Black Star: Ghana, Information Technology and Development in Africa

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Black Star: Preface

This essay is meant to contribute to understanding how people in developing countries use technology, what they want from it, how they can and do form communities based on absorbing and mastering new technologies imported from rich countries, and how they might design their own technologies in ways that are potentially more suitable to the conditions in poor countries and thus more likely to raise living standards in these countries. In a world where two billion people live on two dollars a day, raising living standards remains an urgent task.

Advanced information technology - from computing to communications - played a crucial role in the creation of wealth and rise in quality of life in industrialized countries in the 20th century. With pressures on natural resources growing, any path towards higher living standards for the world's poor depends partly on advances in appropriate technologies. Innovations across a range of fields, from energy to medicine to food production, are essential for poverty reduction. But information technology, broadly construed, remains the most likely area from which poor countries can learn from rich ones - and pioneer themselves.

In this essay, I will concentrate on the role of information technology in the economic and social development of Africa. Among Africans, advances in computers and communications have attracted a great deal of interest and enthusiasm in recent years. Since the mid-1990s, shifts in computing and communications have been rapid, even in poor countries, partly because of liberalization in government telecommunications policies and partly because of sharp declines in the cost of computing and communications equipment. As recently as five years ago, wireless telephony and Internet access were a rarity in African cities. Yet these same places today boast a burgeoning community of plugged-in, switched-on people. While disease, disaster, civil war and government failure shape Africa's present, information technology - applied intelligently and fairly - could write the region's future to an unexpected degree.

The subject of technological change and development in Africa has received increasing scholarly and public attention in recent years. Perhaps the most significant study was published two years ago by the United Nations Development Program: Human Development Report 2001: Making new technologies work for human development. The UNDP report, which covers the entire developing world, offers many valuable insights into the role of technology and development. But the report, while offering scores of examples the role of innovation in social and material change, pays scant attention to the role of location and the relationship between geography and innovation. Location is crucial to understanding technological capacity - and creating policies to expand it, especially in the areas of computing and communications. The literature on technology and economic development contains many important studies of the rise of Silicon Valley, Tokyo, Singapore, Finland or other "technopoles" in the developed world. These studies indicate that space and place greatly influence the pace and nature of technological change. In particular, cities and regions often support clusters of innovation.

The importance of spatial clusters can be obscured by analyses that concentrate on national measures of achievement. In the UNDP's study, for instance, countries were ranked in a "technology achievement index," based on statistical indicators, pro-rated on a per capita basis. Finland and the U.S. were ranked one and two. So far, so good. Yet India was ranked 63rd, two slots behind Honduras, and four ahead of Ghana. The UNDP's achievement ranking misses the importance of cities (Bangalore, in India's case) sub-national windows of analysis) and other sub-national entities such as regions. In my case study of an African country, I will pay particular attention to the importance of urban hubs. In so doing, I hope to illuminate the interactions between place and innovation at both the national and sub-national level.

By looking at both levels of analysis, the picture of an African country as an "technology achiever" looks very different. To be sure, African cities count as technologically marginal-

ized even broken out on their own. But the urban hubs of Africa possess IT capacity, in the form of people and infrastructure - that must surely impossible, indeed unthinkable, based on a reading of national indices alone. By looking in detail at one place (Accra) and the relation of this place to the process of technological innovation, much of the conventional wisdom about IT and development collapses, giving way to a more nuanced version of the prospects and perils of one African nations attempt to use information technologies to its advantage. I hope my study encourages further city-based studies of technology and development in Africa in order to shed more light on the larger question that animates my curiosity: to what degree and in what manner can technology help to "save" Africa?

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Throughout this essay I will use a number of short-hand terms. The most frequent will be to use "Africa" to mean sub-Saharan Africa. The region, as noted above, has common problems of underdevelopment, though its value as a level of analysis should not be overstated. By information technology, I mean computing and communications and the interplay between the two. I sometimes spell out the connection in text, and other times assume it.

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Many people helped me in Ghana over many months and several visits to Accra. Their names are listed in the notes. I also wish to thank Dan Sarewitz and Columbia University's Center for Science, Policy and Outcomes for financial support, guidance and camaraderie.

Chapter 1

Black Star: To The Promised Land

Information Technology and Ghana's "Destiny"

"It is policy, not charity, that will ultimately determine whether new technologies become a tool for human development everywhere."

United Nations Development Program, Human Development Report, 2001

"We paid the price of not taking part in the Industrial Revolution ...because we did not have the opportunity to see what was taking place in Europe. Now we see that information and communication technology has become an indispensable tool. This time we should not miss out on this technological revolution."

F.K.A. Allotey

[Government of Ghana, Ministry of Communications, "Plan for National Information and Communications Infrastructure, 2000-2005"]

"The message for Ghana is that we need to embrace information, knowledge and technology. If we Ghanaians fail to take advantage of information technology, we will be further marginalized in the world."

Clement Dzidonu

Chairman, government of Ghana committee on National ICT Policy and Plan Development

(1)

Can technology save Africa?

This is not a question meant to provoke debate between what some observers describe as "cyber-optimists," "cyber-pessimists," and "cyber-skeptics." Regardless of whether one believes that the electronic network is a panacea or the advent of doom, or whether one thinks that both positions are exaggerated and that there are other decisive factors in social, economic and political affairs besides the interplay of computing and communications, there is a minimal common ground to be found: observers of computerization and new forms of communications agree that these technological systems ought to promote productivity growth, wealth and human happiness - and perhaps more so in parts of the world that are traditionally marginalized, economically and technologically. In response, skeptics have pointed out that technological advance is a symptom of a healthy society, not the source of one. Without strong political, social and economic institutions, innovations developed by others cannot easily be imported into a society. Without a strong educational system and a baseline of health and safety, the talented people necessary for the application of existing technical knowledge and the growth of new know-how won't be available in a society.

I am not prepared to, or capable of, settling the debate over the power of IT. I am simply saying that, until recently, the question of the importance to Africa of technological change (of any sort) has almost never been asked -- neither by Africans, nor by scholars in the field of African studies.

Go back to the dawn of post-colonial Africa, the period of the late 1950s and early

1960s, and the African independence leaders can be heard discussing the need to free their economies from domination by colonial powers; the need to gain control over their basic resources and industry, through nationalization if necessary; the importance of basic education and land reform; the need for black pride and an end to racism; the role of Africa in the Cold War contention between the Soviet Union and the U.S. African leaders spoke about every conceivable topic - except the relevance of science and technology to the African condition.

Outsiders with a passionate interest in Africa - and immense enthusiasm for sub-Saharan political independence - similarly took no notice of the role that scientific and technological innovation might play in the unfolding African story. In an otherwise insightful survey of Africa's prospects at the dawn of the post-colonial era, Immanuel Wallerstein wrote about the European legacy in Africa; the revival of African culture and society; the politics of the new nations in the region; prospects for democracy; Africa's relation to the world. He said nothing, however, about Africa's relation to technology, old or new. The great British Africanist, Basil Davidson, suffered from the same blind spot. In a perceptive book, *Which Way Africa?*, published in 1964, and in a follow-up volume, published ten years later, *Can Africa Survive?*, Davidson nowhere mentions the importance of technology in African development. The blindspot for technology lives on too. In his otherwise excellent 1998 book, *Africa In Chaos*, George Ayittey, a Ghanaian teaching in the U.S., never mentions either computer or information technology despite an exhaustive reckoning of Africa's condition and socio-economic options. Peter Schwab, author of an excellent survey on Africa's problems and prospects, *Africa: A Continent Self-Destructs*, published in 2001, speaks in passing of Africa's technological marginalization but says nothing of indigenous efforts to benefit from advances in computing and communications.

The importance of technological change to Africa's future was a subject of interest to one of the sub-Saharan's most important post-colonial leaders. The first president of Ghana, Kwame Nkrumah, paid particular attention to the importance of the state's mastery over technology. Nkrumah had lived in the United States for ten years, arriving in the middle of the Great Depression and leaving in May 1945, only weeks before the end of World War II. In America, Nkrumah witnessed something of the technological marvel that did and still does define the country. Recalling his arrival in New York, via ship from London, he later wrote:

"I stood open-mouthed at what I saw. There was so much going on that it was a job to focus my eyes on anything long enough to find out what it was. I was conscious of being hemmed in by the most gigantic buildings, so high that they must surely pierce the heavens ...." [Nkrumah, 29]

With the withdrawal of the British government in 1957, Ghana gained political independence and Nkrumah became the West African country's first head of state. Nkrumah had a restless intelligence and a desire to move quickly - to make up, perhaps, for the time lost under the yoke of colonialism. He believed in the power of science and technology to transform society. He vastly expanded all levels of education in Ghana, drawing on the healthy revenues produced by the country's then-booming trade in cocoa and gold. Nkrumah confidently declared, "We shall achieve in a decade what it took others a century" (Ayittey, 115). Influenced by the economic organization of the Soviet Union, Nkrumah placed the state at the center of commerce and development. He was attracted to large technological projects, such as the Volta Dam, which became the prime source of Ghana's electricity in the early 1960s. He embraced nuclear energy, formed an Academy of Science and urged Ghanaians to "take part in the pursuit of scientific and technological research as a means of providing a basis for our socialist society. Socialism without science is void" (Haizel). While rhetoric in the Soviet tradition, Nkrumah's declarations about the importance of science and technological were also meant to rouse Africans - and raise their self-esteem. After centuries of exploitation, plunder, degradation and

humiliation at the hands of Europeans, Nkrumah correctly saw that innovation - the potential of an endless frontier of scientific and technological advance - would create the kind of level playing field that would allow long-oppressed Africans to compete more fairly with their former oppressors. As he said in November, 1964, at the groundbreaking of Ghana's first atomic reactor, "We cannot afford to sit still and be mere passive onlookers..." of technological change (Haizel).

There were limits to Nkrumah's vision. Volatility in cocoa and gold prices made economic planning difficult. Large, state-owned technological systems, such as the Volta Dam, obscured the value of small-scale, decentralized innovations -- autonomous, bottoms-up, pluralistic efforts at innovation that required more flexible approaches to scientific and technical knowledge and an economy open to international flows of commercial ideas and applications. Nkrumah may have someday grown tired of his reliance on big technology projects, but his time ran out. In 1966, while on a trip to China, where he sought to negotiate a settlement to the Vietnam War, he was ousted from office in a military coup.

Nkrumah was one of the first of Africa's independence leaders to lose power in a coup. Those who held onto power (like Kuanda in Zambia or Kenyatta in Kenya) neither embraced a "science for the people" ideology or took note of the rapid and sweeping shifts in information technology in the three decades after de-colonization. While advances on other technological fronts merited attention, information technology claimed a transforming effect on rich, industrial countries, essentially rewriting the rules of commerce and the terms of ordinary life. Computer-ization swept through business and government bureaucracies in the 1960s, moving beyond its original enclave in the military. In the 1970s, the first personal computer was invented, igniting a relentless drive toward putting information technology at the center of every human endeavor. In the 1980s, rapid changes in communications intersected with advances in computer networking, resulting in the popular acceptance of the Internet and mobile telephony in the 1990s. By the mid-1990s, information and communications technologies had moved from an exciting sideshow to the center of economic activity. While sustained by private energies and finance, the "information revolution" remained a priority of national governments in Europe, the United States and, increasingly, the rest of the world.

Yet Africa slept. With the exception of the white-settler states of Rhodesia (later Zimbabwe) and South Africa, the state of information technology and telecommunications was off-the-charts poor in the sub-Saharan. Into the 1990s, computers were scarce in Africa and telecommunications awful. Merely completing a phone call was a cause for celebration. Poverty, naturally, explained some of Africa's inability to gain even a foothold in the information revolution. Endless civil wars in certain countries (Angola, for instance, or the Sudan) provided another explanation. But even in relatively wealthy African countries, technology time seemed to stand still. In Nigeria, the most populous sub-Saharan country and best endowed in terms of oil wealth, a mere 200,000 telephone lines existed to serve an estimated 100 million people. Restrictions on telephony were not only the result of ineptitude by state-owned telephone monopolies; poor or non-existent service was motivated as much by legitimates fears on the part of military rulers that the masses would organize revolts against them with the help of telephones. While in Europe and the U.S., the specter of information overload and the prospect of "ubiquitous" computing and communications made intelligent people worry about too much technology, in much of Africa the search for a dial-tone became a full-time occupation and, in a parody of Gresham's Law, consumed the time and energy that Africans might have spent more creatively on applying information technology to their daily lives.

Times have changed. "Despite the pessimists' dire predictions, ICT [information and communication technology] is spreading more rapidly than anyone imagined and is spawning and spreading other technologies, too," wrote one observer recently (Guest). In 1995, Ghana became the first country in sub-Saharan Africa to have "full Internet connectivity." (Sulzberger, Internet, 2001). Cheap, powerful computers, sometimes second-hand, are widely available in

sub-Saharan Africa. Web cafes are widespread in major cities of most African nations, offering use of a PC and a Web link for as little as fifty cents an hour. Telephony is exploding. Restrictions on telecommunications eased in Africa at the end of the millennium, often not the result of reform of telephone monopolies but the result of pressure from wireless telephony. In Nigeria, within a year of the first GSM wireless service, the number of wireless dial tones reached one million, or roughly five times the number of land lines provided by the country's state-owned telecom company. In late 2002, after the initial GSM ramp up, a wireless line could be obtained in Lagos or Port Harcourt, Nigeria's second most important commercial city, within 30 minutes. At the same time, internet telephony, or "voice over IP," vastly reduced the charges of international calls. In Ghana, where the state telephone company retains an effective monopoly over international calling - and remains, as does nearly every national telephone monopoly in the developing world, "an object of ridicule and rage" (Guest) -- nearly half of all incoming and outgoing international telephone calls escape the high monopoly prices by secretly piggy-backing on the same networks that web cafes use to traffic data. A dozen companies in Ghana offer direct connections to the Internet, from home or office (Sulzberger, Internet, 2001). Older information technologies are exploding as well. In Ghana, after the government loosened restrictions on radio stations, allowing private ownership on a large scale for the first time in the late 1990s, dozens of stations sprang up, dramatically altering the national conversation. While changes in newspapers and television are less rapid, Ghana today has a far, far richer information and communications environment than five years ago. The same can be said about nearly every country south of the Sahara. Africa may not be ready for the information revolution, but it has arrived (for the full extent of the sea-change, see Jensen). In symbolic recognition of this, the annual global meeting of the governing body of the World Wide Web was held in a sub-Saharan city for the first time in 2002.

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The Guardians of the Web met in Accra, Ghana, the country of Kwame Nkrumah. Ghana, and its capital Accra, illustrate how Africans today view the potential contribution of information technology and communications towards the improvement of living standards and economic well-being. (Ghana is atypical of sub-Saharan Africa in only one significant way: the country has among the lowest rates of HIV-AIDS in the region. At about 3 percent, according to definitive surveillance techniques done to international standard, Ghana's HIV-AIDs rate is five times less than neighboring Ivory Coast, six times less than Uganda, and about ten times less than Botswana, along with South Africa perhaps the worst-hit by HIV of the African countries.) Rather than remaining passive spectators to a global technological procession, educated Ghanaians now actively seek to harness technological change for national advantage. What they are doing - and might do in the future -- is the subject of my essay. In three chapters to follow, I will describe the Ghanaian situation and examine the options available to government policy-makers and private actors in the following areas:

+ the role of multinational corporations in the development of an information technology industry (chapter one)

+ the role of finance capital, whether private or government, domestic or imported, in supporting the rise of a domestic high-tech industry, where today, in bald terms, no such industry exists (chapter one)

+ the need to reform higher education, which currently falls far short of even minimal support for either education or research in contemporary information technology (chapter two)

+ the role of the international community, including people of Ghanaian origin living in Europe and the U.S., in helping to form, nurture and sustain communities of technical practice - especially in the fields of electrical engineering and computer science. These communities of practice exist in an infant form in Ghana but face significant threats, notably "brain drain," or the export of talent (chapter three)

+ the severity of inequality within Ghana and the way the growing presence of information technologies appear to be deepening the country's already large urban-rural gap, raising the possibility that the spread of IT will exacerbate social tensions and wealth inequities, leading to the effective disenfranchisement of millions of rural Ghanaians - still a majority -- from the fruits of their country's development (chapter four)

In Ghana, as elsewhere in Africa, policymakers and private actors may not have answers to the vexing problem of integrating the sub-Saharan into the technologically-literate, networked world that increasingly shapes material production in the world. But for the first time in post-colonial history, Africans are asking relevant questions about technological change and insisting that in the history of the future they are not destined to play a bit part. While I do not wish to pass hasty judgment on the question of African under-development, I think it does not require much of a leap to conclude that Africans and development experts alike are disappointed by the region's poor results. There is no reason to expect that information technology, once unleashed, will transform the African condition on its own. A whole range of reforms, including improved governance, better forms of conflict-prevention, and much greater investment in human capital, are necessary steps for increases in living standards in sub-Saharan Africa. But as the case of Ghana illustrates, the spread of information and information technology has altered the terms of the problem of underdevelopment (if not, indeed, presented an immediate solution). Information technology - its application and its creation - is now viewed as central to unlocking Africa's potential and reducing its reliance on aid and its propensity to fall prey to disease, disaster and mayhem.

