

Community-Based Science and Technology and Third World Development*

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Introduction

There is no doubt that science and technology have become key tools in the advancement of mankind. However, many are questioning whether this advancement also includes that of the people in the poorer countries in the so-called Third world. The relationship between science, technology and innovation on the one hand, and the economic development as well as advancement in other areas of the people in the South appears to be tenuous at best. What is at issue is that the fruits of the innovation, which obviously requires much science and technology, do not directly benefit the poorer population. This seems to be due to the fact that the fruits of science and technology typically require a large amount of investment both in terms of capital and intellectual effort. Since the poorer countries do not possess either in a great amount, through various historical, structural and institutional reasons, it is understandable why one has yet to find a clear path from innovation in science and technology to the betterment of the lives of the majority of the world's population.

Thus, in order for science and technology to become key players in the development of the South, these obstacles need to be identified and ways

found to remove them. Due to the ever increasing complexity of today's globalized world, it is but a nostalgic dream to think of the Southern countries as being able to avoid science and technology together and to stick with a vision of pristine lives without them. Globalization has intertwined all corners of the world through the web spun by science and technology, and there is no way out. Hence to search for a way out of the obstacles facing the poorer countries is indeed an urgent task.

I propose that the way to overcome these obstacles could be realized if the context in which some science and technology is done is conceptualized anew. Instead of the traditional models of how and where activities constituting science and technology are performed, one should envision another model where such activities are based more on the local communities themselves. In order for this to be possible, at least some part of science and technology need to be free from globalized business interests, whose activities have alienated a large part of the population in the poorer countries from a kind of trust in science and technology that is crucial in using them to chart a course of proper development for them. With today's model of conducting of science and technology, where most activities take place within the precincts of the transnational corporations, it is very difficult to find such a chart. This is so because, in the eyes of many in the poorer countries, it is precisely this tie between science and technology, and these globalized corporations that constitutes the obstacle in the first place.

I would like to argue here that science and technology must cater to local interests and needs. They must be integrated into the fabric of the cultures of the developing countries themselves. This does not mean merely that the products of science and technology be made available to the

population, but that the activities constituting science and technology should become integrated in the lives of the population. This includes education, training, conducting research and technological development aiming at solving problems facing the communities, answering to local needs. Thus I broadly follow Shahidullah's proposal for an 'innovative engagement strategy',¹ whereby the emphasis is neither on blindly following the models of the West, nor a radical disengagement from modern science and technology. What differs from Shahidullah's analysis, however, is that I propose here that the local communities and villages should have a role to play in formulating science and technology policies too.

A commonly accepted belief among most scientists and science and technology policy makers seems to be that science and technology are neutral and are exactly the same everywhere they are practiced. This belief appears to coincide nicely with the ideology of neoliberalism, which aims at spreading globalization and the logic of rational efficiency to all areas of life. However, since cultural differences still remain very strong and powerful (as evidenced clearly in the tragic event last September, among others), the belief that globalization should spread in such a way as to obliterate differences among cultures is clearly not well founded. Science and technology, coupled with neoliberalist ideology and globalization, could then be a volatile and potentially destructive mixture. I call, therefore, for a new way of thinking on how science and technology are to be conceived and practiced. Science and technology, or at least some part of them, should distance themselves more from global big business informed by the neoliberalist ideology, and should become more aligned with local communities and cultures, answering their questions and serving their goals and values.

Existing Models of Doing Science

When science is viewed historically, one finds that it is a kind of activity that is performed by members of a society, standing in complex relations between other aspects of society as well as sustaining no less complex internal relations of its own. For example, the research laboratory is an organization aiming at producing knowledge, and the lab is typically part of a larger organization, such as the university, the research institute, or the business corporation. The knowledge provided by the lab is utilized in many ways by the society, such as becoming a key ingredient in creating new products for the market, and so on. In any case, science sustains a strong relation with its socio-cultural and historical contexts. And since science has become much intertwined with technology, to the extent that contemporary science is unthinkable without technology, and vice versa, technology in this sense also stands in complex relations with its social surrounding too (and perhaps even more so since technology aims at directly solving problems faced by society). Hence one can group the historical models of doing science and technology into three as follows:

