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A Web-based registry of low-cost information technologies for developing countries

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Abstract.

The paper seeks to explain why no registry of low-cost information technologies for developing countries exists. It advances a set of policy proposals and a suggestion for a dedicated new website.

Introduction

The purpose of this paper is to make the case for, and to describe, various forms of a single (dedicated) online registry of information relating to low-cost forms of information technology that could help developing countries to overcome the digital divide, i.e. the large and growing gap that exists between the extent of information technology applications in rich as against poor countries [1]. (Knowledge about such technology is not, of course, a sufficient condition for its adoption, but it is decidedly a necessary one.)

The first part of the paper seeks to explain why no such registry currently exists in spite of the fact that a great deal of information on low-cost forms of information technology is already freely available on the World Wide Web. Building on the explanation of this seemingly paradoxical situation, there is then advanced a set of policy proposals that is designed to overcome or

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lessen the problems thus identified. At a minimum, it is suggested that a dedicated new website needs to be developed, continuously updated and disseminated among all institutions currently engaged in fostering the use of information technology in developing countries. More comprehensive policy proposals, however, can also be designed, depending, among other things, on resource availability.

Why no central registry exists

It appears that the current lack of a central registry of low-cost information technologies is due to two main factors. The first is that such information as does exist on the topic is highly fragmented, involving, as it does, a large number of different forms of information technology and emanating, as it also does, from a wide variety of different institutions located in a diverse group of countries, ranging from the richest to some of the poorest. The second reason is that this highly fragmented information base is systematically organised neither by the institutions involved in propagating information technology in the Third World, nor (readily) by the traditional search engines of the Internet itself. Let us deal with each of these explanations in turn.

The fragmentation of information

Perhaps the most fundamental point to be made under this heading is that the concept of information technology represents a highly heterogeneous range of innovations that has emerged from the convergence of communications technology on the one hand and computer technology on the other (where the former category is concerned with the transmission of information, as opposed to the latter, which deals with the processing of information). Thus, when one speaks of

information technology, one is referring not only to e-mail, the Internet and electronic forms of telecommunications (such as digital switching), but also to the wide range of computer applications that differ, among other ways, in terms of the hardware and software that they embody.

So diverse a range of technologies means inevitably that some degree of institutional specialisation is bound to occur, partly because the expertise needed in one area of information technology will often differ from that required in another area, partly because some institutions are mandated to concern themselves with only a limited range of information technologies (as is the case, for example, with the focus of the International Telecommunication Union on new telecommunications technologies) and partly because many institutions simply lack the resources required to involve themselves with more than a very limited range of information technologies. If there thus tend inevitably to be a variety of institutions which serve as repositories of knowledge about (different types of) information technology, it also happens to be the case that these institutions differ from one another in a number of important respects, which, in combination, give rise to the problem of institutional heterogeneity referred to above.

With regard, first, to the nature of the institutions that are involved in the generation of low-cost information technologies, there is wide variation, not only according to ownership (with involvement by private and public sector institutions as well as non-governmental organisations (NGOs)), but also according to size (which varies all the way from large international organisations to small-scale NGOs or university institutes). With regard, next, to the location of the institutions in question, one finds again diversity rather than homogeneity, i.e. that they are located not in any one country or even a single continent, but rather that they are to be found in a range of different countries, varying from among the less developed (such as India) to the most developed (such as the USA). These and the other observations made earlier in this section can readily be illustrated in relation to Table 1, which contains a sample list of low-cost information technologies that have actually emerged in practice. For, what is apparent from the table is not only that such innovations have emerged across a wide variety of different types of information technology, but also that they have mostly been generated by an equally wide range of different institutions (where the differences are defined, as above, in terms of ownership, size and location). The prevalence of innovations from India clearly indicates that the traditional

assumption that developing countries are entirely reliant on the developed world for new technologies is no longer valid. However, while it is encouraging that low-cost information technologies are emerging in a country such as India, those who still adhere to the traditional assumption are not likely to look to the Third World as a possible source of such technologies.

The lack of systematic integration of information

Even the highly fragmented type of information described above would not pose a major problem for potential users of low-cost information technologies in developing countries, if that information was being systematically collected, categorised and disseminated in an effective manner. Unfortunately, however, integrative activities such as these are not taking place to any more than a very limited degree in either developed or developing countries.