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In Ghana, there is a growing awareness that the country has stagnated, or worse, since independence in 1957. Over the past half-century, Ghana has avoided a civil war, been spared (in part because of good government policies) the ravages of HIV-AIDS, retained a functioning educational system, kept official corruption to a relatively low-level. Accra is a city, perhaps alone in Africa, where robbery still excites outrage because of its rarity and a murder is an occasion for shock, not a shrug. By the standards of the most violent and corrupt African countries, Ghana is attractive, a place where decency and warmth are sustained even in times of material hardship.

Yet there is a sense of frustration in Ghana over unfulfilled expectations and narrowed possibilities. There is a growing belief that the intelligent embrace of information technology is perhaps the only means of fairly quickly moving the country out of a dispiriting, grinding rut.

The belief that technology can save Ghana comes from a loose reading of another set of former colonies who were poorer than Ghana at its independence, the East Asian countries of Korea, Malaysia and Singapore. Each of these countries is far wealthier than Ghana today. The comparison between Ghana and Korea, first highlighted in Knowledge for Development, a World Bank report, is sobering. In 1962, Ghana's per capita gross-national-product was $500; South Korea's was a mere $80. Today, Ghana's per capita is $340, while South Korea's totals $4,000. "Where Korea is today a skyscraper, we are a little dot," says Clement Dzidonu, technology adviser to Ghana's president, John Kufuor. "We really are far behind the other countries

we started with."

Mr. Dzidonu applies a straightforward principle when he thinks about IT and development. "There is," he says, "no information-rich country that is poor." His point is clear: if only Ghana can enrich its information capacity, then surely its notable poverty - at a mere $400 per capita in annual income, its official national wealth puts it among the bottom group of the world's official wealth table -- will be reduced. He envisions no real alternative, since the country has tried for decades to squeeze more wealth from its traditional sources, gold and cocoa, without success. "We cannot create quality jobs, we cannot generate real wealth, without information technology," he says.

The trouble for Ghana is that, while there is the will, the way is not clear. Only about 10 percent of the country's labor force has attended high school or university. Mismatch between the skill-level of the workforce and the aspirations of the society brings to mind the old Irish joke, about the person from the city who asks a farmer how to reach a certain destination only to be told: "I wouldn't start from here."

Ghana must begin from where it is, even if it surely would realize the promise of information technology more quickly from another starting place. Where Ghana begins is sobering: the country is home to less than forty active members of the IEEE. It has as few as 50 software programmers of international standard and certainly no more than 100. The country remains information poor. Cynicism about the potential for policy to make a difference is widespread. Even when the policies are correct, government faces difficulties getting things done. The most talented people in the arena of science and technology, if they have not left Ghana for more attractive environments, often pursue only private agendas, shunning the civic space. Says one Accra technologist, with a degree from an important U.S. engineering school, "I see the government as a bad virus. My job is to build an immune system against it. What the government should or should not do, I really don't care because, in Ghana, good ideas get ignored, dismissed."

The assessment, while reflecting a widespread sentiment, is unfair. But in one respect, the engineer is correct. Knowledge has scant monetary or social value in Ghana. How to raise the value of information, and those who create, analyze and use it, must underpin any pro-science and pro-technology policies and practices. In the meantime, Ghana's computer-savvy cadre faces a dilemma. As one prominent programmer observes, "There's a market here for a lot of things I can do as a code writer, but either people can't afford to pay me for my services or they don't even realize that they need what I do."

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Chapter 2

Black Star: Virgin Territory, Distant Shores

Multinationals, domestic "champions" and the problem of capital in a frontier state

"African countries can develop a leading edge by ensuring that any new infrastructure is based on the latest technology. The continent could leapfrog decades of obsolete development in telecommunications and IT, taking this giant step with systems that are appropriate for the African environment. "Tropical Tolerant" systems are needed in the developing world, as conditions in the tropics are far more challenging than those of the developed world."

Herman Chinery-Hesse

Multinational corporations have played a large role in the emergence of technology clusters in developing countries. Every region of the globe can boast of some information-technology cluster that is at least partly nurtured by foreign corporations, except sub-Saharan Africa. With the exception of South Africa (which has a very different economic history from the rest of the sub-Continent), Sub-Saharan Africa has received virtually no investment from computer and communications companies since the invention of the transistor nearly a half century ago. Not a single computer or software company of any global significance researches, develops or manufactures any of its products in Africa south of the Sahara. Even corporations who make substantial charitable donations to Africa (chiefly in the form of their own computer hardware and software), such as Cisco Systems, Hewlett-Packard or Microsoft, do not design or make anything in the region.

The lack of investment presents a challenge: when foreign investment is so small, can a recipient country achieve any kind of global, or even regional, competency in information technology? On such a thin international base, how can Ghana possibly follow in the footsteps of Bangalore, India or Kuala Lumpur, Malaysia and become a magnet for IT investment?

The answer, of course, is to increase the level of direct foreign investment in Ghana. Even small, targeted investments by multinational corporations, in combination with the efforts of small but vital domestic IT companies, could transform the industrial landscape of Ghana and the West African region.

In the first part of this chapter, I will review the experience of a large American IT company in Accra, which reveals the potential for multinational corporations to transform the IT landscape in Africa, and also the limitations on the contribution of foreign companies to African technology development. In the second part of the paper, I will examine Ghana's capacity to develop an indigenous IT industry. In conclusion I will briefly describe policy options aimed at increasing Ghana's appeal to certain types of IT multinationals and expanding the opportunities for the country's domestic IT sector.

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Only two U.S. companies have large investments in Ghana, and each is among the largest foreign employers in the country. The first company is Alcoa, a maker of aluminum. More than 40 years ago, Henry Kaiser, famed for mass-producing the Liberty Ships in World War II, struck a deal with Nkrumah, Ghana's independence leader, who wanted financing and a partner for an ambitious infrastructure project. Nkrumah wanted to produce electricity for his

country and organized plans to build a massive dam of the Volta River in Eastern Ghana. Because the dam project would create more power than Ghana immediately needed, Nkrumah struck a deal with Kaiser, giving his aluminum company a 30-year claim on half the electricity produced by the dam. The electricity, purchased at ultra-low prices, would be used to power an aluminum plant in the Accra suburb of Tema. Today the Valco - the name of Alcoa's operating unit in Ghana - employs about 1,000 people, all but a few dozen of whom are Ghanaians. Valco still consumes more than one-third of the electricity generated by the Volta dam.

While the manufacture of aluminum is highly technical, Alcoa's operation is essentially the same today as it was 40 years ago. The company makes no "downstream" products from the raw aluminum it produces in Ghana and it imports virtually everything required prior to the stage where the massive application of electricity to aluminum smelting occurs. Alcoa even imports bauxite, a basic ingredient, from Jamaica, half-way around the world, even though there are supplies of the same raw material a few hours from its Ghana plant in the neighboring country of Togo. For a time, Alcoa talked of switching to local sources of bauxite and raising the West African "content" of its Ghana-made aluminum, but the company never did and it seems unlikely ever to happen now. With a rising urban population, Ghana needs more electricity for ordinary residential and business use, and the government is locked in a quiet, secret struggle with Alcoa over how much of the electricity generated by the Volta dam it can purchase at ultra-low rates. In the past year, electricity rates for ordinary people in Ghana have doubled, chiefly because the Volta Dam no longer covers the electricity needs of Ghana's population and the government now must import expensive oil to fire generators to make up for the shortfall. Since Alcoa insists on a cheap price for electricity, ordinary Ghanaians now increasingly subsidize the operating expenses of a wealthy American multinational corporation.

Alcoa's experience illustrates the way in which technological systems, in the post-colonial era, have enabled the continuous exploitation of African resources (in this case, of the power created by a dammed river). The experience in Ghana of an American information services company illustrates how global communications, computers and a shared knowledge of the English language combine to create opportunities for the integration of Ghana into the transnational knowledge economy.

To provide more detail on the experience in Ghana of the American information services company, I will give the company a pseudonym, Data Flow, and not identify by name the company's executives, who spoke with me many times and allowed me to visit with employees at every level of the company.

In contrast to Alcoa, whose operations are resource- and capital-intensive, Data Flow's operations are labor-intensive and rely on global communications and high speed computers to create potentially an unlimited amount of work in Ghana. To understand how this happens, let me first explain what Data Flow does. The company manages data for customers in health-care and financial services - essentially for anyone who has a form (a health claim or charge sheet) from which data must be extracted. A health insurer, such as Aetna, needs to manage the flow of medical claim forms, handwritten or typed, and to place the essential information into electronic format, which allows Aetna to more quickly and easily decide which claims are covered and for how much. Long ago, Aetna began shifting the task of "key-punching" the data from its claim forms to "outsourcing" companies such as Data Flow. Initially, out-sourcing companies relied on Americans to key-punch for American companies, but over time jobs were shifted to lower wage countries, first on the periphery of Europe and the U.S. (in such places as Ireland, Barbados) and later (in the 1990s) to Latin America and Asia. Data Flow opened its first shop in Mexico in 1995.

Information technology and communications have made possible the globalization of key-punching. Aetna scans its claim forms into a computer, so that each computer record looks roughly like the original sheet of paper. These records are then "shipped" to another location via satellite or land telephone lines, over a computer network. Data Flow, which out-sources for

Aetna, receives these records on its computers in Ghana and its Ghanaian keypunchers, sitting in a front of screens, begin to extract information and insert the information into new records according to certain rules. The chief skills of the keypunchers are reading and typing. Errors in recording are costly because they are difficult to discover, so the speed of the typist must be balanced against the importance of accuracy. Computer networks make supervision easy. If Aetna wishes, one of its supervisors in New York can "watch," electronically, as a keypuncher in Ghana extracts data from a scanned form. The Aetna supervisor, even though he or she is physically thousands of miles away, can instantaneously deliver a message to a counterpart in Accra, alerting them about what might be an error in the making.

Data Flow's information network creates the possibility that a worker, once limited to providing services to customers in his immediate vicinity, can now offer services to people halfway around the world. Managers of outsourcing companies thus have the possibility of finding suitable labor virtually anywhere in the world. The result: a race to find the best quality workers at the lowest wages.

Senior executives of Data Flow first visited Accra in February, 2000. They were looking for people with a command of English -- basic reading and typing skills -- and the discipline to sit before a computer for eight hours or longer. Through a curious connection - the visiting executives are Mormons and so relied on members of Ghana's small Mormon community for their initial contacts - Data Flow quickly identified a source of suitable job candidates. A Mormon charitable group runs a school in Accra and the school trains people, free of charge, in typing and computer skills. Data Flow gave the Mormon school the task of pre-qualifying job applicants - essentially contracting out a training function.

Having found a source of labor, Data Flow studied wage rates and concluded that a keypuncher in Accra would be happy with roughly $100 a month, or twice the pay of an ordinary office worker in Accra, double the pay of a trained nurse and four times the pay of a policeman. Still, a wage of roughly $100 a month was half of what Data Flow paid its keypunchers in Mexico. Given such a large wage difference, Data Flow decided it could offer services from Ghana at a discount to its customers, thus undercutting resistance by customers to sending work to an untested location in Africa.

Data Flow had one final hurdle to clear before opening shop. How would the company get data and forth from the U.S.? The national telephone company, Ghana Telecom, was not an option because its charges were too high and its lines were not adequate to handle the load of data coming from high-speed computers in the U.S. In theory, there was a simple solution to Data Flow's problem: a satellite link could be placed on top of an office building in Accra and data could be sent back and forth, at high speeds, between Accra and any of the company's locations elsewhere in the world. Data Flow would pay a monthly fee for the cost of satellite time, and pay the front-end charges for necessary equipment, and work would begin.

There was a catch, however. No private company in Ghana had ever been allowed to "import" and "export" data in such a manner. The government forbid such activity or, more precisely, reserved the right to permit it, and it never had (for a complex set of reasons including a fear that political dissent would result from freer communications links with the wider world). Because John Mahama, the sitting minister of communications and a young thoughtful scion of a northern Ghana political family, understood the potential of shifting low-wage jobs from elsewhere in the world to Ghana, he rallied to the aid of Data Flow, whose initial application for a permit had languished. With Mahama's intervention, Data Flow quickly obtained permission for a satellite link, enabling it to let the keypunching begin.

Data Flow began work in 2001. Once active, Data Flow expanded rapidly, reaching one thousand employees in barely twelve months. The company's work in Accra was routine, done mainly by young women, many of whom were former secretaries. Some keypunchers quickly became supervisors, improving their wages and working conditions. Management of Data Flow's computer network also required people with know-how. While Data Flow relied on imported

networks, the company purchased all of its computers and some of its other equipment from local dealers. The company sent back a few dozen of its Accra workers to the U.S. for training. Only a dozen jobs in Data Flow's offices (located in a government-owned rented high-rise in central Accra) could be considered highly technical. But scores of employers were exposed to leading-edge products and services, raising their literacy and building a foundation for more highly-technical work in the future. In one example of how advanced know-how oozed into even the routine aspects of data entry, two supervisors (on their own initiative) designed and launched an internal web site and taught their keypunchers how to use the site for training and other work tips.

Ghanaians watched the rise of Data Flow with a mixture of awe and envy. No one had ever grown a high-tech company so rapidly, not only in Ghana but probably in all of sub-Saharan Africa (with the likely exception of South Africa). Data Flow, in addition to better-than-average wages, offered strong benefits. Workers received daily transportation to and from the office, meals on premises and even a local brand of private health insurance. Yet observers were troubled by two characteristics of Data Flow's operations: the near-total reliance on low-wage labor and the lack of links to Accra's indigenous high-tech community. Accra's leading computer people sometimes dismiss Data Flow as "an electronic sweatshop." A local tele-communications expert asks, "Can we build an IT industry based on this?" He thinks not. "If [Data Flow] gets a better deal somewhere else, they'll move. So you can't build a future on this."

Despite the criticisms, Data Flow has changed the landscape in Accra. "People thought we were nuts to come here," says an executive. "They said it wasn't possible to do this in Africa. But we've succeeded." The company processes data for a dozen U.S. clients and today employs 1,100 people. It has withstood frequent electricity outages, repeated unionization drives (forestalled) and the high cost of office rents.

Data Flow's operations have two revolutionary characteristics in the context of Accra, a sprawling city of a few million people where government is the largest formal employer and most people work in so-called "informal" jobs (meaning they are self-employed and hardly earn any money at all). Outwardly what is most unusual about Data Flow is that it operates 24 hours a day, in three daily shifts. No "white collar" company has ever done this in Ghana. When Ghana's President, John Kufuor, made a surprise visit to the company in early 2002, he arrived in the evening to see 150 people bent over new PCs in well-lit, clean, air conditioned rooms. As if this wasn't enough of a shock, he next learned that the work went on all night long. He immediately asked Data Flow's management to advise him on high-tech policy.