(1) *The 'Lone Gentleman' Model*

This is the first model of modern science that appeared in history. The scientist works alone without the benefits of the huge research lab or help from members of the team, which characterize scientific research today. Great scientists from the past, such as Galileo, Kepler, Newton, Darwin and Einstein, all worked according to this model. Funding for the works of these scientists came neither from the state nor from any business enterprise, but

from the personal fund of the scientists themselves. In some cases there may be patrons who are aristocrats or noblemen who take care of the scientist so that he be able to work freely without the constraint of having to find jobs, or in other cases the scientists themselves are noblemen who have rich endowments enabling him to work freely. The patrons may be the King himself or high ranking nobles who have authorities in the state and who have interests in seeing that the work of the scientists benefit the state. In fact many research works on artillery and projectiles of canon balls were funded by kings or nobles who had obvious interests in them. But there was no clear science policy and planning which became common place in the era of competing nation states. Most scientific activities were conducted by individual scientists out of their own personal interests, and the content of science itself was such that it was possible for a lone scientist to conduct original research.

(2) The National Government Model

The lone gentleman model was largely succeeded by the national government model when the overall system of world economy changed from one based on agriculture to one based on manufacturing industry. Beginning roughly at the turn of the last century, the works of individual scientists became rarer and were supplanted mostly by research institutes consisting of teams of scientists working together on common projects. Even though individual scientists still continue working until today, it is clear that the majority of scientific and technological activities have shifted to the research laboratories and institutes funded by the governments.

This model is still the model followed by most developing countries today. In Thailand, for example, vast majority of funding for research and development is from the government. What is characteristic of this model is that, apart from the fact that funding comes from the central government, there is a tendency for a macropolicy aiming for channeling scientific research and development to a specific set of goals. These sets, however, do not always cater to local interests and needs, especially if those needs are not aligned with the prerogatives of the central government. This problem has been especially acute in developing countries, which are still relatively weak in bringing their own governments to be more accountable to the public. What can happen in these countries is that the central government sometimes has its own agenda in conducting scientific research, which provides little benefits to the local population. The government may pursue a policy of conducting research in certain areas without any consultation or participation from the local population who are not scientists. This gap between the government and the population is a cause for a sense of alienation felt by not a few in the developing world against science and technology, a topic which will be discussed momentarily.

(3) *The Transnational Corporate Model*

Much of the discussion on science policy in the Third World focuses on the need to shift from the government model to the corporate model of doing science. However, when looked at from a broad historical perspective, what has happened in the last few decades is a shift from the public government model to the *transnational* corporate one. The locus of scientific and technological activity lies not in the confines of public governments who are,

at least on paper, accountable to the citizens of the respective countries, but to the business corporations whose span covers the entire globe and do not seem to be accountable to any national or political authorities because they can threaten to shift their operation elsewhere should the climate in one political entity is not to their liking. In this current globalized climate, the transnational corporation seems to answer only to their own internal logic of efficiency, with national governments seemingly becoming powerless in comparison. These transnational corporations are linked very tightly with globalization, and their engines in holding globalization together are powered by science and technology. The onset of the Internet, for example, has enabled many firms to conduct electronic commerce, making possible direct contact between the producer and the consumer, and since the Internet spans the globe, the communication and the transaction between the firm and its customer does not have to be restricted to only one political entity. Intensive investment in research and development in computer science has enabled organizations such as Microsoft to become a truly global corporation. The software produced by Microsoft has become standard by which people from around the globe communicate, as can be seen in the predominant operating system and in sending of attached computer files, which are almost invariably in Microsoft format. Microsoft thus has become a presence, a setter of standard which even national governments have to follow worldwide.

It is clear that in the West the majority of scientific research and development is supported and funded by the global business corporations. And much of the literature on science policy in the Third World looks at this as a model of efficiency and as the desired destination which these countries should adopt as their own. However, since the global corporations typically

have to answer to the stock holders and not to the majority of the world population which they serve, their direction appears to be dictated by the demands of the formers rather than the needs of the latter. This makes it quite difficult to see how the model of global business corporations could serve as such a model. A more appropriate model thus seems to be one where the corporations are smaller in scope and where they answer to the local population rather than the distant stockholders. For the developing country, this clearly seems to be a preferable model.

Deficiencies of These Models for Development of Poorer Countries

These three models are not meant as replacements of each other. On the contrary, they overlap each other. In fact the three models can and do exist side by side at the same place and time. One thinks of a lone inventor who works on his or her own in an environment where scientific research and development takes place both in government institutes and business corporations. However, these models do happen chronologically one after another, and their existing together seems to indicate a kind of organic growth where new things exist on top of the older ones.

