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Technological Achievement and Human Development: A View from the United Nations Development Programme

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Technological Achievement and Human Development: A View from the United Nations Development Program

*Ronald Paul Hill**
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ABSTRACT

The primary purpose of this paper is to examine the relationship between technological achievement and human development so that the human rights community may better understand the impact of the digital divide worldwide. Using data collected by a variety of international organizations and in cooperation with the United Nations Development Programme, this research explores the creation, diffusion, and utilization of technology within the context of vast socioeconomic inequalities among nations. The paper opens with a brief introduction to the technology revolution, followed by a discussion of the digital divide. Data descriptions are presented in the next section, along with findings that show comparisons across technology achievement categories. The paper closes with suggestions for abridging the digital divide, and policy implications for the global community.

I. INTRODUCTION

> Yet if the development community turns its back on the explosion of technological innovation . . . it risks marginalizing itself and denying developing countries opportunities that, if harnessed effectively, could transform the lives of poor people and offer breakthrough development opportunities to poor countries.[1]

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1. Mark Brown, *cited in* United Nations Development Programme (UNDP), The Human Development Report iii (2001) [hereinafter UNDP].

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The information and communications technology revolution that began in the late twentieth century is nothing short of a worldwide phenomenon. Spawned by the convergence of the computer and telecommunications industries, the development of the World Wide Web, and the globalization of markets and consumer culture, the network age has dramatically increased access to information across national and geographic boundaries.[2] As a result, social and economic advancement among the peoples of the world has become increasingly tied to technology creation, dissemination, and utilization.[3]

The World Wide Web, which is often referred to as the Internet, has grown exponentially during the previous decade because of these trends.[4] From approximately 20 million users in 1995 to more than 400 million users by late 2000, the United Nations now predicts that one billion people globally will be online by 2005. Additionally, there were only 200 available websites on the Internet in 1993, but this number ballooned to more than 20 million sites by late 2000. International spending by governments and industry on information and communications technology associated with the Internet is expected to advance from $2.2 trillion in 1999 to $3 trillion by 2003.[5]

This explosive growth notwithstanding, the Internet has yet to reach ordinary citizens in the developing world.[6] In a global community where less than half of all people have ever used a telephone, the ability to access the Internet seems quite remote.[7] The United Nations reveals that only 7 percent of the world's population is currently online.[8] These users are located primarily within postindustrial Western nations, which contain 97 percent of Internet hosts, 92 percent of computer hardware and software consumers, and 86 percent of all Internet connections.[9]

These disparities are captured by the term "digital divide," which recognizes the yawning gap in accessibility to the Internet among countries. This definition suggests two distinct sets of issues.[10] The first set is based

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2. Queen Noor Al Hussein, *Keys to the Global Village*, 16 New Perspectives Q. 53, 53–55 (1999); Roland T. Rust & Richard W. Oliver, *The Death of Advertising*, 23 J. Advertising 71, 72 (1994).
3. Jonathan Harrington, *Bridging the Digital Divide*, 48 Probs. of Post-Communism 65 (Jan./Feb. 2001).
4. UNDP, *supra* note 1.
5. *Id.* at 36.
6. Erik Bucy, *Social Access to the Internet*, 5 Harv. Int'l J. Press/Pol. 50 (2000); Jamie F. Metzl, *Information Technology and Human Rights*, 18 Hum. Rts. Q. 705 (1996).
7. Allen S. Hammond, *Digitally Empowered Development*, 80 For. Aff. 96, 97 (2001).
8. Pippa Norris, *Information Poverty and the Wired World*, 5 Harv. Int'l J. Press/Pol. 1 (2000).
9. Fiona Godlee et al., *Global Information Flow*, 356 Lancet 1129, 1129–30 (2000).
10. Harrington, *supra* note 3.

upon disparities in the diffusion of information and communications technology innovations within a nation as well as the level of development of the necessary infrastructure. For example, the high-income Organization for Economic Cooperation and Development (OECD) countries make up only 14 percent of the world's population yet they contain almost 80 percent of all Internet users.[11] The second set is composed of socioeconomic gaps that must be reduced before a country can take advantage of the information technology revolution. For instance, nearly 900 million citizens are illiterate and close to 3 billion people live on less than $2 a day within the developing world. Unfortunately, the digital divide that separates the "knowledge rich" from the "knowledge poor" continues to grow,[12] condemning entire regions of the world to even greater poverty.[13]

Utilizing data collected through a variety of international organizations and standardized by the United Nations Development Programme (UNDP), this paper explores technological innovation and achievement in the midst of socioeconomic inequalities across nations. Descriptions of the relevant data are presented in the next section, followed by a presentation of the findings. The paper closes with implications for the digital divide and global policy.