The second revolutionary aspect of Data Flow's operation is the principle of pay for performance, also known as piece-work. Keypunch wages are not fixed, but fluctuate according to output, which of course depends on energy and skills of the individual worker (and the difficulty of the tasks assigned). Piece-work is common in many parts of the world, but was unknown in Ghana, where people expect to earn the same amount each month - no matter how much (or little) work they do. By international standards, labor productivity is low in Africa, and government employees - the largest single category of workers in Ghana - often do little or nothing for long stretches of time. With the exception of health-care workers (physicians, nurses and hospital clerks and administrators), civil servants are accustomed to a good deal of idle time. The demands are so light that when a new government took control of Ghana's public administration in 2001, it discovered that many thousands of government workers never showed up to work at all. The problem of "ghost workers," as the government calls them, is so severe that some agencies of the government have taken months merely to tally the number of no-shows on their payrolls.

Even in sectors where workers are expected to give a decent effort, wages are low and so is productivity. Workers in Ghana often lack the training and the tools to do a job adequately.

To maintain output, Data Flow pays piece rates throughout the world; Ghana is no exception. Yet piece rates have spawned jealousy among workers in Accra, caused some public

misunderstanding, and fanned periodic calls for unionization of the workforce. The company defends its policies, saying that good keypunchers earn more than $100 a month and that weaker ones, while earning much less, have incentives to raise their pay. Since the legal minimum wage was about one dollar a day when Data Flow began operating, company executives also note that their wage scales are higher than the norm in Accra.

For a variety of reasons, Data Flow has halted expansion in Ghana for the moment. An executive insists that the company "is committed to Ghana" and is studying whether to embark on an expansion plan that would double its workforce over the next few year. But the company sees no further expansion - beyond the possible double - in either Ghana or West Africa. This is disappointing to advocates of multinational-led technology development, so it is worth pondering on the reasons for Data Flow's reluctance to bring more work into Africa. The first reason is technical. Ghana still doesn't have the terrestrial telecommunications lines that can support the company's operations, forcing them to rely solely on satellite communications. "What if the sat-link goes down?" asks one manager. "Many of our customers want to know we have a backup in place so work can continue in an emergency. We can't offer that."

Data Flow also worries that while Ghana is more attractive than its neighbors in West Africa, the country is falling further behind India and China, two populous countries with ample supplies of low-wage labor. The company recently entered India for the first time, opening a large office in Bangalore, where wages for keypunchers are about the same as Accra but communications infrastructure is far better and customer acceptance of the location is much greater. Next on the list is China, where wages also compare favorably with Africa and English-fluency is spreading.

Finally, there is the issue of talent. As outsourcing grows more complex - from handling static documents to interacting directly with doctors or patients over the telephone and perhaps even to improvising decisions - Data Flow's executives believe its workforce will require greater education and more skills. One says, "We know in Accra we have people who can handle tasks on the first tier and maybe the second. But what about the third, fourth and fifth tiers?" So even though the executive says "productivity and quality in Ghana are equal to our other facilities," he worries about the growth potential of Accra's workforce and is convinced he must look elsewhere for low-wage labor.

That Data Flow has fairly quickly exhausted Ghana's capacity to absorb multinational energies does not surprise those with a deep knowledge of the country and its technical resources. "We don't have the people or the market to absorb a large multinational, they are too big for us," says Gilbert Adunasa, a consultant who is a former official in the Ministry of Communications. "We want to look at attracting smaller companies to give synergy to little pockets of initiative in our own country."

(2)

Before examining the possible policies that might promote an "appropriate" and "sustainable" level of foreign-direct investment in Ghana, let's first look at one of the "pockets of initiative" in Accra. A notable one is a software company operating from a single-family home near the University of Ghana, on the outskirts of Accra. Called Soft, the company is the largest of supplier in Ghana of home-made programs for sale to businesses. Soft is best known within Ghana for point-of-sale software and programs that manage customer flow at Internet cafes. The company employs about a dozen programmers, the largest collection of code writers in Ghana who are not purely devoted to the internal demands of a single organization.

Soft was founded in the early 1990s by Herman Chinery-Hesse. Born of Ghanaian parents and raised in Ghana, Herman attended a university in Texas, then returned home and decided to assemble a team to write original software. With programmers in high demand in the US and Europe, Herman's decision to return to Africa seemed improbable. He could have

stayed in the U.S., earned good money, gotten a green card and never looked back. Instead, he traded security for adventure - and the possibility of failure. Today, Herman is sometimes called "the Bill Gates of Ghana" on the strength of the company's delivery of original programs to the local units of such global business names such as Unilever and Barclays Bank. Herman drives a Mercedes and owns an American-style house in a gated community in one of the wealthiest sections of Accra. Still, Chinery-Hesse's hold on success is fragile. His company has never exported to the U.S. or Europe - Herman's dream - and even selling to Nigeria or other countries in West Africa is difficult. Moreover, the company can handle only five or six small software projects at once, based on teams of two to three people each. The company has been trying to raise at least a million dollars for more than two years - capital needed for expansion. Recruiting technical talent is also difficult, although Soft benefits from the relative peace, quality of life and low costs in Accra compared to other African capitals. The company's leading technical person is from Togo, by way of the French Caribbean; its product manager is a British national of Ghanaian descent; and a Dutch national is among its sales executives. Herman and his cofounder, Kojo Gyakye, attended secondary school together in Ghana. Unlike Chinery-Hesse, Gyakye's education and work experience is strictly domestic, but significantly he worked a few years in the 1980s for Wang, a leading American minicomputer company. (Wang dominated the infant market for computers used by business and government in Ghana, accounting for an estimated 70 percent of total minicomputer sales as late as 1987 [Korsah, 4]).

Since electricity outages at its office are common, Soft faces reliability problems. Forcing Herman to spend some time wondering about the efficiency of his backup, gas-powered generator. Programmers are largely self-taught, rely on tools scavenged from around cyberspace and are stretched thin. In the fall of 2002, after Soft introduced a clever program that logs the billable time of customers at a Web café, other development work virtually ground to a halt because the code for one of the early adopters - a Web café running the program across three sites, many different PC models and from a single server - repeatedly crashed, bringing his business to a halt. While Soft solved the problem, the crisis served as a reminder that the company's bench is thin. "We have urgent needs -- and a constant thing of the dog chasing its tale," says one Soft manager. "It's frustrating."

The business environment in Ghana also makes code-writing difficult. "Even the best programmers feel isolated," Gyakye says. "They are working with disadvantages that people in Europe and the U.S. can't imagine." For instance, Soft does little beta-testing of its programs prior to commercial release because of fear that a beta tester will pirate a copy of the program and sell it commercially. Test programs are shared with only three or more sites, limiting the ability to root out coding errors in the development stage. Even the sites chosen for beta tests "are monitored very closely," Gyakye says.

Despite these problems, Soft is likely to grow its business. But as a lone success story, the company's effect on Accra will be limited. "So long as Soft is the only company out there trying to export software we won't make a difference," Gyakye says. "We need five Soft's to form over the next couple of years."

(3)

The commercial benefits of transforming isolated technology pioneers into clusters of related companies are evident from studies of such leading high-tech regions as Silicon Valley in California and the Route 128 area of Massachusetts. The experiences of these important clusters "suggest that industrial systems built on regional networks are more flexible and technologically dynamic than those in which experimentation is confined to individual firms." (Saxenian, 161). Clusters can better withstand the volatility inherent in technological change. By clustering, individual companies share the cost of developing human capital, because all benefit from a growing pool of technically-knowledgeable people. By clustering, companies

effectively reduce the cost of improving infrastructure. They also create the conditions out of which communities of practice arise. When a potentially large opportunity emerges - an opportunity too large for any one company or research group to address, simply because they lack the human power to tackle it - disparate groups within the same geographic location can band together and, for the purposes of pursuing a distinct opportunity, pool their resources. Clusters are thus self-reinforcing, examples of the so-called "network effect."

How to create and sustain a software cluster, or a data-entry cluster, is a major challenge in a place such as Accra. The challenge is critical because clusters deliver more than economic benefits: they deliver cultural and intellectual benefits, by creating the conditions out of which practitioners can create technologies that reflect the lived experience and aspirations of the people who live in their midst - people with a specific history, culture and geographic position.

Often technologies from Europe and the U.S. are presented as universal tools that can be used anywhere in the world, with equal effectiveness and efficiency. The personal computer and the wireless mobile phone are adopted, essentially unchanged, in Sub-Saharan Africa, not merely because these tools "solve" problems, but because they are the only tools being offered. Few specialists in information technology in the U.S. and Europe tackle problems specific to poor societies or Africa in particular. Some of the reason for the reluctance to do so is intellectual: scientists and engineers tend to make universal claims for their knowledge and its application. But increasingly there is a realization that social and physical conditions in Africa are sufficiently different enough from the U.S. and Europe that a fresh approach to the design of information systems is preferable to the direct transfer of systems from rich nations to the sub-Saharan.

That indigenous innovators may produce systems that better meet the needs of Africans is part of the "value added" that comes along with the economic benefits of a technological cluster. But making indigenous technology is difficult. Herman Chinery-Hesse has expressed the promise of an African-style software design in a privately-circulated paper entitled, *"Tropical Tolerant Software Systems for Sub-Saharan Africa."* Chinery-Hesse argues that information technologies in Africa must be keyed to the climate, geography, wealth and educational levels of the region. Software, he says, should be compatible with frequent electricity and telephone service outages; usable by people with only rudimentary educations; tuned to low-cost hardware; and capable of being maintained by "unqualified staff." Software systems that meet Chinery-Hesse's criteria are not likely to be created by European or American designers. Only Africans are likely to possess the local knowledge - and the will -- necessary to produce such systems.

If such an approach is correct, then Microsoft, say, should develop an Africanized version of its Windows operating system and popular applications programs that would work much more simply and on far less powerful computers than required today. But Microsoft, in a manner that proves Chinery-Hesse's point, sees only the need to "localize" the language used in a program, not the powers of the program itself.

To be sure, there is a commercial payoff from standardization, not the least being the economies of scale gained in development and training. There is also the question of whether an indigenous system might be inferior to the international one, consigning Africans to a second-class technological status - or at least denying those Africans who can master the international system. But notwithstanding the risk of a "technological apartheid" arising as an unintended effect of Africanization, Chinery-Hesse's broad point is beyond contest. To cite a favorite quote of his, from the UNDP's *Human Development Report of 2001*, "Developing countries cannot simply import and apply knowledge from outside by obtaining equipment, seeds and pills."

What is needed is to marry roots and wings, the best of the South and the North. One hybrid approach to high-tech entrepreneurship can be seen in Ghana's largest Internet café. Located in central Accra, the café, called Busyinternet, holds 100 net-enabled PCs on the

ground floor. The company's second floor is a high-tech incubator, offering a dozen small offices to anyone launching a new IT venture. Busyinternet opened in November 2001, the brainchild of Mark Davies, a naturalized American (originally from Wales) who launched two successful Web-based businesses in the late 1990s. Davies visited Accra during a four-month tour of West Africa and decided it was the sort of business frontier that no longer existed in the U.S. or Europe. Starting a high-tech operation in Accra proved challenging, however:

"He and partner Alex Rousselet, a 45-year old Frenchman with long experience in the African oil industry, soon discovered they couldn't take the simplest thing for granted here. Electricity in Accra cuts out at least once a week, so they needed a $30,000 backup generator, and a huge battery to keep the computers up and running for 11 minutes until the generator kicks in. Then there is the $18,000 transformer out back; at times the 240-volt power can surge to 290 volts. The computers require frequent cleaning because of the dust that blows down from the Sahara. Customers steal toilet paper, apparently to sell on the street.

Minutes after Mr. Davies wired $150,000 for the lease on the building, a former gas-bottling plant, an elderly neighbor informed him that it was actually her property and that rights to it were in litigation. After a panicked phone call, he stopped the wire transfer, but it took three months to confirm his lease was valid. Customs held his satellite dishes for two months.

Embracing local customs, Mr. Davies arranged for a Ga tribal chief to bless the construction site with a bottle of imported schnapps. But even a tribal blessing can only go so far. Ghana Telecom, the virtual phone monopoly, has installed only 15 of the 30 lines he ordered. The entire country has just 249,000 phone lines, for a population of 20 million.

Despite the obstacles, Busyinternet caught on. The company employs 50 people, and some 1,500 customers pay roughly $1 an hour to use the Internet each day; additional revenue comes from a copy center, meeting rooms, a restaurant and bar, movies, lectures and rent from startups who piggyback on the infrastructure Busyinternet has assembled." (Wall Street Journal).

Busyinternet works because of its hybrid nature; the company is part local and part global. Davies and Rousselet brought foreign expertise and capital, much like a multinational might. They also brought a vision of how their center could be a catalyst for a new kind of cyber-society in a large African city. But Busyinternet also operates in the manner of a small domestic business: only Davies and Rousselet are non-Africans, so the character of the place is very much West African. Some of the technology is too: Davies hired the company Soft to write the code that tracks the time customers remain on line. To be sure, Busyinternet is unique, but its presence in the city validates its self-image as a growing regional hub for high-tech services.

(4)

As we have seen, multinational technology companies can drive technology development only so far in Ghana. Ghanaians must contribute to the creation of technology clusters, and most likely in the competency areas of information services and software programming. To create the conditions for domestic ventures in these fields - to go from a single important software or data-services company to five or fifty - there must be more capital available for new ventures. But capital is not enough. There are many non-financial barriers to commercial innovation in Ghana. The most notable of these barriers is a complicated system of land ownership, poor roads and a derelict telecommunications network. These non-financial barriers hamper any venture in Accra, no matter how well funded.

Financial problems are substantial, however. Private capital is risk-averse and the gov-

ernment is short of funds and unwilling, or unable, to shift spending on low-output activities to potentially higher-output ones.

Interest rates on bank loans exceed thirty percent, partly because of Ghana has a stubbornly high inflation rate of twenty-plus percent and partly because bankers - and the whole society - has a risk-averse mentality. Lower interest-rates may come through reductions in deficit spending by the government and improved terms of trade (currently Ghana imports more than it exports, creating the conditions for the depreciation of its currency, the cedi, which has fallen dramatically in recent years, from about 2,500 to the dollar in 1999 to 8,500 to the dollar today). Neither lower deficits nor improved terms of trade is likely in the near-term because of structural imbalances. The country's social needs - in education and health-care especially - are rising because of a growing population and an increasingly restive one. Steps to reduce imports and improve exports must await expansion in the country's productive capacity. Economic liberalization has meant full openness to goods from abroad - especially low-priced products from Asia -- undercutting local producers (of both manufactured goods and food). The new government of John Kufuor is attempting to improve the competitiveness of textile manufacturers and certain agriculture producers through government subsidies (an echo of the policies of the Asian tigers in the 1970s and 1980s). Even if successful, these policies will take years to reverse Ghana's dependency on imported goods. Entrepreneurs, especially those in technology fields, can expect a more immediate lift from shifts in social attitudes towards risk and reward.

At independence Ghana was relatively wealthy, with an indigenous business elite whose ranks were swelled by traders of Lebanese descent and some British commercial holdovers. A succession of military coups, stretching from the mid-1960s into the early 1980s, destabilized the country's business class, creating a situation where people hid their wealth, if they had it. The military dictator who ended the cycle of coups, Jerry Rawlings, was at first imbued with socialist ideology and suspicious of the wealthy. He froze bank accounts and seized assets. In an unstable atmosphere, where business men could be questioned at any time about the source of their assets, a get-rich-quick mentality took hold. "Ghanaians got used to making a fast buck," says Ken Thompson, who manages the country's lone venture-capital fund. "The entrepreneurial spirit was killed by coups."