These models, at any rate, are rather deficient as appropriate models for development of the Third World. The lone gentleman or inventor model does not generate enough power to sustain the kind of innovation through science and technology that can effectively help solve the development problems facing the Third World. The lone inventor may be able to come up with amazingly original idea or prototype. But to realize the prototype into workable products that can be effective to a wider sector of population requires massive investment and distribution, which the lone inventor cannot

do. The national governments are able to marshal substantial sums of resources and money that is required for intensive research and development that demands a highly concentrated level of knowledge and skills. And even today many research works that do not translate directly to the market are supported by governments or consortia of public institutions.

Nevertheless, the national government models suffer its setback when what is needed is the kind of products that immediately serve the needs of the global consumers. A reason why products based on genetically modified organisms have been developed by corporations rather than government consortia is that the former see the business potential of such products, whereas the public organizations do not see the point of developing them beyond conducting the basic level research in the related science. Thus when these products are actually effective in combating many problems facing the Third World countries, it shows this weak point of the national government model quite well. Furthermore, in the context of finding the way of doing science and technology that is most beneficial to the development of the poorer countries where development at the grass root level in the local communities is crucial, national governments sometimes have their own agenda, which may not include solving local problems as among their top priorities.

A government in a Third World country, for example, may choose to conduct scientific research in an arcane subject or in a topic related to military use which does not translate to benefits for the majority of their own population. In Thailand, the government has monopolized power for so long that it is very hard for the people to imagine what it is like to conduct their own affairs beyond the very weakened mechanisms of local government.

Though there have been talks of transferring power to the locals for many years, this is still being viewed with suspicion. Many fear that power distribution to the countryside would mean that the villages and districts will be controlled by gang leaders who then can do anything they please. Such suspicious attitude is a product of a century of a very centralized government. Since the government cannot know everything in each locality, they apparently are in no position to decide everything for the villagers. In science and technology, the Thai government has also effectively monopolized the funds available for research. Though there have been talks of encouraging business enterprises to invest more in their own research and development effort, this bureaucratic mindset still largely affects the scientists who staff the public agency responsible for science policy in the country. They tend to think of the business entrepreneurs as usually lower in social status than they are and as incapable of conceiving and seeing through research and development effort on their own without help from the government.

The setbacks for the national government models cited above are among the reasons why many researchers in science policy are calling for the transfer of the larger part of money available for funding research and development to the business corporations rather than keeping everything with the government. However, the transnational business model also has its share of problems as an appropriate model for doing science and technology in the poorer countries, as we have seen. Since the corporations appears to be dictated more by their stockholders rather than by the needs of the population, the decisions could come in favor of the former rather than the latter. This can be seen in the case of developing drugs for malaria, where there are not enough incentives for the manufacturers in the West to do so

because most malaria victims are in the poorer countries in the South and thus cannot afford the high initial cost of the drugs once they are developed.

The basic problem facing the transnational corporate model of science and technology is hence precisely that the corporations' actions and decisions do not necessarily correspond to the needs of those in the developing countries. Developing products made from genetically modified organisms is another case in point. Leaving the thorny scientific issue of the actual or potential risks of genetically modified organisms which are released to the environment for the moment, one sees that these products are often perceived as tools by these corporations to enhance their economic status rather than as genuine help for the people. Perception of course can be right or wrong. But the fact that there is widespread public negative perception of GM-related products shows that the people are concerned with the business interests, which could threaten to eliminate the traditional way of farming, that come together with such products. So long as there is no definitive and clearly demonstrated research that genetically modified organisms are genuinely safe, the people are then entitled to their perception.

Another serious setback for the transnational corporate model is that it tends to create disparities and polarization between those who benefit from the fruits of modern science and technology and those who do not. The digital divide is but one example, in one field of technology, of these polarizations and disparities engendered by the model. The divide between those who are connected to the Internet and with it knowledge and information and the ability to stay connected with others around the globe, and those who are unconnected and unable to do so is a potentially destructive condition facing the world today. This has happened when the tools that enable one to be

connected—computers, software, telephone lines, power lines, manuals, and so on—are commercial products developed by companies whose aim lies rather in maximizing profits than in charity work. To be sure, there have been many attempts to close this divide through ingenious use of scientific and technological skills.² But those attempts have to originate from the kind of mindset that does not take the transnational corporate model as the only possible one.