II. TECHNOLOGICAL ACHIEVEMENT AND HUMAN DEVELOPMENT AMONG NATIONS

A. Data Description

The UN assesses the state of human development worldwide through the activities of the UNDP. Founded in 1965, this organization has an annual budget that exceeds $1.5 billion to support field offices around the globe in their conduct and assimilation of hundreds of individual data-collection projects.[14] Major sources of standardized data include the International Monetary Fund, World Bank, World Health Organization, and a wide variety of UN supported agencies such as the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

These efforts culminate in its annual publication of the *Human Development Report*, which has updated the status of the international

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11. UNDP, *supra* note 1.
12. Hussein, *supra* note 2.
13. Margaret Hanshaw, *Venture Philanthropist*, 78 Harv. Bus. Rev. 26 (July/Aug. 2000); Avinash Persaud, *The Knowledge Gap*, 80 For. Aff. 107, 117 (Mar./Apr. 2001).
14. Ronald Paul Hill & Bahram Adrangi, *Global Poverty and the United Nations*, 18 J. Pub. Pol'y & Marketing 135–46 (1999); Ronald Paul Hill et al., *Global Consumption and Distributive Justice: A Rawlsian Perspective*, 23 Hum. Rts. Q. 171 (2001).

community of nations for the last eleven years. The focal topic of the most recent volume is "Making Technologies Work for Human Development," and it is the source of all data in this research.[15] For the first time, the UNDP presents its technological achievement index (TAI), "which aims to capture how well a country is creating and diffusing technology and building a human skill base."[16] This index is a composite of several indicators involving the creation of technology, diffusion of recent innovations, diffusion of older innovations, and human skills.

Creation of technology is determined by two indicators, patents granted per capita and receipts of royalty and license fees from abroad per capita, and the sources of these data are the World Intellectual Property Organization (WIPO)[17] and the World Bank[18] respectively. Diffusion of recent innovations is measured by Internet hosts per capita and high- and medium-technology exports as a share of all exports, using data from the International Telecommunication Union (ITU)[19] to estimate Internet dispersion and data from Sanjaya Lall[20] and the UN[21] to calculate export share. Diffusion of old innovations is composed of the logarithm of telephone lines per capita and the logarithm of electricity consumption per capita, and the data source for the former is the ITU[22] and for the latter is the World Bank.[23] Finally, human skills are measured by mean years of schooling within a nation along with gross enrollment at the tertiary-level in science, mathematics, and engineering. These data were abstracted from Robert J. Barro and Jong-Wha Lee[24] for the mean years of schooling and the UNESCO for tertiary-level training.[25] The range of the combined indicators is from 0 to 1, with higher numbers suggesting greater technological achievement.

Socioeconomic differences among nations are computed by the UNDP through the human development index (HDI). This composite estimates the

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15. UNDP, *supra* note 1.
16. *Id.* at 46.
17. Basic Facts about the Patent Cooperation Treaty (Apr. 2001) [hereinafter WIPO] (no longer available online, on file with author).
18. WORLD BANK, WORLD DEVELOPMENT INDICATORS 2001 CD-ROM (2001) *available at* http://devdata.worldbank.org/dataonline.
19. INTERNATIONAL TELECOMMUNICATION UNION, WORLD INTERNET REPORTS: TELEPHONY (2001).
20. SANJAYA LALL, HARNESSING TECHNOLOGY FOR HUMAN DEVELOPMENT (UN Background Paper 2001).
21. United Nations, Correspondence on Technology Exports, Statistics Division (Jan. 2001) (on file with author).
22. INTERNATIONAL TELECOMMUNICATION UNION, WORLD TELECOMMUNICATION INDICATORS: DATABASE CD-ROM (2001).
23. WORLD BANK, *supra* note 18.
24. ROBERT J. BARRO & JONG-WHA LEE, INTERNATIONAL DATA ON EDUCATIONAL ATTAINMENT: UPDATES AND IMPLICATIONS (Nat'l Bureau of Econ. Research, Working Paper No. 7911, 2000).
25. UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO), STATISTICAL YEARBOOK 1998 (1998); UNESCO, STATISTICAL YEARBOOK 1999 (1999); UNESCO, Correspondence on Gross Enrollment Ratios (Mar. 2001) (on file with author).

