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Autonomous and Intelligent systems (A/IS) provide unique and impactful opportunities in the humanitarian space. As disruptive technologies, they promise to upend multiple historical institutions and corresponding institutional relationships, offering opportunities to "re-intermediate" those settings with more humanitarian and equitably focused structures.

The value of A/IS is significantly associated with the generation of superior and unique insights, many of which could help to foster the accomplishment of humanitarian and development goals and to achieve positive socio-economic outcomes for both developed and developing economies. Among the opportunities for cooperation and collaboration at the intersection of A/IS and humanitarian and development issues are the following:

A/IS have been recognized as key enablers for achieving the goals of humanitarian relief, human rights, and the United Nations Sustainable Development Goals. This recognition provides the opportunity to demonstrate the positive and supportive role that A/IS can play in these critical, but perennially under-resourced and overlooked, areas.

A/IS are related to, but hold a unique place within, the larger "ICT for development" narrative. This intersection creates opportunities for A/IS to be applied in settings where commercial and development agendas meet, and to facilitate advances in the administration and impact assessment of development programs.

There is an ongoing narrative on affordable and universal access to communications networks and the Internet which invites consideration of how the implementations and fruits of A/IS will be made available to populations.

The narrative of "A/IS for the common good" is starting to present itself in various settings. Key elements framing this "common good" conversation relate to the need for it to be human-centered and include the need for accountability and to ensure that outcomes are fair and inclusive.

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The scaling and use of A/IS represent a genuine opportunity to provide individuals and communities — be they rural, semi-urban, or cities — with greater autonomy and choice. A/IS will potentially disrupt all manner of economic, social, and political relationships and interactions. Those disruptions will provide a historical opportunity to re-establish those settings so that they are reflective of more updated and sustainable notions of autonomy and choice.

Many of the debates surrounding A/IS take place within advanced countries among individuals benefiting from adequate finances and higher-than-average living situations. It is imperative that all humans in any condition around the world are considered in the general development and application of these systems to avoid the risk of bias, excessive imbalances, classism, and general non-acceptance of these technologies.

In the absence of that comprehensive treatment, A/IS policy issues will be addressed piecemeal by different jurisdictions and in different sectors. In that context of "distributed policy making," a patchwork of policies and initiatives is the likely result, dissipating potential impact. However, some measure of "policy interoperability" can still be served if there is a common framing or policy generation process for analysis that can be shared across jurisdictions and/or sectors.

The use of A/IS in support of the pragmatic outcomes noted above is best framed within four key domains that comprise the following four sections: **economics, privacy and safety, education,** and **equal availability**. Each of these contexts presents unique challenges, attention to which can inform the trustworthy use of A/IS for the common good.

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Section 1 — Economics

While the increase of A/IS and its positive uses in society are undeniable, the financial gains from these technologies may favor certain sectors, and are not evenly distributed throughout populations where it is created or deployed. Likewise, while A/IS automation of certain human tasks may be beneficial by supplanting arduous jobs, how employment in aggregate for specific populations and job verticals will be affected by A/IS needs to be addressed.

Issue:

A/IS should contribute to achieving the UN Sustainable Development Goals.

Background

The contribution of A/IS to human and sustainable development in developing countries, and in particular extreme poverty eradication, is inherently connected with its contribution to human well-being in the developed world. In a globalizing society, one part of the world has a direct impact on another. With a growing level of interdependence between communities, the challenges and opportunities are truly global. Climate change, poverty, globalization, and technology are closely interconnected. Ethical commitment should entail a sense of global citizenship and of responsibility as members of humanity.

Beyond considering the humanitarian role of A/IS, there is a pressing need to address how these technologies can contribute to achieving the UN Sustainable Development Goals that concern eradicating poverty, illiteracy, gender and ethnic inequality, and combating the impact of climate change.

The inequality gap between the developed and the developing nations is disturbingly wide. With the introduction of hi-tech, the world had witnessed a considerable increase in the existing gap as the new market is dominated by products and services from this new sector. One of the factors contributing to this is the nature of the tech economy and its tendency to concentrate wealth in the hands of few. The tech economy is also susceptible to corporate aggregation.

We need to answer questions such as "How will developing nations implement A/IS via existing resources? Do the economics of developing nations allow for A/IS implementation? What should be the role of the public and the private sectors and society in designing, developing, implementing, and controlling A/IS? How can people without technical expertise maintain these systems?"

The risk of unemployment for developing countries is more serious than for developed countries. The industry of most developing

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countries is labor intensive. While labor may be cheap(er) in developing economies, the ripple effects will be felt much more than in the developed economies as more and more jobs will be gradually replaced along with the development of robots or A/IS.

As an example, in the manufacturing industry, lots of products such as mobile phones and clothes are designed in developed countries, but made in developing countries. Thus, it is not difficult to predict that the developing countries will be at greater risk of unemployment than developed countries if those manufacturing tasks can be replaced by machines. The challenge of unemployment is even bigger for developing countries than for developed countries, which can exacerbate the economic and power-structure differences between and within developed and developing nations.

Candidate Recommendations

The current panorama of applications of A/IS in sectors crucial to the UN Sustainable Development Goals should be studied, and the strengths, weaknesses, and potential of some of the most significant recent applications drawn from these sectors should be analyzed. *Specific areas to consider include:*

- Taking appropriate action to mitigate the gap. The private sector should integrate CSR (corporate social responsibility) at the core of development and marketing strategies and operations. Mitigating the social problems of technology development should be a special focus of responsible companies using A/IS.

