one third of the population in Kenya is an excellent example of innovation through use and learning. The first version of the system, under a different name, aimed at allowing microfinance borrowers to receive and repay loans using the network of Safaricom airtime resellers. What happened when the system was implemented, however, was that users started to use the system in a variety of new and unexpected ways, such as for general money transfer. This led to the creation of M-Pesa which was re-focused to allow money transfers across the country and for making payments. But again users invented alternative usages and started to use the system as a "normal" bank account to deposit and withdraw money, and also to pay bills.

M-Pesa is now developed as a branchless banking service enabling users to complete basic banking transactions without the need to visit a bank branch. It is argued that this banking service is now closer to poor communities than any other banking service in the world. The threshold to start using the "bank" is very low in terms of formal income, amount of money and formal paper, factors which, for example are blocking potential users from banking services in the US. A good mobile network and a large

number of mobile users provide the prerequisite for the successful "flow" of this new innovation. When literally millions of users are engaged, new patterns of use and innovations inevitably develop.

At a smaller scale, but still significant, the innovative implementation of DHIS using modems over the mobile network in Kenya, also demonstrate how innovations are "emerging" through use and learning. Even to use the mobile network for implementing a countrywide HIS is a first of its kind in Africa. The messaging feature in DHIS started as a way to inform users about new features and quickly developed into a more general interactive messaging system for feedback, support and problem reporting. Despite good coverage in Kenya, in rural areas network connection is an issue and the semi-online features allowing users to enter data in the browser while offline was an innovative approach addressing that problem. The system is gradually being spread to new users and health facilities in a way that they all will have access to the network. Therefore many facility managers and staff will have access to a laptop and will start entering data and generate reports for their facility. In this way, the user base is rapidly increasing and alternative usages will inevitably emerge. This is what we mean by using the health sector as an arena for learning, diffusion and innovation of IT based solutions for health. While the goal of better health remains, the intended "side" effect is capacity development and innovative use of data and IT solutions, which again will feed back and contribute to better health.

Summary

Our suggested IT for development policy in the area of health represent an effort, although small, to counteract the tendency of marginalisation in terms of technology learning and innovation, of poor countries in the open global market by urging these countries to work together in networks. Developing countries should develop and engage in collaborative networks of technology learning, sharing and support in an area sheltered form the brutal global market forces in the health sector:

- Countries should use the health sector as an arena for technological learning and for diffusion of IT in areas sheltered from market forces. Learning about technology while at the same time improving health i.e., developing and implementing HIS and IHIA as a cyclical process as described in this book.

- Establish South – South-North collaborative networks of action for developing, sharing and learning about technologies for health, such as the HISP network and collaborative network for implementing and supporting the DHIS.

- Free and Open Source Software is a prerequisite for developing collaborative networks as suggested here.

Our approach to development is to engage with it, in concrete areas of technology development and its application, to address problems of health – one of the largest "unfreedoms" to development.

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