average achievement within a nation on three essential aspects of human development. The first dimension is the ability to live a long and healthy life as determined by life expectancy at birth. The second dimension is knowledge transfer, using adult literacy and the combined primary, secondary, and tertiary enrollment ratio. Finally, the third dimension is the ability to acquire a decent standard of living as estimated by real gross domestic product per capita. The UN,[26] the UNESCO,[27] and the World Bank[28] assembled the input data for these three indicators respectively. The resulting combined index is reduced to a scale between 0 and 1, with larger fractions representing higher levels of human development.

B. Findings

An examination of the technology achievement index (TAI) among nations shows great disparities in the ability of countries to participate in the network age. Values range from a high of .744 in Finland to a low of .066 in Mozambique, and the mean TAI across the seventy-two nations where reliable data existed is .374. The average TAI is .556 among the relatively wealthy OECD countries for which information is available. In contrast, the developing countries of the world have a mean TAI of .272, and within the few least developed states among this group, the index drops to .075. (Table 1 provides a complete listing of countries, TAI and HDI values, and the development and geographic categories to which they belong.)

Further examination of the developing world reveals differences across geographic boundaries. For example, East Asia and the Pacific have the greatest technological achievement with a mean TAI of .354. Latin America and the Caribbean are next with an average TAI of .292, and the Arab states follow as the TAI drops to .238. South Asia, one of the least developed regions of the globe, has a mean TAI of only .182. Finally, data reports from Sub-Saharan Africa provide an average TAI of .150, the lowest mean value among geographic regions.

For the purpose of comparison, the UNDP divided countries of the world into four technology creation, diffusion, and utilization categories: leaders (TAI values of .50 and above), potential leaders (TAI values of .35 to

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26. United Nations, World Population Prospects 1950–2050: The 2000 Revision: Comprehensive Tables (2001).
27. UNESCO, The Internet in Education and Learning, Contribution to the International Telecommunication Union Focus Group on Promotion of Infrastructure and Use of the Internet in Developing Countries: Paris (2000); UNESCO, Correspondence on Gross Enrollment Ratios, *supra* note 25.
28. World Bank, Correspondence on Income Poverty (Feb. 2001), Washington DC (on file with author).

