Digital Divides in the Knowledge Society

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During the last decade, the focus on discussions on digital divide has moved from technology to society. The rapid diffusion of the Internet has made purely technical characterizations of digital divide too simplified and antiquated in less than a decade. In most of the industrialized countries technical gaps have been closing rapidly. Just a few years ago, commentators in the U.S., for example, were worried about the low percentages of women Internet users. Today, there are more women using the Internet than men in the U.S. Although computers and the Internet have their early users, slow adopters, non-users, and dropouts, the extremely rapid cost decreases in computing and communication technologies have increased the access to these technologies perhaps faster than any similar technologies in the human history. There are now more people with access to the Internet than ever before, and the number of people with access has been growing with a record speed.

Techno-optimists, therefore, are inclined to believe that the digital divide is a temporary phenomenon, at least in the industrialized countries. Indeed, we talk about the digital divide to a large extent because information and communication technologies are diffusing at amazing speeds. Computing and communication is now everywhere. When computers run out of power, our air conditioning systems switch off, airplanes stay on the ground, our watches, cars, televisions, telephones, supermarkets, factories, and the rest of the knowledge society stops. Somewhat paradoxically, this is a reason for optimism. In the industrialized countries people have already crossed more digital divides than they ever knew to exist. There is no obvious reason why the currently visible digital divides would remain interesting.

Optimism is also partially based on the observation that information and communication technologies appear to be quite unique economically. Their rapid price declines make them abundant resources. They connect people, enterprises and nations to the global networks of information and knowledge, thus reorganizing the traditional order of centers and peripheries. In the optimistic vision, information and communication are becoming free, costless and seamlessly available anywhere on the globe.

Techno-pessimists, in contrast, highlight the potential costs of first-mover advantage, virtuous cycles, and positive returns. Those who will catch the speeding train will forge ahead, but benefits for some do not necessarily mean benefits for all. If ICTs really have positive impact on economic growth and life opportunities, those who first gain access to the new networks of knowledge will perhaps move ahead faster than average. Instead of trickle-down, the new networked society may be a society of trickle-up. Techno-pessimists point out that those who have power will reap the benefits of new emerging opportunities. In the end, it is not obvious that the less well-off are better off than before. Perhaps the dropouts of the digital world will be worse-off not only in relative but also in absolute terms. Furthermore, whereas the optimists claim that the users can always switch off their ubiquitous information infrastructures when they don't need or want them, the pessimists note that you may loose your credit, reputation, work, health, and life if you try it at home.

It is quite clear that techno-pessimists are partially right. Those who have a good educational background and access to social and economic networks benefit disproportionately from the new electronic networks. Those who learn fast, learn even faster with today's technologies. Those who have power and authority can amplify their power and control using global communication networks.

It is also clear that techno-optimists are right. The Internet and other ICTs are transforming societies and our everyday lives. New technologies can overcome existing barriers and solve social and economic problems. Low cost ICTs will have high-impact in global development. Potentially, they revolutionize the spectrum of opportunities that we see, and make optimistic visions real.

But, what exactly was that vision? How do our discussions on ICTs link with our ideas about development?

This central question has rarely been discussed. Probably this is because a set of strong assumptions and beliefs underlie our modern concepts of development and technology. In the modern world, technology and development are often understood as synonymous. New technology, by definition, means better technology. Technology, in turn, means improved capabilities to achieve goals and overcome constraints. Technology, in other words, means progress. We don't need to ask empirical justification for this simply because the modern concept of technology is conceptually linked to the modern idea of progress and development.

Such a conceptual link between technology and progress is, of course, also often contested by philosophers and sociologists of science and technology. Yet, it is still a common and dominant starting point for many technology-related discussions for a very natural reason. Part of the process of becoming a professional and competent engineer is to learn a system of values that help engineers to say what technical changes are technical improvements. This system includes many unarticulated evaluation criteria that can only be learned through practice, and which engineers describe using esthetic, ethical, and normative terms. Technological designs can be beautiful, clean, and good. The difference between a novice engineer and a competent one is in their capability make such distinctions. When engineers are asked about progress, they therefore easily use their professional value systems and extend them to the rest of the world. Progress becomes increased efficiency and effectiveness, knowledge and control, and improvement of function that previously existed in a less perfect form. And, of course, engineers are often asked about progress in the modern world. New technologies are introduced because engineers think they are improvements over existing technologies. Because they are improvements for the experts, they are expected to be progress for all. This concept of progress has been important in the development of the modern industrialized world.

A more sophisticated view on technology, however, builds on the observation that change and development are conceptually independent. Not all technology is improvement, and new technology is not always improvement for all. The introduction of new technologies also always either revolutionizes social relations or embeds them into our material world in ways that make revolutions increasingly difficult. For this reason, new technologies are often introduced simply to shake up

existing social and organizational structures or to sediment and reify them in technical systems.

The fact that both techno-optimists and techno-pessimists are right indicates that these views are too narrow to cover the essential aspects of the problem. Technology makes increasing differences in life opportunities possible, and it opens up new important opportunities. It can simultaneously push some people ahead and others back. This is why the discussion on technological development has to move beyond individual technology users and talk about essentially social phenomena.

Societal impact, however, cannot be reduced to aggregate numbers, for example, counts of Internet and computer users. Nor can it be reduced to simple distributional analysis. Human needs and capabilities vary and in the knowledge society these variations are becoming increasingly important. Whereas in traditional societies and in the age of the industrial nation states individuals could relatively easily be aggregated to socially meaningful and relevant groups, in the knowledge society such groupings lose their institutional and cultural bases. In the knowledge society, individuals connect to transpatial social and economic networks that often cross cultural, national and institutional boundaries. Individuals therefore represent less well-defined social positions in the knowledge society than before. People also often switch between multiple networks during their lifetimes and even during one single day. Many economic and social positions, therefore, become increasingly transient and dependent on individual capabilities and life trajectories. As a consequence, people use ICTs in different ways, and they gain different benefits from them with widely varying costs. Aggregate measures of development that are based on atomistic views on individual societal members will therefore be as inadequate for measuring development as are their statistical extensions to distributional variances and percentiles.