Ken Ofori-Atta, who runs an Accra financial house, Databank, and is the scion of a famous conservative family in Ghana, agrees that military coups weakened the country's business culture. But he also says of the tendency to blame coup-makers, "These are the excuses we have." Aversion to risk, he says, may run deep in the Akan, the country's dominant ethnic grouping. He cites the popular Akan folklore hero, the cunning, mischievous and selfish spider, Ananse. The spider gets ahead by skirting the rules, not through honing skills and hard work. "There's almost a societal resistance in Ghana to acknowledging real talent," Offori-Atta says. "A purely good venture almost cannot be celebrated. Ananse gets away with everything and society leaves him alone." He takes this to mean that "when good people come they get no support."

Whatever its sources, aversion to risk means a shortage of capital for new ventures. Thompson raised his Fidelity Equity Fund, a total of $4.5 million, chiefly from two international development agencies, one Dutch and the other Swiss. "We couldn't find any [fellow] Ghanaians to invest," he says, adding: "If we're not investing, who is going to invest?"

Then there is the problem of identifying ventures with good potential. As of the end of last year, Fidelity had invested in only two deals, one of which was Busyinternet (where Davies made his proposition more attractive by investing a substantial amount of his personal money). Thompson wants to fund from six to ten deals in total, fully investing the fund by as early as mid-2003.

Not only is the flow of potential deals thin, there is the problem of repayment or "exit." Initial public offerings "are not available," Thompson says flatly. Ghana has a functioning stock market but it is limited chiefly to

companies with a solid base or a link to natural resources. To address the problem of repayment, Thompson has opted for convertible debt so that his fund can show some cash flow. Another possibility is to encourage mergers among new ventures, or sales to foreign companies.

The task of assembling risk capital is daunting and talk on the subject quickly turns to government's role. Any number of people have urged government to form a high-tech venture fund. These calls come with a typical caveat: let private fund managers make the investment decisions. But even a government fund insulated from political favoritism would face the same problems as the country's existing venture fund: few strong deals and limited ways of turning equity into cash.

(5)

Ghanaians tend to concentrate on how new ventures are constrained by a shortage of capital, often glibly saying that more available funds would unlock the country's potential. There is a measure of truth in this view. But even companies who are well-funded can run aground because new ventures face non-financial constraints.

Consider the case of one of the wireless telephony companies in Ghana, Mobitel, which is an affiliate of a Swedish telecommunications company. Mobitel was the first to offer wireless service in Ghana, but the company chose an analog system. In time its chief rival, Spacefon, another foreign-controlled wireless company, gained a dominant share of the market in part because it offered a digital, or GSM, service based on the European standard. By the year 2002, Spacefon had ten times more customers than Mobitel (more than 200,000). Trying to stay competitive, Mobitel decided to introduce a GSM (digital) service and also to give customers the ability to browse the Web, make electronic transactions and convert voicemails into emails. The service is nearly identical to what is offered by the most advanced wireless providers in northern Europe, for instance. To be sure, Mobitel has a business case for offering a gourmet service: its rival Spacefon had nothing like it and Mobitel is playing catch up. But because of all the bells and whistles in its new service, Mobitel seems to violate Chinery-Hesse's principle of "tropical tolerant" systems. The new wireless service was neither keyed to Africa nor simple to use. Mobitel executives were aware of the potential mismatch but gave a straight forward explanation of why they chose the complex system: The cost was only slightly higher for the deluxe system and equipment vendors weren't eager to sell simpler digital system because they lacked the incentive to maintain them and because there was no demand for them in their richest markets, Europe, Asia and the U.S., for these older systems.

The government of Ghana reacted to Mobitel's decision to re-launch its service with a leading-edge technology by doing the unexpected. In March 2001, the government seized $5 million worth of Mobitel equipment at the airport in Accra, accusing the company of importing it for the secret purpose of designing a surveillance capability into its telephone system (and systematically eavesdrop on Ghanaian telephone conversations). The company protested the charges and the government released the equipment a month later. In the following 60 days, Mobitel engineers installed the digital technology, piggybacking on 18 existing cell sites. By June 27, 2001, the company was ready to provide a service that, technically at least, matched the best in Europe. But what seemed like an excellent example of the power of leapfrog - the ability of a poor country to jump technological stages in a single bound - was frustrated by government opposition. For an entire year, the government refused to allow Mobitel to switch on its new equipment. During the standoff, one of the company's senior executives from Europe visited Ghana and made a public apology to the President for "past misdeeds." In July 8, 2002, Mobitel went live, a full twelve months after it was technically ready to do so.

The recent experience of Mobitel is a reminder that the politics of information technology can be as important as the technological issues underlying new products and services. The Mobitel case also belies the quip made to me in Accra by a British agricultural expert who

declared, "Technology isn't the issue. That can be flown in." Well, the technology was flown in and the government seized it. The technology was as good as anything in northern Europe, the hotbed of wireless innovation, but the government was troubled by the political economy of the wireless industry in Ghana. Mobitel is partly owned by a friend of the former President Jerry Rawlings. The new government - longtime critics of Rawlings and his cronies - wished to do nothing to assist Mobitel. "Payback is the one word to describe what happened," says one observer. "The political will to move forward didn't exist even though the technology did."

Politics are only one factor that shape the reception given a new technology. Other institutional forces shape the result as well. One formidable institution is land ownership patterns, which reflect both a complex web of tradition and tribalism and a contemporary legal understanding of property and value. One common problem for wireless companies around the world is where to place a cell tower. Companies must find a property owner willing to accept the placement of a tower - at an acceptable price. In Ghana, the price paid for such a placement is surprisingly high (in Accra, Mobitel recently paid an annual rent of $6,000 for a single tower). But prices can be negotiated; what is sometimes impossible is determining who owns a piece of property. There is no system of land title; no iron-clad, automatic way of determining who owns a particular piece of property. Says one Mobitel manager, "No one can tell us who owns land. Who do we go to see?" In one recent case, Mobitel abandoned a site because two different government agencies made unbending ownership claims.

(6)

What policies can government and civil society support in order to promote more diverse activity in the area of software and information services? Here are several steps worth considering:

"Plug and Play":

The government should create an "outsourcing park," where basic services such as electricity, water and satellite links are maintained at the highest level possible. Ghana doesn't have the capacity to absorb much foreign-direct investment in IT, but the foreign companies who visit Accra - looking to duplicate Data Flow's cost savings - ought not to face a confusing array of regulations and inadequate facilities and infrastructure. A government-built technology park is, in short, essential. Rents in Accra are relatively high for space that possesses infrastructure of a global standard; Data Flow's initial rent in the city was pegged at its highest level (on a square foot basis) in the world. The government ought to move swiftly to make opening an outsourcing business easier for foreigners or foreigners in joint ventures with locals.

"Cluster":

Civil society in Ghana must recognize the benefits of achieving critical mass. If Accra is to win a place (even a small one) on the global technology map, then the city must consciously attract more talent from the region - and more new enterprises. International agencies can help. The World Bank, for instance, can assist local business people in understanding how cooperating with competitors - on common costs such as telecommunications infrastructure and programming tools - can strengthen the environment, thus raising the chances of success for all players. The violent conflicts in the two other important countries in West Africa - Nigeria and Ivory Coast - are unfortunate but they create opportunities for Accra to recruit technical talent from these places. Local companies also must reduce the suspicion with which they view one another. Poor protections on intellectual property make technologists wary of sharing, which may make sense in the short-term but in the long-term leaves Accra's IT people too disconnected from one another. A scarcity mentality is pervasive; many people think that when they help a rival, they lose, unaware that sometimes cooperation is the only way to grow

a market - and reduce costs for all players. Only a self-conscious technology cluster will lift Accra into the global flow of goods and services.

"Smart Recruiting":

The government should take new approaches to promoting Ghana as a location for foreign technology businesses. Rather than pursuing a one-size-fits all strategy, the government ought to identify two or three promising niches in the information technology and communications industries. These niches should match the emerging areas of technical competency in Accra - information services and software programming. In addition to targeting specific areas of computing and communications, the government should also pursue smaller multinational corporations who are sometimes more nimble, flexible and daring than industry titans. Individual foreign entrepreneurs may find Accra attractive, too. One German national, who manages his own Internet company in Accra, explains why he opted to do business in Africa rather than Europe: "Internet in Germany is mature. Big players have market locked up. Accra is virgin territory. If you are small you can build here. This is a frontier."

"Field of Dreams":

A major technology company - an Intel, a Nokia, a Hewlett-Packard - can't open a research or manufacturing facility in Accra for the reasons explained in this chapter, but these companies should consider opening a small development office or even post a single researcher in the city. Even one world-class programmer or telecom engineer, with links to his or her mother ship, could have a catalytic effect on Accra's technology.

That a company would choose to locate a technical person (or small team) in Accra is not far-fetched. Boeing, the aviation giant, a year ago opened an office in Accra, one of two offices it now has in sub-Saharan Africa (the other in South Africa). The office mainly exists to support Boeing's sales and community development activities in Africa, but it is also charged with locating and assisting potential suppliers to Boeing. The specifics of Boeing's mission are less important than the general point: Accra is a legitimate place to test whether the world's leading high-tech companies can do more than sell their wares in Africa.

Chapter 3

Black Star: The Human Factor

Expanding the Supply and Quality of Intellectual Capital

"Universities in Ghana have no commercial aptitude whatsoever"
Nick Railston-Brown

"The EE or CS or physics graduate in Ghana is essentially a lost soul."
Mawuli Tse

"Your skills have to be globally competitive. If you can only work in Ghana, then surely you are not globally competitive, career-wise."
Clement Dzidonu, President's adviser on IT policy

"Our problem is not money but people."
Kwaku Boadu

(1)

Jacob Aryetey's desk is barely reachable between piles of computer books, derelict equipment and aging printouts. Two PCs sit atop his desk, one of which is connected to the Web. A native of Ghana, Aryetey is a 48 year old database specialist and the chairman of the computer science department at the University of Ghana, the most important tertiary institution in Accra (though technically located in the Legon area, just beyond Accra's border). In another city, in another country, Aryetey might be a big wheel, a shaker and mover, an intellectual link between the communities of science and industry, the lab and the market. But at this time, and in this place, Aryetey is a forgotten man, barely surviving professionally and economically while struggling to hold together a computer department that serves 400 students.

Aryetey is one of three permanent faculty in a department that, as of late 2002, also had one part-time faculty member. The staffing level is too low. Aryetey says he needs another four professors - or make that five, since one of his permanent faculty left only days ago to attend graduate school in Scotland. In Scotland, the man can obtain a master's degree. In Ghana, he cannot; no university offers a master's degree in computer science. Aryetey got his own master's in Nigeria, 15 years before (his BS degree is from the University of Ghana's engineering school in Kumasi). He joined the department six years ago and teaches three classes a term, for which he is paid about $300 a month. Aryetey's salary is large by the standards of his country, but software programmers - good ones - can earn more in business or as consultants. Demand for these people is high - too high for Aryetey to fill his open faculty jobs.

The last time he found a competent, experienced person and offered him a job - in September 2002 - Aryetey recalls what happened: "I never heard from the person again. Not even the courtesy to tell me he wasn't interested." Aryetey's explanation: "Industry pays better. Since we don't run post-graduate courses in Ghana, the few who get them are in demand."

Aryetey says he could not remain in his university position were it not for his outside consulting activities. "My ability to work outside is what keeps me here," he says. There is no limit on the amount of days he can spend on other work; he even can cancel university classes (and has) if outside deadlines loom.

Without more faculty, Aryetey believes that instruction in the computer science depart-

ment will remain inconsistent. "Some courses were designed ten to fifteen years ago," he says. Lecturers, gleaned from Accra's small community of commercial programmers and hardware engineers, bring more current practices into the classroom, but few volunteer to teach because of the pay, which is only $5 an hour (the department does cover a lecturer's transportation and preparation time, however).

Jacob Aryetey is a typical technical professional in Ghana. Isolated from the global intellectual currents in his field and short of help, he concentrates on maintaining a minimal standard for the seven to eight courses each term offered by his department, which does not offer a full-fledged bachelor of science degree. Students must double-major in another discipline, usually math, physics or chemistry. By senior year, about 35 students remain in the program - and Aryetey, in addition to all his other activities - personally advises all of them. He estimates that about five members of each graduating year are, in his view, "international class" in software and computer engineering skills. "Our emphasis is to give the fundamental principles in computer software," he says.

Gaps in learning exist. One afternoon, Kwesi Debra, the chief codewriter at the Bank of Ghana, visits campus to talk with computer science students about future careers. After explaining that, only the week before, he took over a class in the computer language C++ (from a professor who left suddenly for Scotland), Debra expresses his shock that some of the third- and fourth-year students in his class - midway through the term - had never even written or compiled a program in that computer language and that in another class they are studying an "assembly language" from the 1960s. "I believe most of what you are learning here isn't relevant," he says, then adds: "Your curriculum must be changed.... It must be relevant to the needs of industry."

The stronger students in the department recognize the inadequacies of their education - at least most glaring ones. The department's computer lab has only about two dozen working PCs - none connected to the Internet. Some students write programs in longhand, then type them into the computer later. Determined students pay to use the Web café on campus, but even at fifty cents an hour, most can't afford to do so.

By the senior year, the best students often have exhausted the department's resources and are left to forage for new things on their own. They are not encouraged to get work experience or assisted in arranging internships. "You have to do it on your own," says one fourth-year student. He frets over "outdated material," such as "five-year old handouts" and lecturers who come to class unprepared, or don't show up at all. "We wait 30 minutes and then we will go," says another student. She adds: "The lecturers never offer to make up class."

Students say they have no one to complain too. "You are not advised to complain," says a top student. "We've seen cases where lecturers retaliate against you. We don't have the freedom to complain." By comparison, the student says, more established departments - with a longer history at the university and more resources - provide stronger instruction and greater support. "In computer science, the university doesn't care about us."

Ayretey admits that the computer science department is a poor stepchild to older academic disciplines and explains that the university is frozen in time, with relatively large resources largely reflecting university priorities of the 1960s (when computing, as an academic discipline, was in its infancy). The university's statistics department remains far larger than computer science. Yet for vestigial departments to give way, upstarts need a vision and a plan. The computer science department has neither. Nor has Ayretey or anyone else organized support - either within or without the university -- for reform. Indeed, Ayretey is dispirited. What more can you do with limited resources?" He shrugs.

(2)

The task of reforming technical and scientific education at Ghanaian universities is

urgent, but the government possesses neither the resources nor the roadmap in order to do so. The timing for educational reform is not opportune either. Prodded by a new government, universities are opening their doors to a wider number of students. While a step towards greater equality of opportunity in Ghanaian society, surging enrollments have the immediate effect of further burdening already-stretched faculty and staff. On campuses, class sizes are swelling and dormitory rooms, originally meant for two students, can house five or six.

Other educational needs, moreover, compete with the tertiary level. Many primary schools in Ghana lack essentials (in some cases, there is no electricity); parents must pay for books and uniforms, meanwhile. As many as one in five of the boys and one in three of the girls drop out of primary school before year six of their education, according to a 1997 government survey. School attendance has hardly improved over three decades. In 1970, the mean years of schooling, for people age 15 and above, was 3.3; in 2000, the figure was 3.9. A major problem is the shortage of secondary school places. Of the 60 percent of the junior high school graduates who pass a national examination qualifying them for admission to a secondary school, only one-third find a place. The shortage of secondary schools essentially consigns a significant number of capable youth to a life without a decent education and effectively ends any hope of their participation in third-level, or university, education. (National Council for Tertiary Education; United Nations Development Program, Ghana Human Development Report; United Nations Development Program, Human Development Report 2001).

The same story - of limited opportunities and squandered potential - is replayed on the university level. Roughly one-fifth to one-quarter of the secondary school graduates attend third-level education, but "demand continues to outstrip the capacity of the existing institutions" and "about two-thirds of qualified applicants are still unable to gain admission to the public tertiary institutions," according to one report. The shortfall of university places comes on the heels of a decade of expansion of third level education. In 1991, university enrollment totaled 12,000. Today more than 30,000 students attend universities while about 15,000 students study in "polytechnics," or the rough equivalent of a junior colleges. Private universities have opened in recent years to absorb some of the demand for higher education, "but these are too few, too small and too specialized to make much impact in the near term," the report added. (Ghana Human Development, 12).