TABLE 1
Listing of Countries by TAI Values

Country	*TAI Value*	*TAI Category*	*HDI Value*	*Development Category*	*Geographic Category*
Finland	.744	Leaders	.925	OECD	Scandinavia
United States	.733	Leaders	.934	OECD	North America
Sweden	.703	Leaders	.936	OECD	Scandinavia
Japan	.698	Leaders	.928	OECD	Asia
Republic of Korea	.666	Leaders	.875	Developing	Asia
Netherlands	.630	Leaders	.931	OECD	Western Europe
United Kingdom	.606	Leaders	.923	OECD	Western Europe
Canada	.589	Leaders	.936	OECD	North America
Australia	.587	Leaders	.936	OECD	Australia
Singapore	.585	Leaders	.876	Developing	East Asia/Pacific
Germany	.583	Leaders	.921	OECD	Western Europe
Norway	.579	Leaders	.939	OECD	Scandinavia
Ireland	.566	Leaders	.913	OECD	Western Europe
Belgium	.553	Leaders	.935	OECD	Western Europe
New Zealand	.548	Leaders	.913	OECD	Australia
Austria	.544	Leaders	.921	OECD	Western Europe
France	.535	Leaders	.924	OECD	Western Europe
Israel	.514	Leaders	.893	NA	Middle East
Spain	.481	Potential leaders	.908	OECD	Western Europe
Italy	.471	Potential leaders	.909	OECD	Western Europe
Czech Republic	.465	Potential leaders	.844	OECD	Eastern Europe
Hungary	.464	Potential leaders	.829	OECD	Eastern Europe
Slovenia	.458	Potential leaders	.874	NA	Eastern Europe
Hong Kong (SAR)	.455	Potential leaders	.880	Developing	Asia
Slovakia	.447	Potential leaders	.831	OECD	Eastern Europe
Greece	.437	Potential leaders	.881	OECD	Southern Europe
Portugal	.419	Potential leaders	.874	OECD	Western Europe
Bulgaria	.411	Potential leaders	.772	NA	Eastern Europe
Poland	.407	Potential leaders	.828	OECD	Eastern Europe
Malaysia	.396	Potential leaders	.774	Developing	East Asia/Pacific
Croatia	.391	Potential leaders	.803	NA	Eastern Europe
Mexico	.389	Potential leaders	.790	Developing	Latin America/ Caribbean
Cyprus	.386	Potential leaders	.877	Developing	Southern Europe
Argentina	.381	Potential leaders	.842	Developing	Latin America/ Caribbean
Romania	.371	Potential leaders	.772	NA	Eastern Europe
Costa Rica	.358	Potential leaders	.821	Developing	Latin America/ Caribbean
Chile	.357	Potential leaders	.825	Developing	Latin America/ Caribbean
Uruguay	.343	Dynamic Adopters	.828	Developing	Latin America/ Caribbean
South Africa	.340	Dynamic Adopters	.702	Developing	Sub-Saharan Africa
Thailand	.337	Dynamic Adopters	.757	Developing	East Asia/Pacific
Trinidad and Tobago	.328	Dynamic Adopters	.798	Developing	Latin America/ Caribbean
Panama	.321	Dynamic Adopters	.784	Developing	Latin America/ Caribbean

(continued on p. 1026)

TABLE 1 (continued)
Listing of Countries by TAI Values

Country	*TAI Value*	*TAI Category*	*HDI Value*	*Development Category*	*Geographic Category*
Brazil	.311	Dynamic Adopters	.750	Developing	Latin America/ Caribbean
Philippines	.300	Dynamic Adopters	.749	Developing	East Asia/Pacific
China	.299	Dynamic Adopters	.718	Developing	East Asia/Pacific
Bolivia	.277	Dynamic Adopters	.648	Developing	Latin America/ Caribbean
Colombia	.274	Dynamic Adopters	.765	Developing	Latin America/ Caribbean
Peru	.271	Dynamic Adopters	.743	Developing	Latin America/ Caribbean
Jamaica	.261	Dynamic Adopters	.738	Developing	Latin America/ Caribbean
Iran	.260	Dynamic Adopters	.714	Developing	South Asia
Tunisia	.255	Dynamic Adopters	.714	Developing	Arab States
Paraguay	.254	Dynamic Adopters	.738	Developing	Latin America/ Caribbean
Ecuador	.253	Dynamic Adopters	.726	Developing	Latin America/ Caribbean
El Salvador	.253	Dynamic Adopters	.701	Developing	Latin America/ Caribbean
Dominican Republic	.244	Dynamic Adopters	.722	Developing	Latin America/ Caribbean
Syrian Arab Republic	.240	Dynamic Adopters	.700	Developing	Arab States
Egypt	.236	Dynamic Adopters	.635	Developing	Arab States
Algeria	.221	Dynamic Adopters	.693	Developing	Arab States
Zimbabwe	.220	Dynamic Adopters	.554	Developing	Sub-Saharan Africa
Indonesia	.211	Dynamic Adopters	.677	Developing	East Asia/Pacific
Honduras	.208	Dynamic Adopters	.634	Developing	Latin America/ Caribbean
Sri Lanka	.203	Dynamic Adopters	.735	Developing	South Asia
India	.201	Dynamic Adopters	.571	Developing	South Asia
Nicaragua	.185	Marginalized	.635	Developing	Latin America/ Caribbean
Pakistan	.167	Marginalized	.498	Developing	South Asia
Senegal	.158	Marginalized	.423	Developing	Sub-Saharan Africa
Ghana	.139	Marginalized	.542	Developing	Sub-Saharan Africa
Kenya	.129	Marginalized	.514	Developing	Sub-Saharan Africa
Nepal	.081	Marginalized	.480	Developing/ Least Developed	South Asia
Tanzania	.080	Marginalized	.436	Developing/ Least Developed	Sub-Saharan Africa
Sudan	.071	Marginalized	.439	Developing/ Least Developed	Sub-Saharan Africa
Mozambique	.066	Marginalized	.323	Developing/ Least Developed	Sub-Saharan Africa