To understand technical development and the emerging digital divides, we have to realize that development depends on the perspective we adopt. The engineering perspective is one important perspective, and the economic perspective is another. But then we have to move beyond a single perspective. Social development is inherently multi-perspective, and particularly so in the global network society. In effect, we have to be able to see development from an integrative perspective that encompasses multiple evaluation systems. I shall argue that only such a wider point of view allows us to distinguish change that can reasonably be called progress. This is a theoretically challenging task. I will try to address it in a preliminary and experimental fashion below. First, I will discuss digital divide as it has commonly been understood by technologists, economists and policymakers in the last decades, as a question of access to technology. Then I will move on to a resource-based view on the digital divide, and further to a process-based view that emphasizes the role of ICTs in social interaction, collective production, and ongoing social practice. I will explore some interesting characteristics of the process-based view using the Linux open source development project as a case example. Then I will return to the question of technology and development, by analyzing knowledge society development in the context of Amartya Sen's capability-based model of economic development. The paper ends with some brief comments on ideas that could lead us forward on the path of development, and towards new conceptualizations of digital divides in the knowledge society.

Digital divide as technology access

Digital divide was originally described in terms of access to computers and the new electronic communication networks. Although there have been differences in emphasis between, for example, Japan, the U.S. and Europe during the last three decades in the ways they have described digital divide and motivated discussions on it, until the end of the 1990s, the discussions often focused on the question of availability of technology.[1]

Technological optimism has historically been well represented in this discussion. Optimists have often adopted an attitude of technical determinism, expecting social, political and cultural dimensions of development to need little explicit attention. This is because the deterministic view assumes that social, political and cultural benefits follow from new technology by definition. New technology means improved technology, and improvement cannot be there without the various types of benefits. Focus on technology, therefore, is enough in this perspective. This view has assumed that the existing societal and institutional infrastructure takes care of distributional fairness, and that societal, cultural and institutional differences are mainly barriers for progress. Technological determinism has often been accompanied by calls for liberalization of global trade, deregulation, freedom of press and independent media, and emphasis on democracy and consumer choice. On the other hand, partly because social, political, economic and cultural benefits have been taken to be more of less natural outcomes of technical change, the specific nature of these benefits has not always been clear. Optimists have tended to claim or assume that information technologies bring with them improved democracy, economic growth, increased consumer choice and other similar benefits. Often it has been taken for granted that everyone understands what democracy, growth and consumer choice mean.

It is easy to point out that new technology does not automatically lead to democracy, freedom and growth. This does not mean that they would be irrelevant or wrong goals for development. It is, however, important to note that the links between new technologies and democracy, freedom, and growth have rarely been explicitly connected. Strictly speaking, we have not argued or justified well why new technologies would increase democracy, freedom or growth. Even when there has been explicit discussion on these links—as for example in the vast body of literature on the impacts of ICT and new technologies on economic growth—a closer look on existing research reveals important conceptual gaps.

The deterministic view has obvious and fundamental difficulties with the possibility that technologies transform political and economic systems, as well as human agency. The knowledge society does not simply bring increased democracy, as democracy will also be transformed in the process. A similar challenge is facing economic theories of growth that try to describe knowledge-based economies. The knowledge society does not simply bring opportunities for economic growth. Instead, it changes our ideas about growth and economy. An indication of this is that productivity researchers now struggle with the fact that most knowledge-related investments are not visible in national accounts. For example, it has been estimated that investments in

[1] See, e.g., Tuomi 2001, ch 2.

intangibles—not including human capital accumulated in the household sector—could be about $1 trillion of business fixed investment in recent years in the U.S. This is almost as much as the accounted business investment, about $1.2 trillion in 2001.[2] In the knowledge society, democracy, economy and freedom are not what they used to be. When optimistic visions are based on deterministic ideas about technological change that leads to social change and development, they are built on illusions.

Pessimists, in turn, have focused on power and politics. Sometimes deterministic views have also framed pessimistic and critical perspectives on technology. New technologies have been understood to increase existing social divisions without transforming them. According to the deterministic tradition, technology is viewed as something that is thrown over existing societies, and which is subsequently taken into use within the existing social structure. Traditional divisions, such as class, gender, race, language, ethnic origin, formal educational background, institutionally categorized disabilities, and citizenship have been implicitly assumed to remain central in the knowledge society. As a result, digital divides have been understood to be about differences in technology access between such groups. Although such discussions typically have good awareness of the societal dimensions of technology and its use, conceptually they still have retained much of the inheritance of technological determinism. In short, they have to a large extent relied on the assumption that the traditional societal categories remain relevant in the future, independent of the progress of knowledge society.

Access to technology has been viewed as a problem to a large extent because both technological optimists and pessimists have believed that it is important. There are many reasons for this. One apparently trivial reason is that statistical offices, market studies, and technical infrastructures produce numbers that focus on this issue. One could ask why the society produces such numbers and not others.

In fact, when we try to study available data on access, it quickly becomes clear that we know much less about access than we commonly believe. Early Internet usage statistics, for example, measured the number of computers that were connected and visible to the Internet and multiplied the estimates by ten to get the number of people that were using the Internet. These numbers were widely reported in the media, and sometimes grounded the belief that by 2003 there would be more than seven billion users on the Internet. Even after considerable effort on refining estimates on Internet access and use, today it is still necessary to study the exact methodology that is used to measure access, before one can interpret the reported numbers. One could still today argue that the numbers that report ICT use tell very little about the use of ICTs.