Part of the problem is that many of the (international) institutions involved with promoting information technology in developing countries are rarely concerned solely with the technological aspects of the problem and hence (understandably) do not view themselves as institutions charged with the task of serving as repositories of information about this type of technology. The Canada-based International Development Research Centre, for example, is heavily involved in the promotion of information technology in the Third World, but very few of its activities have to do with the search for, or the collection of information about, low-cost information technologies; much the same can be said of the World Bank as well. Indeed, even the lesser function of simply *communicating* with other institutions in the same area often seems to receive little or no attention. These problems, one should note, are not confined specifically to low-cost forms of information technology. Indeed, more than 20 years ago, a group of early proponents of appropriate technology in developing countries observed that:

... some international institutions are directing efforts towards the development and/or dissemination of appropriate technologies. Despite this, the fact that the primary responsibility of these institutions does not lie in the field of appropriate technology means that it forms only a peripheral part of their activities. Neither are these international institutions concerned to any significant extent, with research and development directly towards the generation of appropriate technology. In short, *no international institution has the promotion of appropriate technology as its sole objective* [3].

Table 1
Fragmented sources of low-cost information technology: an illustrative sample [2]

| Name of innovating institution and Web address | Type of institution | Location of institution | Area of information technology | Nature of innovation |
|--|---|-------------------------|--------------------------------|--|
| C-Dot (Centre for Development Telematics) www.cdote.com | Semi-autonomous government | India | Telecommunications | Small-scale digital switching adapted to local conditions |
| SatelLife www.healthnet.org VITA www.vita.org | NGO | USA | Telecommunications | Low-earth-orbiting (LEO) satellite used <i>inter alia</i> for health care provision |
| Midas Communication Technologies <i>et al.</i> www.tenet.res.in | Private firms and institutes of technology in India | India and USA | Telecommunications | Cost-effective wireless local loop (WLL) technology known as corDect |
| M.S. Swaminathan Research Foundation www.mssrf.org | NGO | India | Telecommunications | Village information project based on 'value addition centre' and information shops connected to wireless network via modem and special interface |
| New Deal Inc. www.newdealinc.com | Private firm | USA | Computer software | Software able to run effectively on any PC from the latest to the earliest (286) |
| Indian Institute of Science, Bangalore www.simputer.org | Government institution | India | Computer hardware | Simputer is a low-cost (below 200 US\$) computer that enables non-literate users to browse the Internet |
| Oracle www.oracle.com | Private firm | USA | Computer hardware | Network computer without hard disk, priced at less than 200 US\$ |
| Africom www.highwayafric.org.za | Private firm | South Africa | Computer hardware | Provides refurbished computers at low cost |
| Freeplay www.freeplay.org.uk/ | NGO | Britain | Communications hardware | Wind-up technology used to power radios at low cost |

It is, of course, true that there are *other* institutions (often of a national, rather than an international, character) whose mandate is precisely to promote appropriate technology in developing countries and one might thus reasonably expect more from these institutions as repositories of technical information than those described in the previous paragraph. Of these more technologically focused institutions, however, it is probably fair to say that only VITA (Volunteers in Technical Assistance) has fulfilled this expectation to any significant degree in the realm of low-cost information technology [4]. In fact, much of the information that that institution is able to convey to potential users seems to emerge from its own long-standing attempts to develop certain low-cost information technologies for use in the developing countries. In particular, VITA has long believed that:

... it was only logical for it to respond to the challenges facing the developing world in the information age. The organisation's arsenal of communications technologies includes a low-earth orbiting satellite, a series of independent short-wave packet radio systems, and an electronic message delivery system that uses existing telephone networks. For its efforts to bring communications to the developing world, VITA was awarded the very first *Pioneer's Preference Award* by the Federal Communications Commission of the United States [5].

Impressive as these achievements undoubtedly are, however, VITA has necessarily had to limit its activities to certain types of information technology and, perhaps largely for this reason, it provides very little information on the other types of technology listed in Table 1. In any event, VITA clearly cannot be described as a repository or clearing house for low-cost information technology in the broad sense of the concept described above (a function which describes the other well-known appropriate technology institutions with even less accuracy).

The paradox of information retrieval on the Internet

Whether they reside in national or international institutions, the problems described above that militate against the systematic collection of data about low-cost information technology might, one would think, be irrelevant in the world of the Internet, with its remarkable capacity to store and retrieve huge amounts of information. In fact, all the institutions mentioned in Table 1 also have an address on the World Wide Web (as shown in the first column of that table) where they

make information available about their own particular innovations. Is it not then simply a matter of retrieving that same information with the help of one or more of the available search engines (such as Yahoo!, Excite, AltaVista and so on)?