The divide created by following the transnational corporate model of doing science and technology does not limit itself only to the digital domain. Calestous Juma has called the divide between those who are able to benefit from the new biotechnology and those who are left out as the 'genetic' divide. The root cause is the same, namely profit motive versus the need to distribute the fruits of the technologies to the wider sector of the world's population. It is clear, then, that a new model, or a new way of conceptualizing how science and technology are conducted, is needed.

Community-Based Science and Technology

What is being proposed here is that the new model of doing science and technology should incorporate the good aspects of the previous three models while avoiding the pitfalls. It should retain the lively original creativity fostered by the first model, the commitment to public service of the second model, and the efficiency of the third model. In order for science and technology to be most beneficial to the majority of the world's population, the local communities should have a role to play in directing of course of research and development, determining the content of research, and in conducting at least some aspects of scientific research by themselves.

What this means is that the locus of science funding and the central context wherein scientific activities take place should also include the local community, rather than the individual, the public agency, or the private corporation. The community is small enough and flexible enough to foster original creativity, allowing individuals an extent of free space wherein they can innovate without being burdened by directed research. It is also committed to public service, and as a local community with a certain amount of autonomy vis-à-vis the state, it seems to be in a better shape to respond to the needs of their own people than the bureaucratic agencies within the government. Furthermore, nothing prevents organizations directed by the community not to take profits, or to employ modern business methods in their operation in order to enhance efficiency. Such for-profit organizations could come in form of co-operatives, where the profits are returned to the community. While this new model is by no means intended as a total replacement of the previous three models—in fact that would be highly impracticable, the new model should serve as an alternative to the existing models which should respond better to the needs of the people in the poorer countries.

A major potential drawback of this scheme is that the local communities are by themselves too small to conduct large scale science and technology which is sometime required to tackle complex problems. The amount of money available to a community is very often not enough to do anything more than piecemeal attempts to find solution or to seek out new knowledge that can serve as a guideline. However, the communities could form themselves series of networks, pooling the resources and the expertise together in order to create a larger entity that should be more able to do the

job. Due to the rapid diffusion of information and communication technologies, communities based on different regions of a country or even of the world could be connected to one another and share knowledge and experiences which one could find useful in their attempts to solve their own problems locally. And since the kind of science and technology that are done by the communities are not the same as those that require huge amount of money that is the case in the big science projects supported by the public agencies or private organizations, the networked communities are in less need of such huge amount and can make do with whatever is available.³

Another advantage of the community-based model is that this is the model that can better recognize the obviously important role of indigenous knowledge system in development of the poorer countries. Asian countries such as Thailand, for example, do not just pop into existence being poor immediately. They have had a long history as well as a long tradition of knowing the outside world and of making use of the environment to serve their needs. The same obviously goes for countries in Africa and elsewhere. In my research on science in Thai culture and society,⁴ I have found that one of the main reasons why science and technology do not seem to be integrated into the fabric of Thai lives and culture is that they were somehow imported directly from the West and imposed on the Thai people without their real understanding of what is involved. This has created a sense of alienation from science and technology that is felt by the culture as a whole. This sense can be seen in a number of literary works dealing with modern science and technology, where most depict science and technology as a villain, since they are allied with the global business interests, which are based on egoistic desires.⁵ To the Buddhist Thai, this is a highly immoral condition and this,

coupled with the very inadequate educational systems that is still afflicting the country, further enhances the alienation that separates Thai people from modern science and technology. According to Ven. P. A. Payutto, who is one of the most respected monk and Buddhist scholar in Thailand, development in science and technology cannot be complete if one neglects the dimension of mental and spiritual development which informs the former with a sense of morality and values.⁶ Thus, in order for science and technology to be able to work effectively for the betterment of the Thai people in general, this sense of alienation has to be overcome. What is proposed is that the previous three models do not seem to be effective in doing this. The community-based model, on the other hand, appears to be in a better position because it takes the role of the community as central, and as a corollary to this, the role of the indigenous knowledge system which is part and parcel of the culture of the community, should be given a more prominent role.

More specifically, giving more concrete role to indigenous knowledge systems means that a continuous line of development from the indigenous system to modern science is looked for when science and technology are used for development. This could come in many forms, such as using traditional knowledge in herbal medicine to set agenda for research. In this case the traditional knowledge of herbs could be refined and developed further using techniques of modern science and technology which are based on the needs of the people in the community. The key is that development is aimed more at solving local problems rather than developing new products to be marketed globally. Since this proposed model is not aimed at replacing the previous models altogether, different models can exist together, and what the communities gain is a new way of doing science and technology that is

strictly local in character. Doing so will reduce the sense of alienation that many are having against science and technology. Bringing science and technology closer to the cultural fabric of the community and thus reducing the sense of alienation is thus a first step toward an optimal use of science and technology for the development of the poorer countries in the South.