The ways in which we measure society and generate information about it reflect existing social institutions and interests. These, in turn, are designed in to new technologies, as for example Lessig has pointed out.[3] Sometimes, however, technologies emerge from the periphery and are taken into social uses that they were not originally intended for. Internet is an example of such technology. This is one reason why we have difficulties in measuring its use. The Internet, for example, does not currently implement economic interests in its design because it was not intended

[2] Corrado, Hulten and Sichel, 2002.
[3] Lessig, 1999.

for economic uses. Charging the use of the Internet is therefore difficult. As much of societal information is generated about economic transactions, and as many societal processes rely on such information, the Internet remains outside important mechanisms of societal measurement and planning. Similarly, the design of the Internet does not implement the concept of "a user," thus making it difficult to collect data on users. Technologists work around such problems by creatively devising proxy measures that produce data for emerging interests, for example, by assuming that an internet address can be associated with an individual user, or by adding "cookies" to web browsers. The validity of such proxies is, however, highly dependent on the use of the technology. Although we talk about access to technology, it is therefore important to note that we know relatively little about it.

We talk about access because, despite all the problems in measurement, we have some data about access. More fundamentally, perhaps, we talk about access because it directly connects us with traditional discussions on equality and justice. In particular, equal access to information infrastructures is often perceived as equality of opportunities and as distributional equality. Political discussion on the digital divide is therefore easy to locate within the ongoing political discourse.

As Sen has clearly pointed out, every plausible defendable ethical theory of social arrangements tends to demand equality in some 'space' that it takes to be foundational.[4] Explicit and implicit theories of social justice require equal treatment of individuals in some significant respect. This can be related to liberties, rights, income, weights given to individual preferences, or, for example, equal opportunities for a place in the paradise. The digital divide, understood as access to technology, therefore has also become an important symbol that is used to articulate problems of societal justice in a world where technologies are increasingly pervasive. Without much effort, access to computers and networks can be seen as a question of equal access to important goods that are needed for good life and survival, or as equal access to opportunities that can only be realized through ICTs. In the Western world, such claims gain specific force, as access to knowledge and information has been an important defining characteristic of modernity.

The traditional technology-oriented concept of digital divide has therefore integrated important social and economic agendas. Access to technology has become prominent in discussions about digital divide because it has been possible to organize many different discussions around the concept of technology access. Indeed, a review of popular and policy literatures on digital divide shows that the concept has also been a rhetoric device that has connected multiple interests. It has been a powerful concept to an important extent because it has aligned independent and influential goals, agents, and actions. Many voices have been able to talk about digital divide, and the somewhat dissonant variations of the theme have merged into a clear and loud message that has been heard across societies.

Access to computers and the Internet have therefore become symbols of development. The digital divide has been used to legitimize developmental goals. The concept of digital divide has been enrolled for various projects to highlight the importance of urgent change. In the leading industrialized countries, schools have been wired,

[4] Sen, 1992.

innumerable projects have been launched, and increasingly detailed statistics have been generated to monitor the evolution of the knowledge society.

Technology producers have naturally readily accepted and promoted the view that everyone should have access to technology. The general belief that ICTs play an important role in national competitiveness, economic growth, and human well-being has aligned the strategic interests of technology producers and policymakers. Highlighting the importance of overcoming the digital divide, policymakers and researchers have promoted the ICT manufacturing industry, sometimes with explicit industry policy goals, but often also simply as a side-effect.

It is therefore important to note that in a less than a decade, the digital divide has become a boundary where many ideas and interests collide. During the last decade, the collisions were relatively invisible in the industrialized countries, as the dominant interests were exceptionally well aligned towards technologically defined goals. This does not mean that the discussions would have been irrelevant or that technology access would be unimportant. The urgent calls to bridge the digital divide can perhaps be heard somewhat cynically as market war cries orchestrated by global corporations. The fact that ICT manufacturers happily promote the idea that every home and village should have a computer and Internet access does not, however, mean that they are wrong. The fact that bakers want to make and sell bread does not mean that people would be better off without bread. Yet, it is equally important to note that the various interests cannot be collapsed into one. They are different interests. This becomes visible when we move beyond the simple view that the digital divide is about access to technology. We need to be able to say something about these different interests if we want to understand what digital divide means and what it could mean in the future.

Digital divide as access to resources

As technology has become increasingly available in countries with broadest ICT diffusion it has become increasingly clear that technology access does not necessarily lead to disappearing divides. As soon as there is access, demand and use become important. This has lead to more human-centric views on ICTs. Instead of counting machines, we have started to count their use and impact.

The impact of information technology is difficult to measure, as the beneficial uses of information technology require complementary assets. A skilled computer user can benefit from a computer in many more ways than an unskilled user. Similarly, an academic researcher, a journalist, or a stock-trader may greatly benefit from Internet access, whereas a shopkeeper in a small village may have difficulties in finding relevant content on the Internet in languages that he or she understands. On the institutional and societal levels, complementary investments into communication infrastructure and, for example, availability of banking systems, credit cards, uncorrupted dispute resolution systems and enforceable contracts greatly influence the scope of use of ICTs.

ICTs, therefore, could be described as “composite resources.” Technology is one element of the composite. To make it productive, however, it has to be combined with other resources. There may be several useful recipes to realize the potential benefits of ICT, but the right recipe depends on other available ingredients.

Warschauer (2003), for example, has proposed that the effective use of ICTs requires physical, digital, human and social resources. Physical resources include computers and networks. Digital resources include relevant content. Human resources include computer literacy, broadly understood as the capability to use computers, communication and knowledge in meaningful ways. Social resources include communities, institutions and social networks that can facilitate the use of ICTs and increase their impact.