.49), dynamic adopters (TAI values from .20 to .34), and marginalized (TAI values below .20).[29] Eighteen countries are categorized as leaders in technology achievement with an average TAI of .609, and they are located primarily in North America, Western Europe, Scandinavia, Australia, and parts of Asia. Nineteen countries are in the potential leaders category with a mean TAI of .418, and they are found principally in Eastern Europe with substantial representation in Latin America and the Caribbean. Twenty-six countries are considered dynamic adopters with an average TAI of .266, and this category is dominated by nations in Latin America and the Caribbean as well some East Asia and Pacific and Arab countries. Finally, nine nations are deemed marginalized with a mean TAI of .119, and they are from Sub-Saharan Africa and South Asia. Analysis of variance (ANOVA) shows that statistically significant differences exist among the four technology categories ($F = 241.39$, $p < .01$). See Table 2 for more details.

A review of HDI values suggests critical differences across technology achievement categories. For example, technology leaders boast a mean HDI statistic of .920. In contrast, potential leaders have an average HDI of .838, and dynamic adopters of .711. The marginalized nations are at the bottom with a mean HDI of only .477. ANOVA results confirm these differences as statistically significant ($F = 152.61$, $p <. 01$). Once again, Table 2 provides additional information.

To further probe the relationship between technological achievement and human development, correlation matrices were computed for TAI and

TABLE 2
ANOVA Statistics

	HDI	*TAI*
Leader Category	0.920 (0.020)	0.609 (0.071)
Potential Leaders category	0.839 (0.044)	0.418 (0.040)
Dynamic Adopters category	0.711 (0.063)	0.266 (0.044)
Marginalized category	0.477 (0.087)	0.120 (0.046)
F Statistic	152.61***	241.39***

Each number represents the mean and the numbers in parentheses are standard deviations. The notation *** indicates significance at the 1 percent level.

29. UNDP, *supra* note 1.

HDI across and within these four categories (see Table 3). For the entire set of countries HDI and TAI are strongly correlated (.897), supporting the contention that the creation, dissemination, and utilization of technology and human advancement exist within an essential and potentially reciprocal relationship. Interestingly, the correlation in the leader category is rather weak (.172), while the correlations for the other categories are considerably stronger and grow increasingly so as one moves from the potential leader (.611) to the dynamic adopter (.683) to the marginalized (.704) category. These results suggest that the importance of technology to human development, and vice versa, may be greatest under the least favorable conditions for both.

TABLE 3
Correlation Matrices

	For all the countries (n=79):	
	HDI	TAI
HDI	1	
TAI	0.897213	1
For the countries in LEADER category (n=18):		
	HDI	TAI
HDI	1	
TAI	0.17159	1
For the countries in POTENTIAL LEADER category (n=19):		
	HDI	TAI
HDI	1	
TAI	0.610586	1
For the countries in DYNAMIC ADOPTERS category (n=26):		
	HDI	TAI
HDI	1	
TAI	0.683409	1
For the countries in MARGINALIZED category (n=9):		
	HDI	TAI
HDI	1	
TAI	0.704277	1

III. DISCUSSION AND IMPLICATIONS

A. Summary of Findings

Using data collected by the United Nations, its affiliates, and other international organizations, this paper explores technology creation, diffusion, and utilization among nations through the TAI advanced by the UNDP. The findings reveal great differences between developed and developing countries, with the least developed nations facing acute deficits in technological advancement. These differences expose a north/south divide in capability, with Scandinavia, Western Europe, and North America as technology leaders, and South Asia and Sub-Saharan Africa as technology laggards. Most of the rest of the world, Latin American and the Caribbean, East Asia and the Pacific, and the Arab states, reside somewhere in between. The exceptions to this rule are Japan, the Republic of Korea, and Australia.