Those fortunate enough to attend higher education are hampered by a curriculum that seems frozen in time, still emphasizing the hallmarks of the post-colonial period when attractive careers were found in civil service, finance and law (not business or technology). The qualities of intellectual breadth, problem-solving and "learning to learn" - hallmarks of the best in higher education around the world - are notably absent from Ghana's universities. The educational deficits are largest in the sciences where students often lack basic tools and internships are virtually non-existent. But overall, even by the standards of Ghana's history as an independent nation, universities face "the problem of declining quality of teaching and learning." One cause, noted earlier, is a shortage of qualified professors. In 2000, an estimated 50 percent of all faculty posts were unfilled. (Ghana Human Development, 14)

Improved results from higher education are crucial to educating the people that will staff any home-grown information-technology industry. "We talk big but we have to start at the beginning," says Kwaku Boadu, a computer consultant in Accra. "We must build human capability first. Then the rest will come."

All levels of education must improve in Ghana, but the greatest need is for improvement in science and engineering training. University graduates today are poorly prepared to either participate in the creation of new information technologies or to assist in the application of information technology to social and business problems. Links between universities and civil society are weak, and business has little or no influence over university standards. The weak technical and scientific capacities of Ghana's universities are rooted in history. As George Ayittey, a Ghanaian economist at American University, points out in a perceptive section on

higher education in his *Africa in Chaos*, following independence Ghana pursued "the wrong type of education," gearing universities to produce "more graduates in the arts (law, history, sociology, political science among others) than in the sciences and the vocations. Ayittey criticizes university education in Ghana for teaching students "how to consume foreign goods without teaching them how to produce these items." He says this sends a message that "education is a consumption as opposed to an investment good." Finally, Ayittey argues that Ghanaians have tended to view education "as an end, not as a means to an end.... Once a person acquires that degree, affluence, prestige and power are expected to flow automatically." Such a static view of knowledge is a hindrance, even for lawyers and accountants, but these fields change only slowly. For fast-changing fields in science and technology, a static view of knowledge is impossible to sustain - another reason for the relative unpopularity of technical fields among university students in Ghana who largely remain in pursuit of a "safe" job (Ayittey, 143-144).

Educators in Ghana are aware that they must rid universities of hidebound thinking to produce more technically-literate graduates who produce more for employers and the Ghana's economy. But traditions die hard. Paul Effah, director of Ghana's National Council on Higher Education, says, "it is a real challenge for the university to move into science, technology and technical education." Effah says the educational establishment, while not yet ready to break with the past, is increasingly aware of the shortcomings of the system. "We know Ghana needs a core of technical people and that our universities aren't producing them," he says. Indeed, one 1995 study, cited in GhanaHuman Development Report 2000: Science Technology and Human Development, suggested that Ghana was producing "less than 10 percent of the required engineers and technicians."

One potential bright spot is the Kwame Nkrumah University of Science and Technology at Kumasi. For some years, administrators of the university have shown a growing awareness of the central role of electrical engineering and computer science in the formation of new industries. Kumasi's school of engineering is perhaps the best in English-speaking west Africa, and administrators have gradually shifted their emphasis from the mature fields of mechanical and civil engineering into the more dynamic areas of electrical engineering and computing. The engineering school, which was formed in 1952 while Ghana was under British rule, formed an autonomous department of electrical engineering in 1967. The department offers a four-year bachelors of science degree and a two-year masters. The teaching emphasis falls into three areas: electricity and power; electronics and communications; and computers and control.

Traditionally, civil and mechanical engineering have drawn the most engineering students in Ghana, a reflection perhaps of the rural and heavy-industrial orientation of the country's economy. But since the late 1990s, interest in electrical engineering has grown dramatically. The number of graduates in the subject from University of Science and Technology at Kumasi grew from 24 in 1997 to 52 in 2000 to a record number of 76 in 2002. In the fall of 2000, the department launched a program in computer engineering with an initial class of 51 -- another sign of the growing awareness of the profound changes in the field of engineering.

Any plan for integrating higher-education with Ghana's infant computer community must begin with the university at Kumasi. The university's chief, Kwasi Andam, said in March 2003 that he wants to raise the quality of teaching at the university - making it the finest technical school in Africa -- by moving "away from the vastly fragmented, bloated and unfocused university to a more compact, visionary and modern one devoid of waste." (Daily Graphic, March 3, 2003).

The location of the university is problematic, however. Kumasi is the second-largest city in Ghana and the traditional capital of the Ashanti people, who are the largest tribal grouping in Ghana. Though an important commercial center, Kumasi suffers from a woeful road link to the political capital Accra. Because of the poor road, the journey by passenger car can take five hours or longer, placing Kumasi firmly beyond the outer reaches of Accra. As a result, the cluster of technology businesses in Accra - desperately in need of more well-trained technical staff

and ongoing education for their existing people - are too far away to tap the Kumasi labor market.

Still, a strong link between Accra and Kumasi would help. The university recently created an office dedicated to gaining corporate sponsorship - and its first significant donor is Boeing, which two years ago opened its first regional African office in Accra. Boeing hopes to stimulate the creation of an aerodynamics and aviation engineering program at Kumasi and is assisting the university in obtaining corporate support from other quarters. Boeing's motivations are chiefly altruistic, since the company does no research, development or manufacturing anywhere in West Africa. The absence of any operation that requires engineering talent may limit Boeing's role in promoting change in technical education, but the company's involvement in Kumasi sets an important precedent.

Another important precedent - also with links to the U.S. - is a new approach to commercially-relevant technical education. In January 2002, a small, innovative university was launched in Accra with the aim of blending software engineering and business studies in a liberal arts setting. The university, called Ashesi (which means "beginning" in the country's dominant traditional language, Twi), is housed in an attractive compound in the central Accra neighborhood of La Bone. To ensure students gain a foundation in each area, Ashesi requires them to take a set lineup of courses for their first two years. The requirement creates a common experience for students, helps maintain quality of instruction and reduces the cost of running the school.

Ashesi is the brainchild of a former programmer at Microsoft named Patrick Awuah. A native of Ghana, Awuah is a good example of how the African diaspora can help back home. Two years ago, Awuah decided to take some of his winnings from stock-options earned in ten years as a code writer at Microsoft and bankroll an innovative university in his home country. The result is a small university in the La Bone neighborhood of Accra that reflects Awuah's belief that technical education, linked closely to the needs of the market, will most benefit talented Africans - and fill a large hole in the menu of existing educational options.

The very existence of Awuah, of course, comes as a shock to theorists of underdevelopment and the digital divide. To be sure, Accra is marginalized globally and burdened by the twin demands of mastering 19th century technologies and 21st century technologies simultaneously. Certainly, Accra's best and brightest in the fields of science technology - many, if not most - have left the country for the U.S. and Europe. And no doubt that the technologies of tomorrow are being hatched in the bosom of the multinational high-tech companies, the Microsofts and the Intels of the world. And yet here is Awuah, a "graduate" Microsoft who is literally bringing the spirit of Silicon Valley to Accra. Before even assessing chances of doing so, please note his noble ambition. How is it possible he even exists in a place such as Accra?

In short, Awuah is a quiet revolutionary, bent on creating a cadre of successful technology business leaders who are public-spirited and committed to lifting Africa by its bootstraps into the age of cyberspace. "We're not just building a technical workforce," he says. "We're training ethical and entrepreneurial business leaders."

Awuah is 37 years old and is married to an American. He lives in Seattle, shuttling to and from Ghana to administer the university. Awuah, his wife and two children expect to move fulltime to Ghana in mid-2003. Launching a university, he admits, is a gamble, both professionally and personally. Even though he has raised $2.6 million in charitable donations on behalf of the school - some from other former Microsoft employees - Awuah has invested his own money as well. "We're taking some big risks here," he says. In order to maintain Web access for its faculty and students, Ashesi must spend $1,800 a month for a satellite link. Like Busyinternet, the school must create its own infrastructure because the public infrastructure falls short. Awuah is embued with idealism and a belief that Ghanaians who succeed in the wider world must not forsake their roots. As he explained in a speech in October 2002:

"Ashesi University started as a dream, when my son was born in 1995. As the parent of an African child, I realized that the best way to leave this planet a better place ... is to do all I can to help change the African condition. I am a Ghanaian. I grew up in Ghana and completed secondary school here.... I care a great deal about what happens here. I believe that Africa can change its economic fortunes, just as Southeast Asia did at the end of the 20th century. But this goal cannot be achieved without a highly trained workforce and an ethical entrepreneurial engine that will drive the economic engine of Africa. And so with this conviction, I cut short my career at Microsoft to embark on this project. At Microsoft I saw first hand the power of highly educated people, working together to achieve a common vision. At this company one thing was constant: creative thought. I saw a diverse group of individuals, from different national, religious and political persuasions, working together to solve problems, to generate new ideas and create innovative products.

During the eight years I worked at Microsoft, this thinking, learning company grew bigger than the entire economy of Ghana. A lot bigger. And the basis of this amazing economic phenomenon was creative and analytical thinking. Not rote memorization (or, 'chew, pour, pass and forget' as we affectionately call it in Ghana), but rather original thinking."

Awuah, in short, is captivated by the power of an idea. Can technology save Africa? Awuah does not know how it can or will, but he is asking the question insistently and, because his voice comes from inside Ghana, it is hard to forget.

(3)

The Ashesi experiment is drawing the attention of government officials and educational policymakers. But the new university's fees put it out of reach for all but a fortunate few. In the absence of either a good public university or an affordable private school, the enterprising youth of Ghana are compelled to craft their own path. Those who are computer-obsessed grab whatever training they can, from distance learning via the Web to unpaid internships to paid course work at one of the more than a dozen private computer training schools in Accra. Some of these computer enthusiasts end up working in Web cafes, others manage computer networks, and a few customize standard software programs.

Dan Odamtten is one of these software customizers. He must learn programming scripts that allow a generic program to be tailored to a specific purpose. Odamtten has only a high-school diploma. He is 29 years of age. His father wanted him to become a nurse, but "I thought computers were the future," he says.

To get started, Odamtten took a nine-month course at a computer institute, his mother paying the fees without telling her husband. He learned how to program in BASIC and, as an exercise, wrote a payroll program. But on graduation, he couldn't get a job. He begged Ananse Systems, a local software house that specializes in supplying programs to small banks, to train him without pay. The company agreed.

Odamtten began by installing shrink-wrapped software for the company's banking clients. After six months the company decided to put him on the payroll, but only at $30 a month. After another six months he was asked to customize a program in MS-DOS. He has since moved to customizing Windows programs. The company now counts him as among its best programmers and pays him about $200 a month. Despite his success, Odamtten worries about the difficulties he faces in learning more demanding software skills. He fears he is falling behind.

The pressure to keep up with technical change is even greater for the relatively few programmers in Accra who write original code. These programmers usually have some university training, but many are self-taught. One of the most thoughtful and active self-styled programmers in Accra is Guido Sohne. The son of a successful civil engineer, Sohne showed aptitude for computers in secondary school, posted a near-perfect score on his math SATs and

gained admission to Princeton University. But after two years, he flunked out because of poor study habits and repeated absences from class. "I was too smart for my own good," he says. "I didn't go to class. I didn't take things seriously." Instead, he surfed the Internet constantly, becoming an accomplished player of computer games. "On the web, I was this super powerful being, reaching the apex of my power -- around exam time," he recalls. In his final quarter at Princeton, Sohne failed three classes.

That was in the early 1990s. Sohne returned from the U.S. to Ghana with something to prove and sought help from Nii Qauynor, a pivotal figure in Ghana's technology scene. A native of Ghana with a doctorate in computer science from the State University of New York at Stonybrook, Quaynor had in the early 1990s recently returned to live in Ghana after more than ten years working for the computer company, Digital Equipment Corp. Quaynor was the first computer technologist of any standing to return to Ghana from abroad. He formed a networking company in Accra and helped to bring Internet access to Ghana for the first time in the mid-1990s.

Quaynor also helped Sohne to found a software services company, which turned over an impressive $30,000 in revenues over two years before Sohne, ever restless, grew bored of the business and closed it. He then worked for a couple of years as the computer network manager of Soft, the pioneer software house in Accra. Today he works independently as a code writer, battling such difficult conditions as an absence of good tools and frequent power outages. Often, he codes in his parent's bedroom, on his father's PC. Of the "trying experience" of being a software developer in Africa, he writes:

"I remember the days when, less than two months into starting a new company, we had to endure the infamous ... practice of cutting off electricity to whole sections of the city in order to conserve power - never mind that you need electricity to work and eat. Nowadays things are much better - they just cut off the electricity without any warning whatsoever or the power fluctuates crazily and the electricity corporation thinks that is entirely normal. We just have to make saving every five minutes a habit...."

Sohne is an advocate of non-proprietary, copyright-free, open-source code. He is an important voice in the emerging debate over protections on intellectual property in Ghana and the potential benefits of choosing public-domain software over proprietary programs such as those sold by Microsoft. Ghana, as a member of the World Trade Organization, is under pressure to revise and update its existing copyright law, which makes no explicit reference to software or digital media. Legislation to enact a U.S.-style system of protections for software has been proposed, but no action has been taken for many months (the government is waiting to complete an internal review of a lengthy study on options for a national IT policy). Sohne opposes tight protections on software. He argues that while the country's small software producers need to benefit from their intellectual property, they also need to freely draw on the intellectual property of the U.S. and Europe in order to develop a pool of knowledge out of which African innovations may flow.

For programmers such as Odamtten and Sohne, there are few places to go to improve their skills. The computer schools in Accra are too basic and the universities don't offer relevant courses (and aren't geared to older, working students). There is a Ghana Institution of Engineers, in Accra, but the group only devotes a small committee to electrical engineering and had no dedicated computer section. There is an association of "Internet professionals," but it emphasizes marketing and business, not technical issues. "For programmers who need to learn something, it can be lonely out there," says Kojo Gyakye, a co-founder of Soft, the largest programming shop in Accra.

Sohne copes with his situation by foraging the Web for useful bits, sometimes e-mailing Americans or Europeans -- whom he has never met - for help. In late 2002, he wrote a pro-

grammer in Utah, asking for an algorithm to help with a phone billing system that he was writing for Busyinternet, the web café where he has kept an office. The American sent him a useful algorithm for free and Sohne responded, in hacker spirit, by sending him his completed billing code.

Forging technical links with foreigners can be difficult, however. Neither of the major American professional bodies for computer engineers or software programmers, IEEE or the Association of Computing Machinery, has tailored memberships to people living in poor, remote countries. In the fall of 2002, Samuel Oduro, an electrical engineer, inquired about membership in IEEE, which has just a handful of members in Ghana, and was disappointed at the high cost of membership. Even the lowest fee rung, for engineers earning under $11,000 (the income category that Samuel fits) calls for a membership fee of $70. Even if Oduro is willing to scrape together the money, he has no mechanism to pay. He doesn't have a credit card (the normal way to pay on the Web) and the IEEE won't take a check from his local bank (in Ghana's currency). "Even if I want to pay the $70, how do I do it?" he asks.

Sohne thinks that African computer people are compelled to be creative and resourceful. They must live by their wits - and pluck whatever they can from the discarded high-tech materials that turn up in Accra's digital dung-heap. Sohne is committed to staying in Accra. "I have no wish to leave, and the Internet lets me live wherever I want," he says. He knows he would earn much more in the U.S. or Europe (if he could get a job there), but he hopes the scales will grow more even over time. "One day, one day, you will be able to work for clients overseas," he has written. "It's a digital economy and software ships so easily. That's got to be the answer. Stay a Web African.... Don't give up. The future of the Web African software industry lies in enabling scattered bunches of individual hobbyist programmers [like Sohne himself]. Those people who would be coding even if it didn't pay because that is what they like doing."