In contrast to neo-classical economic theory that understands technology as a parameter that shifts supply curves by increasing productivity, the resource-based view sees the productivity impact as a multidimensional problem of configuring optimal mixes of resources. ICTs are exceptional because they can make the creation of these resources increasingly efficient. As a result, the use of ICTs can lead to positive returns and virtuous cycles. ICTs can be used to create better physical resources, content, and skills and they can extend social and economic networks. Although the mix of resources may not be optimal at the start of the process, the virtuous cycles can quickly lead to accumulation of resources and improved possibilities to create better mixes. This dynamic of ICTs, indeed, is one of the reasons why some people believe that investment in ICTs is a good strategic choice, even when we do not exactly know how they will be used.

The resource-based view on digital divide is a useful improvement on the simpler technology focused view. Most importantly, it reminds us that technology does not automatically generate progress. It also makes it clear that successful recipes depend on the practical context at hand, and that theoretically optimal recipes are not always possible. Sometimes the best road toward knowledge society may start without much technology. Indeed, often the choice can be about "bread or broadband."[5] Efficient policy choices cannot be made by blind belief in the benefits of technology. Useful policies require a good understanding what technology is supposed to do and where it can play an important role. Yet, it is also clear that ICTs may have developmental dynamics that make technology exceptionally useful when it is applied wisely.

Beyond access and resources: the process-based view

The resource-based view on the digital divide leads to the question how people actually use ICT. This is partly an empirical question and partly a question about the appropriate level of abstraction.

Starting from the actual use, we easily find some apparent discrepancies between visions and reality. A realistic assessment of the current possibilities and problems is a good starting point. Popular media tells us that the economic growth impact of the Internet can be mainly seen in sex related services. The new freedom of opinion and electronic democracy and participation are mainly visible in the fact that over half of the messages on the Internet are now unsolicited spam mails. Governments invest in technologically advanced countries huge sums of money to be able to monitor and record all communication that moves on the Internet.

[5] Bogdanowicz, Burgelman, et al., 2003.

However, looking the actual uses of the Internet more closely reveals that it has already become an extremely important infrastructure. The visible negative impacts of the Internet are possible only because they are parasitic on a much larger living body of ongoing social interaction. Internet is used for personal and group communication, search for information, social support, collective production of goods and services, learning, coordination of social activity, media for cultural expression, politics, identity construction, religious services, crisis management systems, information distribution, scientific research, and for many other uses.

The modern ICT infrastructure shares many characteristics with writing. ICTs and written text are both protean technologies that can be used in extremely varied ways. We need paper and pen to write, but we can only write if we know how to write and what to write. Socially meaningful writing requires that we are able to participate in social communication, that there is someone who reads what we write, and that we know the language and genre in which we operate. By learning to use written language we become able to participate in a process of communication that transcends both time and space, and which connects us with conceptual systems that have accumulated during the history of development. This was one of the reasons why the developmental psychologist Lev Vygotsky argued that written language fundamentally changes our capabilities for thought.[6]

The use of written language is an active process even when it superficially can be characterized as passive consumption of text. The texts that are consumed gain their meaning to a large extent because the reader uses them as resources in social activity. We can read just for entertainment and fun, but even in those cases the entertainment and fun often result from shared and mediated communication with others. Similarly, we can play computer games for entertainment but a closer look often shows that they are played in social settings that make playing meaningful.

On the Internet, the link between consumption and production, however, is particularly strong. Although some early visions of the Internet saw it as an extension to the Hollywood model and as a distribution channel for centrally produced content, the Internet does not only provide access to information and knowledge. In addition, it is used to produce knowledge and communication. In fact, knowledge and communication is never just passively accessed or consumed but they are always actively constructed and reconstructed by the people who participate in the processes of knowing and communication. The users, therefore, are not only the end points of global networks of information; they are also sources that adapt, modify, create and distribute knowledge. Beneficial use of ICTs, therefore, cannot be described in technical terms anymore than the impact of written text could be measured by counting the number of pencils. Productive use of ICTs requires dynamic interaction with knowledge, where existing information and knowledge becomes reinterpreted and combined in ways that add value to it.

Furthermore, the outcome of ICT use rarely is static knowledge that can be "stored" in information systems or "distributed" using information networks. Within the European cultural traditions, purest knowledge has often been seen as something objective and independent of the context of use. In practice, however, knowledge is

[6] E.g., Vygotsky, 1986.

manifested in activity. Instead of technologies of knowledge, we should therefore be talking about technologies of knowing. Knowing is an active process of proceeding in practical contexts, and only in very specific situations knowledge can be context independent. Dictionaries make an important mistake here, as they do not point out that knowledge is a verb.

This implies that information rarely makes sense outside specific material and social contexts. These contexts are not just abstract conceptual landscapes of meaning. The "composite" of knowing includes also elements of the concrete environment where knowing occurs. For example, information and knowledge that makes sense on the floor of a steel-mill relies on knowledge of the particular physical environment and work practices in the mill. Knowledge, as Suchman (1987) put it, is "situated." Similarly, knowledge about human health often requires access to diagnostic instruments, medicines, and medical practices before it becomes meaningful and understandable. Access to descriptions of medical practices rarely creates proficient practitioners. Indeed, learning to be a doctor is to a large extent about learning tools, procedures, and practices that form complex social and technical systems. ICTs, therefore, become meaningful and relevant through a process of adaptation and co-evolution where the capabilities and possibilities of ICT become integrated in social practices. In this process, also social practices change.

The emphasis on access to ICTs could be justified on the basis that without access to technology, we can never cross the digital divide. A broader view, however, shows that the "digital divide," understood this way, rarely defines socially interesting divides.

There are many ways to use ICTs for socially and individually important goals. Sometimes the best way to use technology is to redefine the problem so that technological solutions become unnecessary. Indeed, good engineering often simplifies designs by designing away avoidable complexity. Useful technologies are often invisible and sometimes they are invisible because engineers have understood how to avoid them.