An Example: Production of Wine and Beer in Thailand

In order to illustrate how this model can work out in reality, we consider a case of the production of fruit wine and other kinds of beverage in Thailand. For at least five or six decades, production of alcoholic beverage in Thailand had been monopolized by the state until the law was repealed a couple of years ago. Before then villagers who had been fermenting and brewing their own wine and beer for millennia found themselves committing illegal acts and were quite severely punished. Hence they either had to take their production underground or to stop brewing altogether. Villagers found it increasingly difficult to drink their own local kind of wine, beer or fermented rice juice, and had to contend with the mass produced and utterly tasteless brew produced by a handful of large national companies licensed by the government. This harsh act against using traditional knowledge and skills involved in the production almost killed off the knowledge and skills involved in production of local beer and wine. Thai words for the different varieties of the local brew, such as '*kachae*', '*u*', or '*sato*', became during this period associated in the minds of the urban elite Thais with country bumpkins who committed illegal action out of their ignorance and stupidity, or their audacious challenge to the state (more of the former). One quite often hears reported news stories of villagers being arrested for producing their

brew, their equipment impounded and destroyed. It is amazing indeed that the knowledge and skills involved in producing local wine and beer persisted until today despite of all these efforts to suppress them.

After the economic crisis of 1997, however, there emerged cries from many corners of Thai society for the return to their roots in order to find their own source of economic prosperity without having to rely on foreign capital and foreign techniques. It is rightly perceived that direct inflow of foreign capital into Thailand coupled with the unbridled enthusiasm for the superficial prosperity it engenders are among the leading causes of the crisis. Part of these calls for the return came from the villagers and their allies in the academy and the non-governmental organizations, who call for the repeal of the alcoholic beverage monopoly law so that villagers are allowed to use their latent indigenous knowledge and skills in producing their own wine and beer. Understandably, the licensed national companies did not want to see the liberalization happen, since they had had a lot of vested interests in having the entire market to themselves for selling their own tasteless brew.

Thus a struggle ensued. Apparently following the recommendation of the IMF, the government itself installed its own policy of liberalizing its own monopolies; however, when it came to producing alcoholic beverages, it strangely turned silent. The government at first tried to argue that alcoholic beverages were not good for the health and that the villagers did not know the proper techniques of producing clean wine. But it shortly turned obvious that these arguments did not hold water. For they are undercut by the government's own granting of licenses to the handful of companies which have become hugely rich from their monopolies. Moreover, the villagers already knew the *proper* technique of producing their own wine and beer,

since it was integral to their own technique of planting rice (which was not considered illegal). It is the government's own attitude that prevents it from seeing that the villagers' technique could be improved further on. Since producing local wine and beer had been declared illegal for so long, the villagers lacked any kind of support to do so effectively.

At any rate, the government finally succumbed to the nationwide call for the liberalization and repealed the monopoly law. Suddenly there was a tremendous boom of fruit wine producing cottage industries nationwide, as the repeal actually released a vast store of pent up energies and creative forces that had been pushed down by the wrong policy of the past. Hundreds of small firms in the villages have sprung up producing their own version of *kachae, u, sato* and other kinds of wine and beer. After having collected a lot of excise taxes from these start up village firms, the government then changed its attitude and declared the liberalization to be their own policy and their own work. The current government of Prime Minister Thaksin Shinawatra even has put wine production as one of its priorities in its "One District, One Product" policy aiming at stimulating local industries. The government has even organized a huge trade fair showcasing the hundreds of kinds of locally made wine and beer from different regions of the country for both domestic and, potentially, foreign consumers in mid 2002. The Prime Minister even talked to reporters that he intended to introduce one of these local wine brands on board of Thai Airways flights to show Thai ingenuity and traditional arts. This perhaps signified that the official attitude toward the 'village moonshine' of the past has completely changed.