(4)

To Guido Sohne, the "hacker" as a social type is a driven programmer who persists even in the face of daily humiliations and in the absence of a decent educational system. To Sohne, the hacker is a new kind of African nationalist who draws on free resources (available chiefly from the World Wide Web) to harness the global forces that might transform his circumstances. In taking advantage of the Web and low-cost computers, Sohne envisions a future where at least some Africans transcending the downward spiral engulfing much of Africa and - against the odds and as an equal partner -- joining a global community built around innovation, knowledge-sharing and pragmatism. Sohne's libertarian, free-wheeling approach to African development - with its concentration on the role of "non-state actors" and civil society generally - contradicts the two dominant approaches to development in the post-colonial era, which I will call "statism" and "aid dependency" for short. Sohne's emphasis on self-help, a model that seemed quaint and irrelevant in the heady nation-building era of the 1960s or the band-aid era of the 1980s and 1990s, may have fresh value at a time when many African states are achieving a measure of stability and searching for new ways forward.

Because there is much to be pessimistic about in contemporary Africa - the persistence of HIV/AIDs, the lack of foreign investment, the continuing outflow of talent, the frequent civil wars, the poor transportation infrastructure, the Islamic-Christian divide - many observers envision the further decline of sub-Saharan Africa. The thrust of these arguments can be read from such titles as Africa in Chaos or Africa: A Continent Self-Destructs. Pessimism about African prospects cannot easily be dismissed. The region's political leaders, when not corrupt, have often been inept, and the economies of most sub-Saharan countries remain dominated by natural-resource exploitation. Ghana is no exception: fifty years ago, gold, timber and cocoa dominated its exports, and the same is true today. Isn't Ghana, and by extension Africa, locked in stagnation at best?

Sohne would argue that enterprising individuals, relying on their own resources, can propel Africa out of stagnation or slow decline. His stress on the power of a single person to triumph, even in the face of hostile institutional forces, might seem naive, which is why the philosophy of self-help must be combined with an equal stress on clustering, because autonomous enterprising individuals must associate with one another, in order to leverage their talents. The emphasis on self-reliance neatly reflects the emergence of the hero-engineer in U.S. business in the last quarter of the 20th century, a period in which American hegemony over technologically-based industries was cemented. The hero-engineer, as a social type, is rooted in the capitalist transformation of Europe as well. A leading 19th century popularizer of the role of the hero-engineer was Samuel Smiles, whose book Self-Help argues that freedom and self-reliance are the soil out of which useful innovations spring. As historian Donald Cardwell has written:

"Smiles found, in the lives of the engineers who had carried through Britain's Industrial Revolution, plenty of examples to support the doctrine of self-help. Men like Watt and Stephenson's had overcome formidable physical obstacles and often strong human opposition to carry out their work. From the essence, the common factor of these studies, a triumphant vindication of the doctrine of self-help can be inferred; Such men, Smiles asserted, had often risen in the world from humble beginnings with no material advantages and little education beyond the elementary." (Cardwell, 496)

The hero-engineer provides only a partial explanation for technological development in the industrial age, of course. The advent of the computer and the rise of the Internet demonstrate that large public institutions, mobilizing great resources, were essential to the emergence of commanding technological systems. But in a country such as Ghana, where civil society is

undeveloped and individuals look to the government (of to foreign donors) for plans and materials, the corrective value of the hero-engineer is clear.

Ghanaian society has yet to grasp how to mobilize the potential power of Accra's budding hero-engineers. In 2002, the government of Ghana launched an ambitious effort in support of local clothing and textile manufacturers, providing training dollars and help in landing foreign customers. No such program is planned for software writers, though they would benefit from it. At the very least code writers and hardware engineers need assistance in forging technical alliances, which would enable larger groups of Ghanaians to bid on more complex and lucrative contracts. Today, technical people in Ghana are isolated from one another. To share knowledge with another practitioner often is interpreted as to give something away for nothing. With too little work spawned by the domestic market, computer people often feel they are in a stronger position if no rival knows what they are doing. "I'm surprised how proprietary attitudes are here," says Franklin Joyce, a volunteer technical adviser in Accra for the development group, Geek Corp. "Everyone acts like they own it." There is a saying in the local Twi language that quickly describes the stalemate brought about my rivalry, mistrust and a lack of cooperation: konongo kaya ("If I'm not moving, no one else can move").

In recent years, three separate attempts to bring together technical people foster learning and growth within the community, have flopped due to lack of interest. The most recent attempt to form a learning network came in November 2002, when hardware and software people gathered at Busyinternet to launch an "open source" association. About 30 people attended. At the meeting, a computer network manager, Samuel Larmie, said that the biggest hurdle facing technical people in Accra is secrecy. "Most people like hiding what they know from others, especially here in Ghana," Larmie said. "Either he pays for it, or he doesn't get it." Larmie adds, "We people in Ghana won't share. This is a terrible attitude."

The resistance to sharing information in Ghana arises from what one observer describes as an absence of "progress culture," resulting from "low educational attainment among the people and ... superstitious and fatalistic cultural beliefs" (Ghana Human, xiv). More specially, Ghanaians are information poor. Not even the most existential experiences are routinely recorded. For instance, two-thirds of all births and three-quarters of all deaths go unreported. (Daily Graphic, Feb. 27, 2003).

To be sure, information poverty is under attack. The new government of John Kufuor cancelled Ghana's criminal libels laws in 2001, immediately expanding freedom of speech in a country with a long tradition of press restrictions. Government is also asserting the formal names of streets and numbers of housing in an exercise aimed at making Accra more understandable. An explosion of radio stations is bringing greater awareness of public events and urban activities, at least within Accra. One entrepreneur is making a computerized, geo-coded map of the entire country, sending out researchers to pinpoint the location of gas stations, banks and other locations that might want such information for competitive reasons. There are now three television stations, compared to only one as recently as ten years ago. One station broadcasts CNN (commercials included) every morning. Old episodes of Oprah Winfrey also are shown.

The Internet, of course, brings into Ghana a vast amount of text and images from around the globe. The effect of the Web on the consciousness of the ordinary Ghanaian is difficult to gauge, especially since many people use the Web chiefly for email and a high percentage of those who wander through web sites are looking for a means of escape from Ghana (in this regard, a comment by Mark Davies, co-founder of Busyinternet is apt: he once estimated that 80 percent of his Web customers are looking for a way out of the country). The point about the Web being a path out of the country is not a trivial one. Theorists of Internet culture often concentrate on the flood of information that the Web brings into an information-poor country. But as important, is the way the Web makes poor people more aware of their poverty and perhaps more disenchanted with their station in life. With its many representations of the good life, the

Web carries on a tradition of Westerners telling Africans that what they see around them, at home, is inferior and unsustainable. To be sure, I am not arguing that Africans would be better off not having the Web, or knowing where their society stacks up in comparison to others. But in making Africa an information-rich place, techno-reformers must avoid inspiring self-hatred among Africans - and reinforcing the tendency for the best and the brightest to believe that they can only realize their potential out of Africa.

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The steady flow of educated people out of Africa is perhaps the most unpredictable variable in the factors playing for and against the emergence of technology centers in the sub-Saharan. Though the region has the lowest educational achievement on average of any in the world, African immigrants to the U.S. are more educated on average than not only native-born Americans but every other immigrant group. According to UNESCO, as many as 30,000 Africans living outside of the continent hold doctoral degrees. Thus, African migration to the U.S. (and to a lesser extent to Britain, France, Germany and Holland) is a migration of elites. The elite migration pattern is especially applicable to Ghanaians (look no further than the secretary-general of the United Nations, Kofi Annan, who hasn't lived in his country of origin for decades). By one estimate, cited in the World Competitive Yearbook 2001, 26 percent of the professionals educated in Ghana today live in wealthy countries. By comparison, about three percent of the professionals educated by China and India live abroad.

Most of professionals who leave Ghana are doctors, accountants and nurses. In the late 1990s, more than a thousand nurses may have left the country to take jobs in nurse-hungry Britain, South Africa and northern Europe. Ghana doesn't produce a large enough number of electrical engineers and computer scientists in order to lose enough of them to approach the number of departing health-care workers. But because demand for skilled computer people is already so high in Accra, Ghana's largest labor market, even a small outflow hurts the local market.

Some of the best technical talent in Ghana leaves the country after secondary school, finding places in British or American universities. These students are unlikely to ever return to Ghana since the skills they gain from attending top universities essentially "price them out" of the Accra labor market. The case of one recent MIT graduate, Victor Mallet, is instructive. Mallet received all of his pre-university education in Ghana and won admittance as an undergraduate by MIT on academic grounds. He majored in chemical engineering, graduating in the spring of 2002 after four years. Before graduating, Mallet helped to organize a contest in Ghana -- based on a similar contest at MIT - that evaluates business ventures proposed by students. Mallet spent the fall of 2002 in Ghana, working to establish the project. He then joined the prestigious Boston Consulting Group as a rookie consultant. Given the intensity of the consulting world, Mallet's ability to continue to contribute to Accra's IT scene is an open question. Mallet's brother, incidentally, also went to the U.S. for his undergraduate degree and now works at Microsoft in Redmond, Wash. The journey of Mallet brothers suggests that, in Ghana at least, family networks are critical in the formation of professionals and explain how and why people leave Ghana.

The question of brain drain is central to any analysis of the transformative potential of technology in Ghana. Says an American executive in Accra, "Brain drain is the biggest problems here. What can be done to reverse it?"

Recruitment of new code writers - even at an average starting salary of $500 a month, or ten times the wages of a policeman or a nurse - is difficult. And retaining good people is difficult. With no university offering a master's degree in computer science within Ghana, people who want advanced training - and can absorb it and afford it - often leave the country. In October, one programmer simply vanished. "Keeping skills, stopping the brain drain, is our

number one priority," says David Bolton, a British-born Ghanaian who manages programmers at Soft. "As soon as a programmer realizes what he can earn in the U.S., how do you keep them?" Bolton, whose task is to find ways to keep code writers at home, points to his own decision to leave Britain a decade ago and move to Ghana, where his mother was born. "We have a good quality of life, but programmers need the latest tools, challenges and rewards," he says.

The shortage of accomplished technical people raises costs and reduces output. "They are not a lot of good people," says an Australian in Accra who for many years as the engineering chief of a wireless phone company. "The good ones become consultants and they are bloody expensive." In late 2002, the chief engineer lost one programmer after a rival agreed to triple her salary - from $700 a month to nearly $2,000 a month. In the search to replace the vacancy, the chief engineer selected eight finalists: of the group, four never showed for an interview and one dropped out, leaving three. The chief engineer hired two of them, at $700 a month.

There is no quick fix to the brain drain. Government policymakers seem flummoxed by the situation. One response, however, is not to educate fewer people in computers or electrical engineering. The government needs to boost enrollments. One intriguing possibility is to mobilize a planned software institute that will initially help the government improve its own use of information technology. Initial funds for the institute, likely to open in the second half of 2003, come from India, whose government was privately importuned by Kofi Annan to assist his country (an example of how a smart diaspora can help; of this more later). India, whose prowess in software is well known, agreed to outfit a research and training lab - and train an initial group of Ghanaian instructors for six months in India. The institute, while expected to assist government departments with computing needs, will be open to the general public, offering courses and customized study. The institute, which is expected to open in late 2003, could appeal to the country's top programmers - and thus undercut the temptation to exit Ghana.

To be sure, the brain drain won't be stopped but perhaps it can be tamed. Quaynor argues that the country must produce more computer and communications professionals, even if the domestic economy can't absorb them. If they succeed elsewhere in the world, he believes, "these people can be mobilized from a distance." And he warns against making it too hard for Ghanaians outside of the country to contribute back home. "Let them contribute easily and earn a reward."

To start with, the government should first begin to compile a skills inventory of the electrical engineers and software programmers of Ghanaian origin who are living in the U.S., Europe and South Africa (the government should compile such an inventory for all its non-resident professionals). The governments of Singapore, Ireland and Finland - home to comparatively small but dynamic high-tech clusters - have done something similar and found that an empirical grasp of their respective country's diaspora helps in both recruiting emigrants back home and in attracting foreign investment. In Ghana's case, the purpose of the inventory would be two-fold. First, the inventory would better help policymakers understand why technical people have left and what these people the government might do to create more attractive conditions for Ghana's infant high-tech community. Second, the inventory would be of value to multinational corporations who are considering a project in Ghana but fear that the existing labor pool can't support it. Perhaps a specialist living outside of Ghana can be persuaded to return home; even the possibility of recruiting members of the diaspora might nudge a multinational to open an office where otherwise they might dismiss the possibility. Members of the diaspora, meanwhile, might be happy to know that an Intel or a Hewlett-Packard is considering opening shop in Accra.

Indeed, some Ghanaian computer specialists do return - and bring substantial skills with them. Quaynor returned to found an Internet service provider and a number of related computer businesses. A former field engineer for International Business Machines is managing an outsourcing company that has an initial U.S. client and hopes to grow along the manner of Data Flow. A recent graduate of MIT - one of a couple of dozen Ghanaians to have gained

undergraduate degrees in the university over the past two decades - returned to Ghana for three months in the fall of 2002 in order to launch a program that promotes the formation of new technology businesses in Ghana. The flow into Ghana remains small compared to the flow out, but the willingness of talented people to return suggests that there are legitimate opportunities to build technology businesses in Ghana and that the current political and social environment is attractive enough for a growing number of people to try.

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What policies can government and civil society adopt in order to improve the quality of scientific and engineering education at universities, support the infant software and computer services businesses in Accra and improve the technical knowledge of Ghana's labor pool generally?

Create a strong Computer Science department at Legon:

The University of Ghana in the Accra suburb of Legon is receiving increased funds budget for expansion of its student body, its infrastructure and its academic activities. Yet no plan exists to exploit the potential of an improved computer science department, probably the one department with the greatest potential to generate commercial activity in the country. The department needs the resources to improve instruction and the quality of its graduates. The department needs to establish a full-fledged major. It needs to increase its faculty by a factor of three. It needs a proper computer lab with an active link to the Web. A partnership with a leading computer science school in Europe or the U.S. would enhance the environment for both faculty and students alike. MIT's decision to offer university coursework online might be the basis for an experiment in distance learning. Prior to its revamping, the computer science department needs a board for advisers consisting of people such as Herman Chinery-Hesse, Mark Davies, Kwesi Debra and the venture capitalist Ken Thompson. No high-tech cluster anyone in the world has succeeded without a decent electrical engineering or computer science at its core. Accra has the makings of such a department, but much work needs to be done to achieve the level of excellence in instruction that will enrich Accra's software cluster. The university alone cannot improve its CS department. Only in partnership with software professionals and business can the university do so.

Support an association of software writers:

Computer programmers in Accra need to raise their skill-level. They need a social network that promotes sharing among community members - and helps to support associations of code writers who can pool their know-how to pursue more complex and lucrative jobs. A civil-society association should be formed that serves as a broker between members of the software community, emphasizing the importance of knowledge-sharing and improved skills. The association could also serve as a lobbying organization to increase resources for computer science at Accra's university.

The Government of Ghana should expand software training beyond the university:

The Indian-sponsored training academy for information technology, scheduled to be opened in Accra over the next year, lacks a clear mission and a sound organization. The institute, presently viewed chiefly as a means to help government manage its own computing needs, should take responsibility for creating a center of excellence in software tools and methods - for both advanced students and people working in software and related services.

International technical organizations, reach out:

International engineering and computer science organizations, both in Europe and the U.S., should create new forms of membership that enable technical professionals, whether self-trained or university graduates, to enlist as foreign members, and receive information about trends in their fields via email. Membership should be free, so benefits must be limited - but still enough to help to reduce the sense of isolation felt by African technical people - and inspire a sense of hope.