The need to move beyond a view that sees digital divide as a problem of access to technology or given resources has been clearly visible in studies on organizational information systems. Researchers have noted, for example, that organizational change management is critical for success in information systems projects. In practice, a great majority of resources and time in information systems projects usually has to be allocated for organizational change. The technical implementation of new information systems is a relatively simple task. Competent information system project managers rarely would argue that access to information systems implies that the projects have been successful. In particular, information systems that are used in collaborative and knowledge-intensive work usually fail without extensive organizational support and facilitation. Typically, new information systems require new organizational incentive systems, new work and management practices, as well as shared understanding of goals and interests within the organization.

One way to conceptualize the digital divide, therefore, is to ask what it takes to cross digital divides. Organizational knowledge management projects can be used here as a comparison point. In successful global organizations information systems are

deployed using the best current knowledge about effective use of ICTs. Global well-managed organizations represent state-of-the-art practice in overcoming all those "digital divides" that knowledge-intensive firms find important. They can also deploy the most advanced technologies to solve their problems and make concentrated investments in dedicated infrastructures. Comparatively speaking, business firms have relatively few economic constraints, as they can often borrow money for investments as soon as the investments seem to have positive return. Furthermore, global organizations can rely on their management processes to institute and institutionalize organization-wide change that implements beliefs about best organizational practices. Global organizations, therefore, can be viewed as the "laboratories" of knowledge society. Although they obviously do not have to deal with all issues that relate to knowledge society, in many areas they can be illustrative benchmarks.

Information system projects are rarely launched because people would need access to technology and they can rarely be launched simply with the goal of providing access to information. Usually organizational decision making and budgeting requires that project proposals describe the needs that the system is supposed to address, and estimate the alternative ways of addressing the needs. If information systems seem to provide a good return of investment, the projects may be launched, depending on resource constraints and competing investment proposals. In project evaluation, several types of costs are taken into account. For example, knowledge management initiatives usually need to address simultaneously multiple dimensions of the "knowledge management problem" which each require effort, investment, and time. A graphical representation of the interdependent dimensions of such a knowledge management problem is shown in Figure 1.

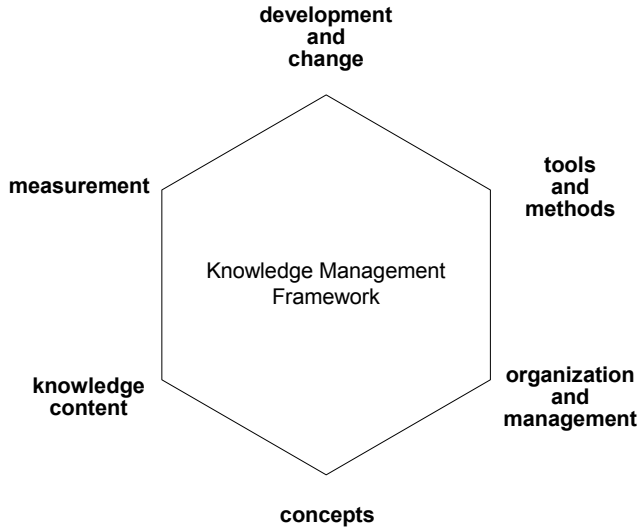

Figure 1. A framework for organizational knowledge management.[7]

From consumption to production: the open source case

The resource-based view on digital divide highlights the point that technology is only one element in the production, reproduction and redefinition of social divisions. But

[7] Tuomi, 1999: 370.

while digital technologies produce and reproduced social structures, they can also produce other kinds of things. Indeed, the discussion on digital divide is to a large extent motivated by the belief that we are moving towards a knowledge economy, where much of the economic production depends on information and communication technologies. It is therefore interesting to peek to the future and see what kinds of opportunities Internet-based production will provide us. A particularly interesting example here is the open source production model. It has achieved spectacular successes that have puzzled economists and organization theorists and which have shown that the Internet can potentially support new modes of development.

One of the most interesting and best-studied open source projects is the Linux development process.[8] It is particularly interesting because the community that develops Linux has been globally distributed since the beginning of the project and because the resulting operating system has generally been acknowledged to be of quality that compares well with the best commercial software systems. The astonishing fact about Linux is that the system has been developed with little economic incentives, relatively few economic resources, and by people who have often learned their skills while developing the system.

Linux is, of course, special because it is developed by computer enthusiasts and because the resulting system is software. It has been particularly well suited for a networked mode of development that extensively relies on computer networks. Yet, the development model that underlies Linux has also more general relevance. First, as an increasing amount of economic production is assumed to be about software and information, the diffusion of Internet makes electronic collaboration increasingly common. Second, the geographical distribution of labor that underlies Linux development is also becoming increasingly important. Third, the way in which Linux developers have been able to connect skill development, innovation, and production is of great interest to all producers, including existing business firms and public sector organizations.

The Linux development model has evolved considerably during the history of Linux, and economic interests have become increasingly important for it during the last years. A fundamental characteristic of the model, however, has been that economic interest have played only limited and indirect role. Linux developers have been creating technology that the developers have believed to be useful and interesting. Although economists have tried to explain the success of the project by postulating various types of incentives, including accumulation of reputation, improved access to labor markets, and, for example, economic network effects, the importance of learning has received too little attention. Linux developers have often been interested in learning. In fact, the Linux development process is very much about social learning, where people gain satisfaction as their competence increases and when the increased competence becomes a source of meaningful social identity. Linux development is not only, or even primarily, about creation of technology. Instead, and without any exaggeration, it is about human growth. As the developed technical system becomes something, its developers become something. The technology provides an opportunity for realization of human potential.

[8] Cf. Tuomi, 2002.