The UNDP reports and the data support a reciprocal relationship between technological achievement and human development.[30] For example, technology advances build human capabilities through the swift dissemination of progress in medicine, communications, agriculture, energy, and manufacturing. Additionally, improvement of human capabilities in education, income, health, and political freedom fuel the knowledge creation necessary for rapid technological change. The findings using the Human Development Index corroborate this mutually reinforcing association, with HDI values increasing as the TAI categories advance from marginalized to dynamic adopters to potential leaders to leaders. Additionally, the correlation data show the strength of the interdependence between the two, especially among the least developed nations.

B. Abridging the Digital Divide

The creation and diffusion of recent and old technologies associated with the Internet represent an expanding opportunity for governments within developed countries that seek to advance the quality of life of their citizenry. Such nations possess the necessary technological infrastructure in telephony and electricity that allow for the widespread dissemination of increasingly affordable Internet connections. Furthermore, large majorities within these countries possess the formal education and training required to establish a meaningful relationship with the Internet and to effectively utilize the vast amount of information that currently is available.

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30. *Id.* at 28.

Nevertheless, the developing and least developed nations globally have few or none of these assets. Their telephony and electricity infrastructures typically are poor when compared to postindustrial Western democracies, and the cost of service, as well as the necessary computer hardware and software, is beyond the reach of most citizens. For example, the UNDP reports that normal access charges amount to approximately 1 percent of the monthly income of US citizens, but represent 614 percent in Madagascar, 278 percent in Nepal, and 191 percent in Bangladesh.[31] Thus connection to the Internet is a rare commodity and available only to the wealthy in many nations. Regardless, even if the Internet was universally available, illiteracy and a lack of experience with advanced electronics by the majority of people in the poorest regions of the globe make effective use unlikely.

Fortunately, recent technological innovations in telephony have improved the ability to connect to the Internet within many parts of the developing world. High capacity and fiber optic linkages now span several continents in these regions, advancing accessibility within China, Latin America, and Africa.[32] Additional technological improvements, especially with spectrum radio, low-orbiting satellites, microwave, and laser connections, will expand wireless connectivity to isolated locales, making infrastructure problems with telephony and electricity less restrictive.[33] The Grameen Telecom organization has taken advantage of the opportunities associated with these advances by pioneering a new model for telephone connectivity.[34] Based on shared access to one wireless cellular phone within a village, Grameen Telecom makes available a lucrative business opportunity for the wireless women who dispense phone service to poor neighbors at affordable prices.

These successes notwithstanding, the diffusion of old technologies is only part of the problem in the developing world. Diffusion of recent technologies that allow for Internet access also is hindered by the cost of the necessary electronic hardware and accompanying software. To help eliminate this impediment, academic researchers are developing low-cost computers that are more widely affordable. For instance, computer scientists at the Brazilian Federal University of Minas Gerais have built a basic Internet access system at a price of approximately $300 (US).[35] The original

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31. *Id.*
32. Hammond, *supra* note 7.
33. Godlee, *supra* note 9.
34. Muhammad Yunus, *Alleviating Poverty Through Technology*, 282 Science 5388, 409, 410 (1998).
35. Jennifer Rich, *Compressed Data: Brazilians Think Basic to Bridge the Digital Divide*, N.Y. Times, 12 Feb. 2001; Tony Smith, *Brazil Attacks Digital Divide with $300 Volkscomputer*, Detroit News, 3 Mar. 2001, *available at* www.detnews.com/2001/technews/1003/03/technology-194796.htm.

model includes a modem, color monitor, speakers, mouse, and Internet software. The Brazilian government plans to install this technology in public schools, providing access to seven million students within the nation, as well as selling it on credit to low-income families. The Indian Institute of Technology in Chennai also created an economical technology product that functions without a modem or high-priced copper lines.[36] The end result provides more efficient and effective access to the Internet within poor Indian villages. This computer system recently was licensed to producers in India and China, and the technology currently is being disseminated in Yemen, Nigeria, and Tunisia.[37]