The Road Ahead: Developing and Utilizing Science and Technology

Locally

What this example has in relation to our discussion on community-based science and technology is that science and technology have indeed to play a key role in the development and refinement of these products made by the villagers. What we are now seeing in Thailand at this moment is the initial stage of a development of a kind of product where hundreds or more of start up firms all come up with their own offerings for the market. Each brand of beer and wine all tastes differently because they come from different regions of the country having different kinds of soil and climate, all of which affect the aroma and the taste of the wine produced. Each village also employs different techniques in producing their own kind of wine and beer. Furthermore, what is very interesting is that many kinds of fruits are being used to produce wine. Thus we now have in Thailand banana wine, mango wine, longan wine, morinda wine (wine made from the juice of *Morinda Citrifolia*), and so on. These are in addition to the many different kinds of beer produced by different varieties of rice and barley in different regions of the country. These tremendous numbers and varieties point to the fact that Thailand is poised to have major wine and beer producing industries in the near future. All that is required is the modern knowledge and technique which could improve the quality and boost these products to the world market.

The community-based science and technology model can serve this by shifting the locus of research and development to the villages themselves. In these cases, the already existing knowledge of wine making is not adequate because no one, as far as I know, has done any research on how the fruits of

this or that variety of banana could yield such and such quality of wine. The tremendous numbers and varieties of the producers and the products make it necessary that any single, nationwide research institute cannot do the job fully. The village communities have then to conduct their own scientific research and development by themselves.

This can be done by infusing knowledge and skills to the villages. Networking is thus of crucial importance, and model at Media Lab serves this very well. The villagers already have the energy, commitment and determination to see their products succeed. Competition in the market will ensure that any producers that do not take good care of the quality of their wine or beer will be eliminated. If the government does not take a wrong turn again by preselecting certain producers and monopolizing alcoholic beverages, what we will see is that a natural competition among these village firms will certainly push up the quality of the product, as well as the quality of packaging and marketing techniques which are indispensable in today's market. A virtuous cycle could thus ensue when the need for better quality drives the need to do science and technology, and the more intensive effort in contextualized science and technology will boost up quality in production, management and marketing.

Some Policy Recommendations

Before the end of the paper, I would like to conclude this essay by offering a few recommendations for policy makers. Firstly, what is need, as we have seen, is sustained infusion of knowledge and skills to the wine producing villagers. In fact this does not merely pertain wine production, but the model could well be applicable in other fields. This infusion should take

place both in form of formal and informal education. Since at present no one in the world knows anything about how to make fine wine out of the *namdokmai* mango, for example, the infusion here cannot mean direct injection of knowledge and technology to the villagers. In fact to do so would be to miss the point. The knowledge and skills have to come from the villagers themselves. Nonetheless what the government and the developmental organizations can do is to help the villagers nurture their own traditional knowledge in such a way as to be able to withstand the forces of the market.

Secondly, the government has to ensure that the environment is conducive to developing new products and new ideas. The government has to be the impartial rule maker and regulator with the intent of seeing that all these varieties that are fast developing have their equal chance of success. What it cannot do is to select certain firms and slate them for success. This will bring down the whole process. This does not mean that the government take the hands off approach. Far from it, it means that the government takes an active role in ensuring a fair environment, a level playing field, for all the players. Another the government can and should do is to promote these wine and beer abroad so that the global consumers are aware that there are other kinds of wine apart from European or North American wine, and that wine does not have to come from grape juice alone. Eventually some of these start up firms could wind up becoming a major business corporation and even a transnational one. But that is ultimately the responsibility of those who manage the firms themselves. The point is that if the government did not provide the necessary environment, this could not take place, and that it has the primary responsibility to ensure development of the poorer sectors of the

country through employing the virtuous cycle of science, technology and innovation mentioned above.

NOTES

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¹ Muhammad Shahidullah, "Science and Technology Development in the Third World: Competing Policy Perspectives" *Knowledge, Technology, and Policy* 12.1(1999): 3-20.

² See how the people in Laos are able to be connected to the Internet in "Making the Web world-wide", *Economist* 364.8292(September 28, 2002), p. 79. It is reported there that a low cost computer has been devised to help people in the remote region of Laos to get connected to the Internet. The computer, which requires neither electricity nor telephone line to operate, gets its power from a car battery and employs today's outdated chip (the 486) and does not have a hard disk. It is connected to the Internet via wireless connection to another computer that is already connected. This is a good example of how ingenuity in solving local problems using locally available material could do wonders.

³ An example of how this networking really works in practice is the ThinkCycle network (<http://www.thinkcycle.org/>), which is an academic, non-profit initiative aiming at creating a culture of open source design collaboration, where individual from the far corners of the globe participate in solving problems that can well arise locally. This is akin to the open