As pedagogical theorists (e.g., Jarvis 1992) have pointed out, there is a continuous conflict in the process of learning. Learning is crucial for transmission of existing cultural systems and development of skills that are relevant for the current systems of production. Learning, however, also opens up the possibility for human development. It can expand the possibilities for human action and social change.

Formal educational systems have traditionally emphasized the transmission function. In particular, they have focused on teaching children and making them civilized and productive members of the society. The emerging knowledge society has increased the importance of adult education and life-long learning, and implicitly also questioned the goals of educational systems.

The Linux development project is an interesting example of continuous learning. It provides a practical context of development of competences whose content and relevance evolves as the project goes on. By becoming members of the development community and evolving together with the created technical system, the members gain new competences that are relevant for the task at hand. The networked and collaborative nature of the process make social peer-to-peer learning central to the co-evolution of the system and its developers.

In the Linux development process, the technical infrastructure of the Internet therefore makes it possible for the developers to simultaneously learn and produce socially beneficial outcomes. Using existing technological infrastructure, the process self-organizes itself based on needs that the development community sees important. With relatively few economic resources and incentives, the collective production system successfully generates outputs that compete with the outputs of best commercial and market-driven product development processes.

One of the success factors in this process is its effective division of labor. The modular technical architecture of Linux allows the different developers and their sub-projects to focus on areas where they have specific interest and competencies. In software development, knowledge and competences are often highly contextual. Development often requires situated knowledge that combines knowledge about particular uses of technology, existing hardware components, and skills and experience that have developed in that specific area. The modularity of the Linux architecture allows the developers to align their existing competences with developmental tasks. Because the process is motivated by individual growth and interest in applying accumulated skills in areas where their impact is high and visible, the development challenges and developer motivation are well aligned. In such a context, learning is meaningful. This leads to rapid individual learning, which is supported by effective social learning mechanisms. The visible result of this dynamic is a technical system that embodies high levels of skill and knowledge.

It is therefore natural to ask whether such learning dynamic could work also in other developmental processes. I have argued before that this probably is the case.[9] In the global knowledge society, many important stocks of knowledge are contextual and situated. A traditional problem in development initiatives has been that engineers and

[9] Tuomi (2002) Open source for human development.
http://www.infonomics.nl/FLOSS/workshop/papers/tuomi.htm

economists have tried to import abstract development ideas, which they have believed to be universal answers to developmental issues. The Linux model has turned this idea around. The network infrastructure has allowed Linux developers to appropriate local knowledge in a larger context of development, and make local initiatives useful and meaningful parts of the larger project. The end result has been a product of global importance.

The problem of linking local development efforts into a global system is not trivial, however. Linux developers have solved this problem by effective social coordination and control that is in many ways supported by and embodied in the tools that are used in the process. Most important, the modularity of the development process has required careful design and management of interfaces between sub-projects. One important factor has also been the fact that the produced output is software code. Although developers may not always understand the local problems and context specific knowledge that other developers use, the global development community understands the language that is used in the process. The developers are also effectively socialized in a system of values that provides the foundation for deciding what kind of changes are improvements. Moreover, in software projects, the description of the product is the product itself. This reduces ambiguity and provides a unified environment where the value of ideas can be tested using commonly accepted evaluation criteria.

Many important development problems in the knowledge society are related to software development and creation of competences that make effective use of information technologies possible. The open source development model is therefore important beyond existing open source projects. Potentially, the model can be applied in development projects that are not focused on software production. If this is the case, access to ICT infrastructures may indeed mean access to development.

Networks and human capabilities

Above we have argued that the traditional technology-access view was insufficient for understanding the nature of digital divides and the ways that they interact with socio-economic development and life opportunities. We also noted that the resource-based views provide a richer starting point for such discussions. The open source model highlighted the point that not only access to resources but also the processes that create them are important. In particular, the open source model showed how relevant competences can be created in geographically distributed electronic networks of social learning, and how contextual knowledge can be integrated in projects that extend beyond local contexts. Still, we have an important question to deal with. This is the more abstract question of the relationship between technological change and development. Information and communication technologies open up new possibilities for human interaction and life, and these technologies are increasingly being used to create even more technology. But when new technology is development? What kinds of technology we should create to achieve progress?

Here I propose that we use as a starting point Sen's work on economic development. Sen has argued that we should study economic development by analyzing is impact on

human opportunities for action and choice. Development occurs when the space of making important choices expand.[10]

Sen's capability-based model of development is built on the concept of human "functioning." Functionings are the different ways of acting and being that a person can achieve. Capabilities, in Sen's theoretical framework, consist of sets of possible ways to function. Similarly to the traditional economic concept of a budget set that defines all the different patterns of consumption that a person can have, capabilities define the space of potential activity and ways of being.

Information technology, as well as other technologies, enters this picture as possibilities to augment and expand capabilities. Not all possibilities to act and be, however, are considered to be important and worth achieving. Underlying the evaluation of capability spaces there is a system of values that define the relevant dimensions of the space and the weights that we give to the progress in the different dimensions. Technological progress, therefore, depends on how new technical possibilities expand the capability space in dimensions that are important.

The dimensions of capability spaces cannot be reduced to technical dimensions. Although sometimes technical characteristics map easily with human functionings, in general, human functionings span a complex space that includes elements that are inherently social, political, and ethical, and which relate to the meaning of things and not only to their functionality. As Sen has shown, there are no universal sets of functionings or universal criteria for selecting the weights for the different functionings. Different value systems lead to different evaluations. In practice, however, many evaluations can be made with incomplete information and without complete agreement on the relative weights of different functionings. For example, the ability to be sufficiently nourished and the possibility of being socially recognized and respected may be valuable functionings in many different value systems.

Many societally important evaluations can be made even when functionings remain conceptually ambiguous. For example, people may often agree that democratic rights are important, even when these rights are only described on an abstract level that does not completely specify what democracy means. On the other hand, even when would know exactly what the concept of democracy means, we do not necessarily know if and to what extent it actually is realized in the society. We may simply lack relevant knowledge.