Even with these dramatically reduced costs, personal control of the necessary technology is infeasible for most citizens within poor regions of the world. An alternative that has taken hold within developing countries is shared usage of Internet access through cyber-cafés and kiosks.[38] This approach is compatible with Grameen wireless telephony, providing an entrepreneurial venture for community members while simultaneously meeting the connectivity requirements of the local village. Cyber-cafés and kiosks maintain very economical Internet access through wireless connections, and they are capable of employing touch screens for low literacy citizens and prepaid chip-cards for e-commerce that meet the needs of the poor. Solar energy can power this technology, making the Internet and its wealth of information available in even the most remote locations.[39]

These achievements are more likely to abridge the digital divide if they are organized so that this variety of public and private concerns works together to meet superordinate technology creation, dissemination, and utilization objectives. Thus, their accomplishment will ultimately require the consolidation of efforts by government, nongovernmental organizations including the World Bank, philanthropic establishments such as the Bill and Melissa Gates Foundation, and a host of other concerned entities like the Grameen companies.[40] To operate effectively, the UNDP recommends that these partnerships:

> Ensure transparency and accountability in decision making and governance;
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> Agree on how intellectual property rights will be established;

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36. M. Anand, *Professor Wireless*, Bus. World India, 22 May 2000, *available at* www.businessworldindia.com/archive/200522/Infotech2.htm.
37. *Id.*
38. Hammond, *supra* note 7, at 98; Yunus, *supra* note 34.
39. Jacques Attali, *A Market Solution to Poverty: Microfinance and the Internet*, 17 New Persp Q. 31, 32 (2000); M.S. Swaminathan, *Science in Response to Basic Human Needs*, 287 Science 5452, 425 (2000).
40. Godlee, *supra* note 9, at 1130; Norris, *supra* note 8.

Make resulting technology products as affordable and accessible as possible; and

Contribute to local capacity building through collaborations with researchers and users in developing countries.[41]

An illustration of public-private partnerships is the joint venture between the Argentinean Ministry of Education and venture philanthropist Martin Varsavsky. He provided $11.2 million to create and disseminate an Internet portal that may give up to ten million grammar, high school, and university students connectivity to the Internet as well as other computer-based resources.[42] (According to the UNDP, "schoolnets" are being established in other developing countries such as Chile, Thailand, and South Africa.)[43] Along with the government of Argentina, Varsavsky founded Educar SA to manage the portal and to market e-business opportunities to other companies.[44] While the use of marketing to support this venture is contentious, private sources of revenue may dramatically expand accessibility by underwriting the costs associated with technology products.

C. Public Policy Issues within the Global Community

Regional and worldwide collaborations that cross ideological and geographic borders also can facilitate the creation, dissemination, and utilization of technology. Consistent with this approach, the Group of Eight (G-8) nations "are at the forefront of producing information and communications technology."[45] At their recent Okinawa Summit, the leaders of these countries established the Digital Opportunities Task (DOT) Force to organize their efforts to abridge the digital divide globally. Members of the DOT Force are diverse in their backgrounds, and they represent governmental as well as nongovernmental organizations within G-8 and developing nations including China, Brazil, and India. Their work is focused specifically on establishing the required technological infrastructure to facilitate Internet access throughout the world by seeking agreement among diverse political interests, promoting public-private alliances that create innovative solutions, and advancing the amount of official assistance from developed nations.[46]

One policy initiative calls for the eventual demise of government-

41. UNDP, *supra* note 1, at 101.
42. Hanshaw, *supra* note 13.
43. UNDP, *supra* note 1.
44. Hanshaw, *supra* note 13.
45. UNDP, *supra* note 1, at 115.
46. *Id.*

controlled monopolies of the telephony and electricity industries worldwide.[47] A model for this radical change may be the United States Telecommunications Act of 1996, which is the first significant modification to US information and communications policy since 1934, a time before television, personal computers, and the Internet were given consideration.[48] This act resulted in significant growth of financial investment within a diverse set of information and communications industries, increased inter-type competition across traditional market boundaries, and reduced cost of and improved access to the World Wide Web. Concern exists that the predicted influx of multinational technology organizations could give rise to a nationalist backlash within some developing nations,[49] but the potential for a dramatic advance in opportunities for average citizens may negate much of this unrest.[50]