Unfortunately, the answer to this question is much more complex than it might at first seem. For, in spite of their obvious general usefulness in retrieving information, these search engines are also known to suffer from a number of rather serious weaknesses. When considering the difficulties which World Wide Web search engines face, Lempel and Moran [6], for example:

... distinguish between narrow-topic queries and broad-topic queries. This distinction pertains to the presence which the query's topic has on the Web. Narrow topic queries are queries for which very few resources exist on the Web, and which present a 'needle in the haystack' challenge for search engines. An example for such a query is an attempt to locate the lyrics of a specific song, by quoting a line from it ... Search engines encounter a *recall* challenge when handling such queries: finding the few resources which pertain to the query.

On the other hand, broad topic queries pertain to topics for which there is an abundance of information on the Web, sometimes as many as millions of relevant resources (with varying degrees of relevance). The vast majority of users are not interested in retrieving the entire huge set of resources ... The challenge which search engines face here is one of *precision*: retrieving only the most relevant resources to the query [6].

These problems may bear especially heavily on the search for low-cost information technologies, partly because these technologies are described under an unusually large number of synonyms such as micro-electronics, communications technologies, convergent information technologies and so on. In addition, information on each of these (more or less) synonymous concepts may often be listed in country-specific terms and hence become unamenable to search queries using more aggregated geographical categories such as Africa, Asia or developing countries as a whole. For these and other reasons described in the technical literature on information retrieval problems on the World Wide Web [7], one would be hard put to find (within a reasonable period of time) more than just a few of the low-cost information technologies listed in Table 1, using the general search engines mentioned above. Thus, although it is argued below that the World Wide Web has a central role to play in any proposal designed to provide a registry or clearing house of information on low-cost information technology, at present, its usefulness is somewhat less than one might at first hope.

Policy proposals

The policy proposals here are guided by the recognition that although the Internet was shown to be a rather blunt tool in retrieving information about low-cost information technologies, it can nevertheless be highly effective in disseminating this information *once it has been gathered together in a systematic fashion* (the issue of whether and to what extent better information *alone* induces a greater degree of adoption of new technologies in general and information technologies in particular is left aside for the moment).

It would appear, therefore, that there are two fundamental tasks for an Internet-based registry of low-cost information technologies to perform: the initial gathering and classification of relevant information on a new dedicated website and the subsequent widespread dissemination of the site among institutions concerned to promote information technology in developing countries. As has been suggested above, the first task needs to be performed by experts who (most probably on the basis of their experience as technical consultants in different parts of the world) are familiar with the various types of information technology that, in terms of costs (among other factors), are likely to be suited to the conditions prevailing in developing countries (many of the entries contained in Table 1, for example, were provided by just such a person [8]). Whether it is conducted under the aegis of an existing or an entirely new institution, this search process will culminate at a certain point in the construction of a dedicated website, the purpose of which, one should emphasise, is *not* to provide direct technical assistance to potential users. It is rather to bring this group into contact with potential suppliers [9] who can then present their products in a form that is relevant to particular users in different parts of the world, who are likely to pose different questions from one another and who require correspondingly different answers.

If it is to perform this bridging function successfully, however, the new policy tool will need to be disseminated (over the World Wide Web) to as large as possible a number of institutions that deal in one way or another with promoting information technology in developing countries. Those institutions, in turn, will be inclined to include the new site on their own (as, say, a hyperlink) the more it is perceived by them as being credible and authoritative. Thus, whether or not the dissemination function is performed by the experts who are responsible for the collection of information, what is important is that it be associated with, or endorsed by,

a number of influential persons or institutions (such as the World Bank).

In addition to the initial information collection and dissemination functions that have just been described, over time, other needs will emerge, such as keeping the information up to date (no minor task in the rapidly changing world of information technology) and editing the contributions that are made to the site by its readers (for this latter function, some type of editorial board may prove useful). Because all these various functions (collecting, disseminating, updating and editing information) are closely related, it would be desirable if there were close working links between those who perform them (as would, of course, occur automatically if they each relied on the same, or an overlapping, group of personnel).

Introducing the demand side

So far, what has been presented is the concept of an online registry of low-cost information technology entirely in terms of supply, i.e. in terms of making information about such technology more readily accessible. As such, there is an implicit assumption that it is the current lack of accessibility to this information, as opposed to other factors, that constitutes the (binding) constraint on the demand side. While this may be true in some cases, it will not be true of others (since low-cost information technology would not then be selected even if potential users were fully aware of its existence and characteristics). It is well known, for example, that there are numerous socio-political factors that in some circumstances strongly militate against the choice of this type of technology [10]. For one thing, there is sometimes said to be an 'ethos barrier' that has to be overcome in the use of recycled, re-engineered or early model computers (of which the cases provided in Table 1 are good illustrations). The problem in such a case is not that potential users of these computers lack the relevant information. It is rather that in many developing countries, in both public and private sectors, there tends to be a bias in favour of the 'latest' technologies and against older vintages that are regarded as 'outdated' or as developed country 'cast-offs' (a problem that has, in one guise or another, long beset advocates of 'appropriate' technology in developing countries).