This is an important reason why information and communication technologies are special. They do not only expand our spectrum of life opportunities by augmenting existing functionalities, but they also potentially improve our access to knowledge and information. In addition to expanding the possibilities for being and acting they also expand our possibilities to evaluate different functionings and reduce ambiguities that are produced by informational limits. Furthermore, evaluative exercises and theories of social justice always rely on some informational bases that select particular types of information as relevant for assessing justice and fairness. ICTs expand our access to these informational bases and improve our abilities to process information that is potentially considered to be relevant. In a simplified way one can say that ICTs are

[10] Cf. Sen, 1992; 2000.

special because they increase our possibilities for ethical way of being. Similarly they increase our possibilities for political way of being, by augmenting our abilities to find agreements in areas where different value systems lead to similar choices.

The theoretically problematic negative side of this expanded ability to sort out practical indifferences between different valuation systems is that the differences also may become more visible. Knowledge society is inherently a transparent society. Whereas in the industrialized society cultural differences and their accompanying value differences were geographically mediated, the new information and communication technologies remove the traditional barriers and make value conflicts increasingly important. To manage such value conflicts, knowledge society needs new types of conflict management systems. The vision of global information society where value systems would be "modernized away" and become irrelevant simply missed the point that its own value system was insufficient to implement the idea of globally integrated networks of social interaction and communication. It is now widely accepted that the deterministic view on digital divide was inadequate, as technology needs skills and complementary assets before it can create benefits. Similarly, the global network and knowledge society will require institutions that complement new technical systems and make a global knowledge society possible. This is one of the fundamental reasons why we will need better conceptual models for understanding technical development in the future.

Sen's capability-based model does not define what exactly the important human functionings are. Its primary importance is in showing what kinds of questions we have to ask to be able to answer that question. Sen has, however, argued that there are five fundamentally important freedoms that provide the foundation for economic development. It is interesting to try and see how ICTs impact these fundamental freedoms.

According to Sen, the human form of life requires freedom and autonomy, and therefore freedoms can be ethical ends as such. Sen maintains, however, that freedoms can also have instrumental value. They are constituent factors in economic growth and development. Political freedom is among the five central freedoms of economic development. Effective utilization of societal resources requires that the citizens have to be able to decide how the society uses its resources and power. Second, the possibilities for human action and choice depend on the fact that people can borrow, invest, and exchange economic resources. Third, people need freedom for social interaction. This implies access to socially meaningful relations, but also access to institutional social relations, such as systems of education and healthcare. Fourth, people need access to the information systems of the society. The transparency of the society is a precondition for the capability to plan and coordinate actions. As the fifth central freedom Sen defines the freedom from life-threatening but avoidable disasters. Now and then the individuals eventually face acts of god and evil that drastically impact their capability to function. The society therefore needs security networks that, which stop the fall before irreparable damage is created.

Using these five freedoms of economic development, we can characterize the impact of knowledge society and its information and communication technologies.

The nature of political freedoms, and the ways in which the often contradictory political goals are negotiated, are changing. The transformation of politics occurs in the knowledge society, for example, because the channels of political opinion formation and social action are changing. The widespread use of information and communication technologies also means that political interests globalize both in the economic and cultural dimensions. As a consequence, knowledge society will reorganize traditional political structures. Some of the traditional divides will disappear. The reorganization can be expected to lead to important struggles where the old positions are maintained against the pressures of the emerging reality. It is therefore important that the institutional infrastructure of the knowledge society has ways to release such pressures and direct them to developmentally beneficial directions.

Also the access to and manageability of economic resources will change in the knowledge society. In the networked and electrified world, capital will flow in new ways and the traditional forms of capital will be increasingly irrelevant. The economic system connects people in increasingly complex chains of causality, and our capabilities to understand the consequences of our actions extend a far shorter range than their impact. In the knowledge society, the economic system will therefore need help and support from political and ethical systems. Only the combined and complementary operation of these systems can integrate actions and the evaluation of their consequences into a framework of development.

Information and communication technologies will also create new forms of community and social interaction. Electronic discussion forums are already important sources of social support, reciprocity, cultural production, and learning. Also the systems of education and healthcare, highlighted by Sen, will become available in new ways through the new applications of technology.

Similarly, basic security and management of life-threatening risks can be organized in new ways in the knowledge society. Partly the question is simply about more efficient organization of services such as healthcare. On a more profound level, the knowledge society will, however, lead to revaluation of risks and responsibilities in the increasingly informationalized society. In the developed Western countries, responsibility has been tightly connected with the ideas of agency and knowledge. In an increasingly connected world agencies become distributed in time and space, and moral consequences of expanding information lead to pressures to reinvent the institutional bases of risk and responsibility. As Durkheim noted in his famous analysis of the birth of the modern society, the changing social relations were accompanied and required new social institutions that were to a large extent expressed in changing laws. The global knowledge society will have the challenge to create systems of laws and institutions that cross multiple value systems.

A new balance between risks and responsibilities is also driven by the increasing societal transparency. The actors in the knowledge society make choices that reflect expectations and information about other actors. This, as Beck and others have noted, leads to increasingly reflexive action and new forms of unpredictability and risks. Individual existence, identity, and opportunities for action can be threatened in new ways in the knowledge society.

This brief exploration of the possible impacts of ICTs on the five fundamental freedoms described by Sen show that digital divides are not only technical, and that development policies need to address a broader set of issues. Furthermore, it shows that many of these issues probably require global collaboration. The emerging knowledge society is not easy to map on traditional institutions and many of the important challenges are irreducibly global, international, and transcultural. The fact that we do not have adequate institutional systems to deal with the emerging issues should not come as a surprise. It simply reflects the fact that the knowledge society is a new system that networks the world in new ways. The digital divide, therefore, does not disappear by switching on a computer and connecting it to the Internet. At that point we just see the first spark of the real digital divides of the future.