Another relevant policy initiative involves the appropriate implementation of the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement. Considered the most significant change in worldwide intellectual property rights since the Paris Convention of 1883, this policy initiative gives computer software the same legal protection as copyrighted works of literature.[51] The United States, in concert with other technologically advanced nations, promoted this agreement after lobbying by software firms whose intellectual property was being pirated abroad. Developing nations' good standing in the World Trade Organization (WTO) now is predicated on acceptance of this arrangement, and lack of enforcement may result in economic sanctions from developed nations whose rights have been disregarded.[52]

When this initiative was proposed, tensions arose between the developed and developing worlds, with the least developed states apprehensive about increasing dependency on and financial debt to the West.[53] In order

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47. Persaud, *supra* note 13.
48. Thomas S. Andolfo, *Telecommunications: The Wireless Personal Communications Services (PCS) Industry*, 69 APPRAISAL J. 333 (2001); PATRICIA AUFDERHEIDE, COMMUNICATIONS POLICY AND THE PUBLIC INTEREST: THE TELECOMMUNICATIONS ACT OF 1996, at 1 (1999).
49. Edward A. Comor, *The International Implications of the United States Telecommunications Act*, 31 J. ECON. ISSUES 549 (June 1997).
50. Michael E. Whitman, *A Look at the Telecommunications Act of 1996*, 14 INFO. SYS. MGMT. 82 (Summer 1997).
51. MICHAEL BLAKENEY, TRADE RELATED ASPECTS OF INTELLECTUAL PROPERTY RIGHTS: A CONCISE GUIDE TO THE TRIPS AGREEMENT v (1996).
52. Carlos M. Correa, *The TRIPS Agreement and Information Technologies: Implications for Developing Countries*, 5 INFO. & COMM. L. 133 (1996); Michael W. Smith, *Bringing Developing Countries' Intellectual Property Laws to TRIPS Standards: Hurdles and Pitfalls Facing Vietnam's Efforts to Normalize an Intellectual Property Regime*, 31 CASE W. RES. J. INT'L L. 211, 217 (1999).
53. *Id.*

to create a more balanced arrangement, the final agreement includes provisos that support postponing implementation for up to five years in developing countries and economies in transition, and up to eleven years among the least developed nations worldwide.[54] This compromise may promote the dissemination and utilization of Internet-based technology products in the short run, but the creation of additional open-source software that provides Internet access at little or no expense may be the best long-run strategy for the poorest regions and countries. Another possibility is a debt-for-technology swap between developed and developing nations that could serve simultaneously the needs of both parties.[55]

IV. CLOSING REMARKS

The opening comments by Mark Brown aptly recognize the opportunities and risks of technological achievement for human development across the many different nations of the world.[56] Connected to one another in complex and reciprocal ways, the creation, diffusion, and utilization of technology and the quality of life of the citizenry will be closely aligned in the 21st century. Unfortunately, most nations and their people lack the resources, educational levels, and infrastructure necessary to partake in this global revolution. Thus, the UNDP[57] makes two summary recommendations in order to abridge the digital divide:

First, more public funding spent in new ways, with public policy motivating creative partnerships among public institutions, private industry, and nonprofit organizations. Second, a reassessment of the rules of the game and their implementation, ensuring that international mechanisms—from the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) to the allocation of domain names by the Internet Corporation for Assigned Names and Numbers—are not loaded against late comers or implemented to the disadvantage of those already behind.

The choice is clear and the message is familiar to the human rights community: a world that tolerates massive inequalities will continue to suffer great misery, but one that comes together for the greater good can build a better tomorrow for all.

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54. Correa, *supra* note 52.
55. UNDP, *supra* note 1.
56. Brown, *supra* note 1.
57. UNDP, *supra* note 1, at 95.