Mobilizing the diaspora:

The Government of Ghana can't track all of the professionals who leave the country , but it needs to know who has left and with what skills. In the fields of computing and communications, a "skills database" of the Ghanaians working in the U.S. and Europe could assist in recruitment of foreign investment and also aid people in Ghana who benefit from foreign know-how. Diaspora networks are proving to carry significant economic clout within home countries. In the case of Ghana, cash remittances total roughly $250 million a year. Little of this money, however, goes into productive enterprises but is rather passed on to family members to cover immediate living expenses. Ghanaians living abroad have considered forming an investment company that would invest in Ghanaian businesses, but the company is not yet active. In any case, such an investment fund needs a focus; it might bear more fruit if it concentrates on a single sector of the economy, such as software and related services. (Zachary, Diasporic Development)

Chapter 4

Black Star: Revolt of the Elites

Technology and the Limits of the Egalitarian Ideal

"At no time in the modern history of Ghana has there been so much talk about poverty and the need for all to commit to the improvement of the living conditions of the average Ghanaian."

Ghana Human Development Report 2000

"The costs of inaction by Ghana to join the information and knowledge economy are much higher than the risks posed by the advancing information society."

proposed national policy on information technology, 2002

"Technology is not a panacea to all our problems but it can help."

Clement Dzidonu
Presidential adviser on technology policy, Ghana

"IT is creating a new divide in Ghana."

John Mahama

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Ghana is a country that is characterized by striking inequalities. There are notable divides between men and women, tribal groups, geographic regions and economic class. Inequity is a given in Ghana. In considering the potential of information technology, Ghanaians have concentrated on the possible wealth-creation stimulated by innovations in computing and communications. The need to ignite growth is keenly felt in a country that has seen declines in living standards, in absolute terms, in the past forty years. The steady fall, in real terms, in the value of Ghana's two chief export commodities (gold and cocoa) underscore the hunger in the country for a new source of wealth. Just as in Silicon Valley, where observers spoke of a "new gold rush," recalling the original attraction to California in the 1850s, Ghanaian patriots wonder how the interplay of computing and communications might unlock a second gold rush of their own.

I am describing the link between high-tech and wealth-creation as a way of highlighting the relative lack of thinking about how information technology might address unmet social and material needs in Ghana and redress the imbalances within the country between rich and poor, urban and rural, men and women. The enthusiasm for technological innovation turns on its potential to boost private enterprise. A secondary interest is in using what the Ghanaians dub "ICT" to improve the effectiveness and efficiency of governmental services. Coming in a poor third is the question of the democratic character of the new information technologies and whether their introduction might actually worsen inequality in an already lopsided society.

On the level of policy, the Government of Ghana has struggled to address either of the broad issues of wealth-creation or equity. Former President Jerry Rawlings showed a healthy interest in computing and communications. He had his own adviser on computer matters and

pushed through a liberalization of telecom that had initial success (though later lost steam). Yet his national policy on technology, while enacted into law in the late 1990s, never moved beyond hollow rhetoric. The new Kufuor government, as of its first two years in office, has yet to deliver any policy documents on information technology, despite having a full agenda. The government has promised a new national policy on information technology and development; it must act on a reform of Ghana's copyright law, which currently makes no reference to software; it needs to issue regulatory rules for the agency that is supposed to manage competition among wired and wireless phones (included among these rules is expected to be one on the legality of Web-based telephony). The government's inaction has limited Accra's technology activity, disappointed potential foreign investors and frustrated some important foreign investors.

To be sure, how Ghana can best mobilize technological innovation is a weighty question. But the state has plenty of studies to work with. About the time that Kufuor came into office, the Ghana office of the United Nations Development Program released a comprehensive report on the state of science and technology in Ghana. While the report lacked a plan for reform, the report should have given the new government a running start towards developing forward-thinking policies in the areas of information technology and communications. Instead of using the report as a foundation, the new government commissioned a fresh study under a personal adviser to the President. The adviser, after consultations with scores of leading computer and communications people, produced a dense, lengthy document that was, after a decent interval, discarded. A new study was commissioned in late 2002, under a new presidential technology adviser, who submitted a report to Ghana's president in March 2003 (as I write in late April, the report remains unreleased). While this last report may indeed prove valuable, the process of study has gone on too long. The government also appears confused between two laudable goals: that of improving the way government uses computers, and of creating an enabling environment for businesses engaged in information technology and communications. Much of what has been discussed under the rubric of a national technology policy actually concerns government's ability to leverage digital solutions for improved civil-service performance.

What is distressing about the preoccupation with how government can benefit from IT is the message it sends: that government's own needs are more important than the needs of the private-sector. For a government that campaigned on a promise to create "a golden age of business" in Ghana, the rhetorical emphasis on the digital seems misplaced. While surely civil service reform is needed, efforts at reform are nearly two years old and have absorbed a good deal of funds and energy from the World Bank. Rather than improve government services, investments in computing and communications equipment might simply become another form of government waste. The government, after all, has shown an inability to carry out on its own such basic exercises as firing workers who never appear for work (i.e., "ghost" workers). After months of surveying the extent of the problem, the government identified tens of thousands of ghost workers, but then did nothing until it received a grant of $750,000 from the Japanese government. The government has presumably fired its phantom workers, yet it has never declared how many it has fired.

The government also has shown caution towards its national telephone company, which is the source of many problems. The key regulatory body, the National Communications Authority, has never issued regulations governing competition between wired and wireless phone companies. As a result, the country's virtual telephone monopoly, state-owned Ghana Telecom, has abused its rivals, chiefly by failing to provide enough "inter-connect" circuits between its network and rival networks. Moreover, Ghana Telecom needs a foreign investor to help fund its ambitious performance goals, but it cannot attract one in part because of the absence of rules governing the sector. Meanwhile, the largest American technology investor in Ghana, the company I have called Data Flow, chose to open a new operation in India because of its inability to obtain adequate wired-line service to the Internet in Ghana. And other companies, both domestic and foreign, have been forced to build private networks - enabling both Net

access and Net-telephony - at great cost. Investments in these private networks could have gone toward productive technology activities rather than merely creating conditions that the telecom sector should have provided as public goods.

The government should immediately release rules for the NCA to enforce, and include among those rules permission for Net-telephony under limited conditions. The government has had more than two years to study various drafts of the rules. It has turned down assistance from the U.S. Federal Communications Commission. It has ignored the pleas of telecom companies in the country. Until Ghana's telecommunications sector runs fairly and consistently, the young technology cluster in Accra will be greatly handicapped.

The thicket of policy options in the area of wealth creation has pushed to the back seat discussions of how IT might address unmet social and material needs and build bridges across many of the "divides" within Ghana. Before looking at the potential for IT to do so, let's examine briefly the experience of three other technology-intensive fields, health care, water delivery and agriculture. In these areas, technological innovations would seem to have an evident value to the poor and rural dwellers generally. Any push for IT-solutions to unmet needs in Ghana must be viewed in the context of the potential to apply mature technologies to problems long ago mastered in the developed world.

First, a health-care example. Ghana has a longstanding research effort on malaria, led by the Noguchi Memorial Institute of Medical Research. The institute is small, yet internationally known. It is a partner in an ambitious new malaria research project, funded by the Gates foundation and led by the London School of Tropical Diseases and Medicine. Malaria is a killer in Ghana - the leading cause of death in children under the age of five and a significant cause of adult deaths too. It is hard to imagine an unmet need in Ghana that would have a larger payoff than a dramatic reduction in malaria incidence. To be sure, "rollback malaria," as the World Health Organization calls its campaign, requires a grand global partnership and levels of funding that go far beyond anything Ghana can contribute. Yet more targeted responses are within Ghana's grasp. Consider the case of bed nets. When impregnated with an insecticide, bed nets are proven to reduce malaria incidence. A medical researcher in Ghana, Fred Binka, even conducted a scientifically-rigorous trial in northern Ghana in the 1990s and published his findings six years ago. Yet the government has never acted on the research by introducing a campaign to promote the use of bed nets, which have never been used in Ghana in any numbers. While the failure to promote bed nets can be explained by pointing to competing projects of greater urgency, what explains the government's continued refusal to lift an import duty that increases the cost of bed nets?

Malaria education also is needed. In January 2003 the government's health minister triggered a top news story by declaring that malaria parasites in Ghana, and West Africa generally, have become resistant to chloroquine, a low-cost drug that's been the chief pharmaceutical treatment of malaria for some years. The minister's declaration was accurate, but he failed to note that malaria experts had for several years been saying the same thing. Worse, these same experts advise that resistance of malaria parasites can be overcome by a treatment consisting of a combination of chloroquine and a derivative from a Chinese plant medicine, Artesunate, which costs pennies per tablet. Yet health officials in Ghana have either yet to learn of the effectiveness of the Chloroquine-Artesunate combination or remain unconvinced of its power. So the health minister succeeded in undermining the credibility of chloroquine - a drug many malaria sufferers in Ghana have never taken out of ignorance - and failed to offer an alternative treatment, even though a promising one exists.

The application of technology can also help to reduce the shortage of water in rural parts of Ghana. A private American aid organization, World Vision, has drilled more than 1,000 wells in remote parts of Ghana, relying on a hand-powered mechanical pump made in India to bring the water to the surface. The drilling of a well might seem to be a straight forward task, yet World Vision's learning curve was steep. The organization chose an all-mechani-

cal hand-pump made after realizing that villagers would be unable to maintain more sophisticated pumps. There was also surprising resistance in some villages to abandoning unclean river water. World Vision engineers were once chased out of villages by elders who believed in the religious significance of river water. In response, World Vision began sending an advance team of educators to address concerns of "the power structure" of a village who might interpret the introduction of a well as "an attack on their religious beliefs." The overall lesson is that "you might be fixing the thing technically but it doesn't work unless you deal with the social issues," says World Vision's water manager.

The benefits of clean water are manifold. Besides improved health conditions, a village can see a spike in productivity. The former water source may have required a lengthy trek. Since children often assist their mothers in gathering water, school enrollments rise following the arrival of a well. The village also can learn about responsibility, since World Vision requires that a local committee maintains the well and insures that water is distributed fairly (and, say, not hoarded by a powerful local clique and then sold at high prices).

The cases of malaria and well-water suggest that there are benefits from applying established technologies to unmet social needs. Let me give one more example, from outside the domain of computing and communications, before returning to the field. Ghana is rich in agricultural potential. Yet the country, like the rest of sub-Saharan Africa, has never had its "green revolution," the transformation of farming practices and produce distribution that has brought food security to such densely-populated countries as China and India who fifty years ago seemed far more likely to face chronic starvation than anywhere in Africa.

Why Ghana can't grow enough food to feed itself is a study in how the sociological can trump the technological. Land reform has never occurred in Ghana. Few farmers own their own land. Large plots can't be assembled because farm land is rarely sold. There are virtually no plantations in Ghana. Small farms are the norm, and they unproductive. Half the amount of cocoa is produced per acre in Ghana as in Ivory Coast, where French colonial-era practices endowed the country with large plantations and more efficient growers. Poor roads, moreover, cut production even further. An estimated one-third of bananas, cassavas and pineapples spoil before they reach market. There are virtually no fruit canneries in the country. Transportation difficulties also hurt efforts by farmers to compete against foreign food. Ghana imports about $100 million of rice a year - an amount in excess of the government's spending on education). Ghanaian farmers grow rice, yet generally do so unprofitably -- because the costs of growing rice in the North of the country and transporting it to the cities is far greater than the price of importing rice from Thailand or the U.S., shipping costs included. Because Ghana's main port is located near Accra, imported food need not travel very far once it arrives in country.

Ghana has not sat still in the face of agricultural stagnation. The government spends $7 million a year on 13 scientific and technological institutes that operate under an umbrella state agency called the Council on Scientific and Industrial Research. The council's institutes together employ 800 researchers with either a master's or a doctorate. These researchers concentrate on crop, tree and soil studies. None of the institutes have anything to do with computer science, electronic communications or biotechnology - essentially the entire range of activities in "high tech." Some of the institutes are obsolete, such as the one devoted to studying Ghana's soil (even the council's director admits the country's soil has probably been studied enough). Still, the council searches for relevance. One of its institutes concentrates on road building technologies and has tried to invent durable materials less expensively. These locally-invented materials may assist road building, but technique is not the decisive factor in whether roads are or are not built in Ghana. Road building is expensive, requires good planning and disciplined public workers. The shortage of good roads in Ghana is a problem of governance, not technology.

Market forces, which do so much to bring new information technologies to the attention of African leaders, can work against the democratic spread of innovations by creating powerful incentives to over-invest in certain areas (where, say, wealthy people spend their money) and

under-invest in areas of potential benefit to large numbers of poor people (who lack purchasing power, however). Let's consider the investment in wireless networks in the Accra area, which already accounts for 70% of Ghana's wired telephone lines (Government of Ghana, "Framework for the development of a national policy for information technology," 22). Taken together, these wireless networks represent the most significant infrastructure project in Ghana in the past five to seven years, representing a total investment of anywhere from $50 million to $100 million. The result is that Accra boasts four competing networks, while the rest of Ghana, with the exception of second-city Kumasi and the southern coast of the country, makes do with patchy services. Only one wireless carrier, Spacefon, seriously tries to offer nationwide service.

Today, there are more than 250,000 wireless subscribers in Ghana and the figure, already greater than the number of wired lines, is rapidly approaching 300,000. Without wireless telephony, life and commerce in Accra would come to a halt. The benefit is large. Yet wireless telephony is a powerful driver for inequality in Ghana. Less than five percent of the population directly benefit from wireless service - a small number of privileged people who now possess a productivity tool that can empower them to widen their lead over their less fortunate neighbors.

To be sure, even people without wireless phones benefit from the productivity gains delivered by the technology. Yet the wireless imbalance is also greater than it seems. In search of the "cream" of the market - the wealthiest five percent of Ghana's population - the wireless companies have stopped investing in low-cost technologies, switching instead to the most sophisticated, costly and indeed complicated systems. Wireless companies no longer invest in analog networks, for instance (only Mobitel even maintains one as a legacy to its original 25,000 customers). The reason for the switch to digital is clear: Digital phones and equipment offer better quality and the possibility of such exotic services as text-messaging and shopping by phone. Analog phones and network equipment is cheaper, which is an important consideration in a country where the average 3-minute wireless call costs about 50 cents - costlier, for instance, than the same call made in the U.S. In search of the "cream" of the Accra phone market, wireless providers are concentrating on a relatively expensive technology that locks their customer base into more expensive phones and airtime charges. Thus, market forces render extinct an analog technology that, at least, was more poor-friendly than its replacement.

Novel approaches to the organization of telephony (rather than innovations in the underlying technology) should better serve the poor. More dial tones are needed in more parts of the country. The government has prodded its national telephone carrier, Ghana Telecom, into expanding phone service, more than doubling the number of lines over the past five years to about 250,000. Wireless telephone companies offer a similar number of lines. But the lines are concentrated in the wealthiest parts of the country, Accra especially. The costs of serving remote rural areas are formidable but the government has largely failed to tap into the democratizing potential of the least expensive of the new communications technologies, voice-over-Internet. The government has banned Web-based telephony except under rare circumstances and is trying to protect the revenues from international calls received by Ghana Telecom. The quickest and least expensive way to improve access to telephony, however, would be to radically embrace Web-based telephony, perhaps initially by creating special zones in the most deprived parts of Ghana where telephony would be available virtually free of charge. Such an experiment, in addition to giving poor people a telecommunications backbone, might also educate the government about the actual effects of allowing Web-based telephony.

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How might information technology solve unmet social needs in Ghana? People are pursuing socially-useful IT applications in ways that suggest they have a solution looking for a problem. Let's consider the case of providing market information to cocoa farmers. This is the

sort of exercises extolled by the World Bank in its important 1998 study, Knowledge For Development. In Ghana, hundreds of thousands of families depend on cocoa for their livelihood and the country is the world's second or third largest producer of the crop (after Ivory Coast and, some years, Indonesia). Cocoa beans, as a commodity, trade on global markets. A good deal of information about cocoa prices exists. But pricing information is unevenly distributed: farmers often don't have enough of it. A favorite example of techno-enthusiasts is to assert that computers and communications can deliver essential market information to farmers, thus empowering them. But technical barriers prevent this. Telephone links to rural areas is poor. Wireless companies haven't the incentive to cover rural areas because of low call volume. The national phone company has placed the vast majority of its lines in cities. If wireless coverage was expanded, or voice-over-the-Internet was allowed by the government, at least for selected telephone-impoverished rural areas, then cocoa farmers could obtain, either via the Web or by voice calls, the latest world cocoa prices.