Conclusion

The concept of digital divide mobilized policy makers and stakeholders partly because it was seen as a gate to the future and also partly because many different interests were easy to articulate around the concept. The digital divide was also something concrete and tangible. It was possible to bridge the divide by computers and electronic wires. When the digital divide was perceived as an issue about access to technology, complex discussions about the nature and dynamics of the divide were avoided, and the successes and failures in closing the divide could easily be observed by counting computers. This, however, left the original question unanswered. We still do not know how and if improved access to technology leads to development. Although there perhaps are many concrete cases where technology is related to immediate and concrete progress, the intellectual link is still to be made.

The view that in this paper was called the resource-based view on digital divide expanded the perspective beyond technology. Most importantly, it focused on the use of technologies, noting for example, that computers cannot lead to beneficial uses if there is no relevant content or applications for users on the net. Computers do not help in development if, for example, they only speak the language of day traders and computer freaks. The electronic networks need to connect people with relevant content, and the users need complementary skills and resources to be able to use technology in meaningful ways.

The third view presented in this paper could be called the process-based view on digital divide. Technology becomes meaningful for people when it is used in meaningful social practice. Social practices produce and reproduce our social world. Economic practices and transactions are part of this process, but they exist only in relation to a larger system of social interaction. Our consumption is always also production, although not all production is captured by national accounts and economic indicators. The networked technologies increase the importance of collaborative and distributed production, showing that the conventional industrial age division between production and consumption was to a large extent illusion. The process-based view on the digital divide, therefore, emphasizes the role of information technology and communication networks as media that facilitates and constrains social interaction. This view allows us to ask how different types of technologies transform our current modes of social interaction. They also highlight the point that we do not only “use” digital technologies but that we also produce with them. They are used to produce not only economic goods, but also non-economic goods such as knowledge, social

relations, identity, values, and meaning. This is what we see empirically if we observe what people really do with these technologies. Technologies are integrated in social practice, and only if the users are successful in this integration process, technologies become meaningful and real. This integration process is rarely based on the functionality of technology, per se. Instead, the resources that make the integration possible are often local and context-dependent. This is what we see when we study the history of information and communication technologies. They are rarely what their designers expected them to be. The most important information and communication technologies have been invented by their users, often against the will of the original designers.[11]

The capability-based model of economic development was discussed above as a potential conceptual framework for linking technological change and development. Those technologies that expand human capabilities for good life could reasonably be called "progress." Measurement and evaluation, however, are fundamentally social and cultural processes. There are no abstract and universal criteria for progress. Progress is something that has to be negotiated. This process of negotiation and the knowledge that it creates are, in fact, essential elements of progress. Progress is not out there in the domain of technical inventions, but it is in the co-evolution of technologies and our improved understanding of the ways how they could beneficially be used. In this sense, progress is about learning simultaneously the how and why of new emerging technological opportunities.

Often the hows and whys are well represented through the market mechanism and there is no specific need for separate policy assessment. In the modern world, innovation is to a large extent routine improvement. At times, however, innovation creates qualitatively new opportunities and challenges. When this is the case, policymakers may have to be involved. Prospective assessment of technology can be used to help people to articulate their expectations, goals, and priorities. As the history of technology shows, most beneficial uses of technology, however, are unintended. Technologies are rarely born in the shape that they have when they are truly part of social life. For this reason, technology needs to be assessed also retrospectively. It is important to study the real impacts of technology, and to adjust policies based on emerging knowledge.

Technologies are, however, not created only for socio-economic development. In fact, most new technologies are produced without any direct link to society-wide impact. Computers, for example, are conceptually ignorant of the space of functionalities where digital divides live. The societal evaluation of technologies, therefore, needs to be added on top of existing systems of technical valuation. The important question is: How can we do this in practice?

The capability framework is one potential starting point for evaluating developments. Nussbaum, for example, has tried to interpret the capability model in the context of Aristotelian concept of good life.[12] Nussbaum has tried to define central human capabilities that are constitutive for what we call "human life," and basic human functionalities that could be used to define what we mean by "good human life." The

[11] Examples include the telephone, packet-switched networks, mobile messaging and the World-Wide Web, cf. Tuomi, 2002.
[12] E.g. Nussbaum, 1995.

list of basic functionalities is one starting point to measure development and progress. It includes functionalities such as being able to live a life of normal length; to be adequately nourished; to be able to move from place to place; ability to avoid unnecessary pain; ability to think, imagine, and use the senses; ability to have human associations; ability to be engaged in critical reflection about the planning of one's own life both in the private and public sphere; self-determination and identity; and for example, freedom from unwarranted search and seizure.

Such lists are not complete and they are not universal. The important thing to note is that they provide an expanded set of criteria to evaluate technical change. Only from this broader foundation we can argue that specific types of change can be called progress. Without this additional layer of evaluation, there is no way to make distinctions that separate novelty from improvement. The traditional technical criteria of improvement are local for the technical development community in question. They assume that the existing system of evaluation is given and that is cannot be contested. These criteria are embedded in engineering cultures and they operate well within their own micro-worlds. In these micro-worlds, value systems cannot conflict because the socialization of the members guarantees that the evaluation criteria are shared. Real world, however, extends beyond the specific and specialized communities of engineering. In this broader world improvement can only be measured against socially negotiated and contested criteria. When technologies become real, they move into the real world and gain ethical and political dimensions that can be neglected only as long as they stay in a laboratory and on the engineer's drawing board. As Sen has shown, traditional economic systems are similarly blind to the dimensions of development. To the extent that information and communication technologies move human life further in the dimensions of important human functionalities, we can argue that we are closing digital divides in the knowledge society.

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