In an interesting recent example of this type of selection bias, one of the world's poorest countries, the Democratic Republic of the Congo, was offered 400 relatively old (486) computers as part of an aid project, but rejected the offer in favour of a lesser number (40) of

more recent Pentium computers, even though this meant that ten times fewer people were given the opportunity to work than would otherwise have been the case. Alternatively, to take another example from Africa, albeit of a more political nature, it is often the challenge posed to the monopoly telecommunications provider in the country that prevents the application of certain types of low-cost information technologies (such as VSAT service providers that, in the USA and Europe, provide terminals at a price ten times cheaper than is currently available in Africa, where it is most needed. However, because of the national regulations supporting the monopoly telecommunications company, no service provider will be able to roll out enough VSATs to justify the costs of setting up such low-cost services) [11].

The implication of these and other examples that could easily be cited is that if one is to promote the adoption of low-cost information technology beyond the constraints imposed by the lack of accessible information, quite some attention will need to be paid to the demand side of the issue [12, 13, 14]. In particular, one would want to investigate the range of factors that militate against the choice of this technology and to study cases where the constraints thus identified were successfully overcome, as well as cases where they were not.

Conclusions

As one means of lessening the digital divide between rich and poor countries, the latter can, in principle, make use of the large number of low-cost information technologies already in existence (an illustrative sample of which was shown above in Table 1). Unfortunately, however, information about these technologies remains highly fragmented (and hence difficult to access), partly because of problems that are difficult to overcome with the available search engines on the World Wide Web and partly because no single institution has yet sought to collect, evaluate and disseminate the existing information in a systematic manner.

To overcome these problems, the need for a dedicated, new, Web-based registry of information has been argued; information that would initially be gathered by technical experts in the area and which thereafter would be disseminated to as wide a group of relevant institutions as possible (with the help, where possible, of influential endorsement by prestigious individuals and institutions).

The simplest (and least expensive) proposal that has been made focuses entirely on the supply side of the issue, i.e. it is assumed that the demand for low-cost

information technology would increase merely by making available to potential users better and more accessible information (an assumption that has some, but by no means, universal validity). A second, more elaborate proposal, accordingly, recognises that even with full information, potential users may not necessarily select this technology because of a variety of socio-political constraints on the demand side. Thus, if one is concerned to promote the adoption of low-cost information technology beyond the limits currently imposed by the lack of information, a good deal of attention will have to be paid to the other factors that influence the choice of technique. More specifically, the proposed registry would need to include cases where the constraints thus identified were successfully overcome as well as cases where they were not.

Acknowledgement

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- [7] See, for example, the relevant articles in *Proceedings of the 9th International World Wide Web Conference, Amsterdam, 15–19 May 2000*.

- [8] Namely, Mike Jensen, a consultant mainly to African countries.
- [9] See: J. Peizer, *Bridging the Digital Divide: First You Need the Bridge*. Available at: www.mediachannel.org (21 June 2000). Potential suppliers may be contacted via what Peizer refers to as a 'third-party, trusted source that brings together like-minded sites under an umbrella site acting as a portal into the larger community'. According to Peizer: 'An excellent aggregator example is *OneWorld.net*, the human rights and development site aggregator. OneWorld spiders information from each of its site members. Editors categorize the information and format it as the OneWorld entry point for those seeking access to the human-rights and development sector on the Web. Individual members still have their sites and their autonomy'.
- [10] Just as they did in relation to what in earlier periods was referred to as 'appropriate technology'. See, for example: F. Stewart, *Technology and Underdevelopment* (Macmillan, London, 1977).
- [11] These examples were kindly provided by Mike Jensen (see [8]).
- [12] This need was recognised in the literature in the late 1970s that dealt with various types of global action for appropriate technology (see [13]). Stewart (see [14]), for example, took note of the strong reasons for believing that socio/economic variables may be of as much significance as technological ones in determining the choice of techniques. Providing information about appropriate techniques (old ones or newly developed ones) may be necessary but not sufficient. A vital element of a successful appropriate technology policy may then be the identification of the other elements necessary for successful introduction of appropriate techniques.
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