In an ideal situation, such information would help farmers. But in Ghana today, such information would have less value than at first meets the eye, because of laws governing the sale of cocoa. Farmers in Ghana can only sell cocoa they grow to the government. As the only buyer, the government sets a price for cocoa that ranges from one half to two-thirds the value of the world price. The government's share is essentially a tax on the farmer's labor, though to some degree covers the cost of subsidizing the cost of inputs, such as fertilizer, and agricultural training. Given the government's cocoa regime, knowledge of world market prices may make farmers unhappy, or encourage them to take up cocoa smuggling, which is a criminal offence. To be sure, information technology may raise the awareness of cocoa farmers about the inequity of the government pricing scheme, which might prompt them to protest in favor of an alternative. But neither information alone nor the tools to manage the information will help to raise cocoa prices. Only an end to government control of pricing will do that. But since the government depends on its "tax" on cocoa farmers to bolster its treasury, there is no debate over alternative approaches to managing cocoa - notwithstanding the government's professed support for individual enterprise and neo-liberal economic policies.

To be sure, there are plenty of areas of Ghanaian society where information technology can help reduce inequities, starting with schools, medical clinics and hospitals, none of which routinely possess computers or Net-access. Yet the question of competing priorities looms over any proposed initiative to apply IT to an urgent, unmet social need. What might be done instead? In Accra's main hospital, Korle Bu, the intensive care unit for newborn babies has no computer, no data base on patient care, no IT resources whatsoever to apply to the treatment of an average of ill or underweight babies. The nurse to baby ratio is roughly three nurses to 40 babies (the ratio would be nearly one-to-one in a U.S. or German hospital). IT applications can certainly improve patient care, especially if a Web-link allowed nurses to immediately query a doctor in, say, New York with a question about a baby in distress. One can imagine a network of small, inexpensive video cameras, linked to a PC, which would beam pictures across the Net to the doctor in New York, further assisting him in the formulation of his advice. Enthusiasts of computing and communications cheer such possibilities and indeed we all should. But enthusiasm for IT must crash against the hard rock of reality of technological systems in a poor African country. The very infant ICU that I am describing does not have a secure electricity source. When the power goes down, the incubators go dark. The hospital's backup generator then kicks in - for a few hours. So which is more important? To install a better backup generator, so children do not die in a cold incubator; to hire more nurses; or to invest in a Web-based communications network for the purposes of improving the quality of care? Or perhaps in a country as poor as Ghana, a public hospital has no business even attempting to bring to bear the sophisticated high-tech treatments required to heal premature, underweight and sick newborns? While no country is presented with a zero-sum choice, technological options often do not complement one another but are pitted against one another. Advocates of IT for social

development (as distinct from economic development) should be mindful that the universe of possibilities is wider than they usually acknowledge.

(3)

I next wish to examine how the spread of computing and communications in Ghana is both promoting equity and inequity, in different spheres and in different ways. In this brief discussion, I will concentrate on two significant and somewhat overlapping divides within Ghana: between the poor and the less poor and between those who live in Accra and those who don't. These two existing divides - over income and over place - reinforce one another. These two divides also seem porous to the effects (both positive and negative) of innovations in information technology and communications.

Ghanaians often prefer to maintain the fiction that everyone in Ghana is poor - everyone equally marginalized in global terms and thus everyone possessing an equal claim on the attention of the aid workers and other purveyors of foreign charity. I recall a curious moment, during one of my first visits to Ghana in the year 2000, when a British adviser was trying to convince officials in the Ministry of Health to direct more resources to the poor. As I sat in the back of the room, I watched bureaucrats squirm. Finally, one of them asked the British expert, "Aren't we all poor?" Not waiting for a reply, the people in the room exploded in agreement: "Yes, aren't all Ghanaians poor."

Not really. An estimated 40 percent of Ghanaians are classified as poor in terms of the country's own living standards. Only 4 percent of people who live in Accra qualify as poor, suggesting the enormity of the urban-rural divide. In all other zones of the country, the poverty percentage ranges from 45 percent in coastal zones to 70 percent in rural northern areas (Center for Policy Analysis). The poverty figures suggest that the government ought to drive the spread of information technology into rural areas, where the poorest people live, as part of an effort to raising productivity and living standards. Precisely the opposite is happening. Computing and communications capabilities are concentrating in Accra. While this concentration increases Accra's potential as a global IT node, it also widens the rural-urban divide. Hence, there is a seeming conflict between promoting equity and promoting economic development.

The conflict cuts at the heart of Ghana's situation: Maybe it is necessary to use information technology to improve life at the top in order to undercut the brain drain and create a labor pool, concentrated in Accra, that both foreign corporations and domestic champions can draw on? But the price of such a strategy will be the further marginalization of rural areas. The evidence is clear: Accra has raced ahead of the rest of the country. For instance, an estimated 90 percent of the Web cafes in Ghana are located in greater Accra (Ghana Human, 92). Officials in Ghana, besieged with the task of bringing Accra's technologies up to date, have only begun to ask how they can include rural areas in the information age. There are policy options that might undercut Accra's advantages. The government could allow selected rural areas to experiment with voice-over-Internet (while forbidding it in Accra). The government could reconfigure the national phone company, incorporating other networks owned by the government, and creating a Ghana-wide Internet provider who would service rural areas at a deep discount. It could create an IT park in the coastal city of Cape Coast, which while only a few hours from Accra, lacks robust computing and communications links. The natural beauty of Cape Coast, which was once the colonial capital of the Gold Coast Colony, and its relative proximity to Accra, makes it a potential IT center. With the construction of a decent road link between the two cities, travel time could fall from more than three hours to less than 90 minutes, deepening the links between the two places.

*

The expansion of computing and communications has enhanced Accra's advantages, deepening the urban-rural divide and giving the country's elite new tools that can strengthen its hegemony over Ghanaian commerce and culture. In this sense, IT is another driving force - along with increased mobility and the globalization of finance, trade and culture - behind the gradual integration of elite Africans into global society. As Accra's elite gain greater ability, through computing and communications, to remain in Africa -- while at the same time participating commercially, socially and culturally in the wider world - the potential grows for the indigenous elite to become unhinged from the rest of Ghana. Today, a prosperous Ghanaian can live in a gated-community, in a home built by a Texas real-estate developer and whose electricity and water are supplied by a private association. Inside his home, he can watch British football games on satellite television, shop at LL Bean over the Internet or study at a top university via distance-learning. The elite Ghanaian need no longer interact with the have-nots of his society if he chooses to avoid them. Empowered by IT, the elite African remains home alone. Of course, he is still on African soil, which is a better situation than his joining the brain drain. Yet the isolation of the African elite - an isolation reinforced by information technology -- suggests "a nightmare scenario" to quote Marguerite Michaels. Writing in Foreign Affairs, she envisions "a two-tiered Africa where existing political and economic elites reintegrate with the global economy ... while increasingly isolated rural populations are integrated internationally as perpetual recipients of humanitarian aid." (cited in Schwab, 149).

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But information technology is also a force for equity. E-mail has given the ordinary Ghanaian - who never received home delivery of paper mail -- the chance to send and receive messages. By having an "electronic address," the person has a virtual reality where before he had none. The psychic benefit of digital validation is hard to measure, but also hard to dismiss. Ghanaians living abroad are better able to target their remittances because improved communications allow relatives at home to better describe what they need and when they need it. The arrival in Ghana within the past 10 years of Western Union - whose electronic network allows the transfer of money within 15 minutes from a branch in Europe or the U.S. to a branch Ghana - has eased the burden of sending cash.

In the public sphere, IT has helped too. The combination of low-cost computer power and pervasive telecommunications appears to promote democratization. The sea-change in Ghana's government, which occurred in the national election in December 2000, suggests the extent to which the spread of new and old media forms and improved telephony contributed to ending what was effectively a one-party state. President Jerry Rawlings could not run for re-election because of term limits. He had served eight years as a civilian president, which followed more than 10 years as military dictator. Rawlings selected an unassuming university professor, Attah Mills, to stand in his place. Mills was pilloried by country's new radio stations who also skewered Rawlings for his alleged misdeeds. The barrage of criticism against the Rawlings regime, while reflecting popular discontent, was all the more pointed because Rawlings himself had allowed the expansion of FM radio as part of his telecommunications liberalization. Political commentators in Ghana widely credit the country's expansive radio media for the election of a reform democrat, John Kufuor. Many leading radio stations, such as Joy, Choice and Vibe, are available live over the Internet, thus giving non-resident Ghanaians more information about their home country. On his victory, President Kufuor created further space for the media by ending the possibility of criminal libel. The new president also embraced a vision of a knowledge economy where Ghana would no longer depend so heavily on the export of natural resources but on the brains of its people.

Information technology has altered the political dynamics in Ghana, but it is an open question whether the change means greater participation in politics by the population. In an

analysis of the 2000 election published in the journal *African Affairs*, Jonathan Temin and Daniel Smith found the media's influence limited to the Accra metropolitan area. Neither the radio stations nor the feisty independent newspapers that caused so many problems for Rawlings in the capital could be heard or read in vast parts of the country. Poor roads make the national distribution of Accra's best independent newspapers impossible. And there are no national independent radio networks. Access to the web, meanwhile, is heavily concentrated in Accra. Thus, any political revolt prompted by wider access to information is a revolt of an Accra-based elite.

That the elite benefits from technological advances is not surprising. The creation of information technology is an elite activity, requiring skills and experiences open to a relatively few people. To the extent that government acts to support the creation of IT products and services, it will be supporting an elite. One answer, of course, is for the government to support less privileged people in the use of IT. The government has not shown much of an inclination to do so.

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The problem of uneven development within a country is not new. Even very wealthy countries, such as Britain and the U.S., have pronounced and durable rural-urban divides. The government of Ghana would do well if it merely reduces the pace at which the IT gap between Accra and the rest of the country widens. For policymakers and the public, the highest priority should be placed on creating a "technopole" in the Accra area. The benefits of a high-tech cluster in the West Africa would be substantial and could provide resources needed to spread IT more broadly throughout the country and the region. Yet in boosting the prospects of Accra as an IT producer and consumer, elites will benefit disproportionately. In doing so, elites must adopt a new spirit of public-mindedness. If they fail to do so, Accra will become an enclave, a distant echo of the rest of Ghana, plugged into the global cyber-scene but isolated from its home ground.

(4)

Why the poor have so little clout over IT reflects a wider contest in Ghana over the future of the egalitarian ideal in the country. In recent months the government has taken a number of steps that have vastly increased prices of basic services for people living in cities. In January 2003, the government doubled the cost of gasoline sold at state-controlled outlets. Last year, electricity charges were doubled by the state electricity company. Both sets of price increases are aimed at ending government subsidies, once substantial, on these products. Since most of the country's gasoline and electricity gets consumed in Accra, the end of these subsidies has the effect of increasing the cost of living in Accra - and leveling the playing field with the rest of the country. Poor people in rural areas don't usually have access to electricity or piped water and they certainly don't own cars. If the government, through the price increases on basic needs, reduces its burdens by ending subsidies, it free up public money for other purposes, creating the potential for the poor to benefit from government reforms. Road-building is the government's top priority, and rural people especially need better roads.

But any benefits from price increases on essentials will take some time to arrive, and even that depends on government spending wisely the monies freed up by ending subsidies on electricity, gasoline and water. In the short term, the government's policies will hurt the poor because the price increases raise the cost of everything that depends on electricity and transportation, everywhere in the coutnry. While the well-off can absorb some prices increases, the poor cannot. Inflation, already at roughly 25%, may go higher, dragging down the standards of

living of both the urban worker and the rural poor.

To the extent that IT is creating imbalances that benefit the wealthy over the poor, these imbalances are likely to be overwhelmed by inequities created by government policies that are placing great pressures on both urban and rural poor. Ghana last saw such dramatic price increases in the chaotic 15-year period that followed the ouster of President Kwame Nkrumah in the mid-1960s. In the years after Nkrumah, military dictators alternated with weak civilian presidents, resulting in the wrecking of Ghana's economy. In the first years of the new century, Ghana is led by a democratically-elected government that takes individual freedom and the revolutionary power of computer and communications more seriously than any government, colonial or post-, ever has. Whether IT can help turn the tide in Ghana is an open question, though surely better government policies and a more dynamic private sector will help. In the meantime, Ghana's poor view the struggle over technological change through a bitter prism: a daily life that is growing ever more harsh.

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Figures

1. Population Growth … doubling in a quarter century

2002: 19
2015: 27
2020: 30
2028: 38

Source: Government of Ghana

2. Age structure of Ghana … a very young people

0 to 14 (age range)	44 (percentage)
15 to 64	51
older than 64	5

Source: Government of Ghana

3. Income stagnates, debt grows

Income per capita

1980 ……. $430
2000 ……. $340

Debt per capita

1980 …… $140
2000 …… $350

Source: Government of Ghana

4. Half of merchandize exports are raw materials

Total exports in 2001	$1.884 billion
Cocoa beans	$316 million
Gold	$617 million
Lumber	$75 million

5. Exports Lag Imports

Exports of goods	$2.885 billion
Imports of goods	$4.267 billion
Exports of services	$483 million
Imports of services	$760 million

Source: World Bank, based on 1999 figures

6. Communications in Ghana exploded in the late 1990s (1995 to 1998)

	1995	1996	1997	1998
telephone lines	53,067	77,886	105,000	179,594
public telephones	30	453	483	1,814
tele-centers	30	76	96	176
computers /100 people	0.12	0.14	0.16	0.30
radios /100 people	23.1	23.8	68.1	68.2
televisions /100 people	4.04	4.49	29.7	35.2
satellite dish subscribers	--	--	--	15,000
internet host sites	6	203	241	253
internet users /1000	0.18	1.56	2.38	4.17

Source: Ghana Human Development Report 2000

7. Still, the rural-urban divide remains huge in access to mass media among adults 15 and over (1998)

	No access to mass media	Read newspaper weekly	Watch TV weekly	Listen radio weekly	All
Urban					
Female	12	35	75	75	29
Male	5	62	83	81	53
Rural					
Female	40	10	34	50	6
Male	20	29	43	74	17

Source: Ghana Human Development Report 2000

8. Ghana sees a rapid increase in Web cafes, chiefly used for sending and receiving e-mail

42	Oct. 2000
90	April 2001
165	July 2001
250	July 2002

Source: Busyinternet

9. The number of electrical engineering students is small but rising at Ghana's chief science and technology university, in Kumasi:

1997	24
1998	38
1999	44
2000	52
2001	74
2002	76

Source: E.A. Jackson, University of Science and Technology, Kumasi

10. The number of students at Kumasi's University of Science and Technology declaring EE as their major now roughly equals the number of civil engineering students, traditionally the most popular engineering sub-discipline in Ghana (for year 2003-2003):

Freshman	118 (EE)	136 (CE)	689 (Total engineering)
Sophomore	145	137	655
Junior	71	84	389
Senior	80	81	360

Source: E.A. Jackson, University of Science and Technology, Kumasi

11. Declining revenues from international telephone calls to Ghana Telecom because of shift to voice-over-Internet:

1998	$42 million
1999	$34
2000	$26.4
2001	$21.2
2002	$14.1

Source: The Ghanaian Chronicle

12. Selected Demographic Indicators:

Life Expectancy (male)	58.7
Life Expectancy (female)	62.2
Under 5 mortality per 1,000	119
% households w/out toilet access	20
Adult literacy (male)	65
Adult literacy (female)	37
Male school attendance (6-25 yrs)	66.2
Female school attendance (6-25)	58.4

Source: Ghana Human Development Report 2000