- Developing mechanisms for increasing transparency of power structures and justly sharing the economic and knowledge acquisition benefits of robotics/A/IS.

- Facilitating robotics/A/IS research and development in developing nations.

- Empowering the education sector with advanced courses on A/IS is the first step toward creating a nation that can handle the new economic and power shifts.

- Investing in technology transfer will help developing nations reduce the gap.

- Adapting legal and policy frameworks which will help to favor equitable distribution of wealth, empowering competent international organizations to favor a minimally viable competition level on the A/IS markets to avoid detrimental monopolistic situations.

- Identifying A/IS technologies relevant to the UN Sustainable Development Goals such as big data for development (agriculture, medical tele-diagnosis), geographic information systems (disaster prevention, emergency planning), and control systems (naturalizing intelligent cities through energy and traffic control, management of urban agriculture).

- Developing guidelines and recommendations for the nurturing and implementation of these technologies in developing countries.

- Documenting and disseminating successful examples of good practice, and evaluations and conclusions of experiences.

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- Developing appropriate impact indices for the evaluation of A/IS technological interventions in developing countries from multiple perspectives.

Further Resources

- United Nations. "Sustainable Development Goals: 17 Goals to Transform Our World." September 25, 2015.

Issue:

It is unclear how developing nations can best implement A/IS via existing resources.

Background

Do the economics of developing nations allow for A/IS implementation? How can people without technical expertise maintain design specifications and procure these systems? The potential use of A/IS to create sustainable economic growth for LMICs (lower and middle income countries) is uniquely powerful. If A/IS capacity and governance problems are addressed, LMICs will have the ability to use A/IS to transform their economies and leapfrog into a new era of inclusive growth if a clear path for development is provided. Particular attention, however, should be paid to ensure that the use of A/IS for the common good — especially in the context of LMICs — does not reinforce existing socio-economic inequities.

Candidate Recommendations

- Develop mechanisms for increasing transparency of power structures and justly sharing the economic and knowledge acquisition benefits of A/IS.

- Facilitate A/IS research and development in developing nations. Ensure that representatives of developing nations are involved.

- Along with the use of A/IS, discussions related to identity, platforms, and blockchain are needed to ensure that all of the core enabling technologies are designed to meet the needs of LMICs.

Further Resources

- Ajakaiye, O., and M. S. Kimenyi. "Higher Education and Economic Development in Africa: Introduction and Overview." *Journal of African Economies* 20, no. 3 (2011): iii3–iii13.

- Bloom, D. E., D. Canning, and K. Chan. *Higher Education and Economic Development in Africa* (Vol. 102). Washington, DC: World Bank, 2006.

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- Dahlman, C. *Technology, Globalization, and Competitiveness: Challenges for Developing Countries. Industrialization in the 21st Century.* New York: United Nations, 2006.

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- Fong, M. Technology *Leapfrogging for Developing Countries. Encyclopedia of Information Science and Technology*, 2nd ed. Hershey, PA: IGI Global, 2009 (pp. 3707–3713).

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- Rotman, D. "How Technology Is Destroying Jobs." *MIT Technology Review*, June 12, 2013.

- McKinsey Global Institute. "Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy" (report), May 2013.

- Sauter, R., and J. Watson. "Technology Leapfrogging: A Review of the Evidence, A Report for DFID." Brighton, England: University of Sussex. October 3, 2008.

- "The Rich and the Rest." *The Economist.* October 13, 2012.

- "Wealth Without Workers, Workers Without Wealth." *The Economist*. October 4, 2014.

- World Bank. "Global Economic Prospects 2008: Technology Diffusion in the Developing World." Washington, DC: World Bank, 2008.

Issue:

The complexities of employment are being neglected regarding A/IS.

Background

Current attention on automation and employment tends to focus on the sheer number of jobs lost or gained. Other concerns include changes in traditional employment structures.

Candidate Recommendations

It is important to focus the analysis on how employment structures will be changed by automation and AI rather than on solely dwelling on the number of jobs that might be impacted. The analysis should focus on how current task content of jobs are changed based on a clear assessment of the automatibility of the occupational description of such jobs.

While there is evidence that robots and automation are taking jobs away in various sectors, a more balanced, granular, analytical, and objective treatment of this subject will more effectively help inform policy making. *Specifics to accomplish this include:*

- Create an international, independent agency which can properly disseminate objective statistics and inform media as well as the general public about the impact of robotics and A/IS on jobs and growth.

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- Consider both product and process innovation and look at it from a global perspective as a way to understand properly the global impact of A/IS on employment (refer to Pianta, 2009 and Vivarelli 2007).

- Focus the analysis on how employment structures will be changed by A/IS rather than on the number of jobs that might be impacted. The analysis should focus on how current task-content of jobs are changed based on a clear assessment of the automatibility of the occupational description of such jobs (refer to Bonin et al. 2015 and RockEU, 2016).

- Make sure workers can improve their adaptability to fast technological changes by providing them adequate training programs. Those training programs could be available to any worker with a special attention to low-skilled workforce members. Those programs can be private (sponsored by the employer) or public (offered freely through specific public channels and policies), and they should be open while the worker is in-between jobs or still employed.

- Ensure that not only the worker whose job is concerned benefits from training programs, but also any employee in the company so everyone has the chance to be up to speed with technical changes, even if one's job is not immediately concerned (not only *reaction* but also *prevention*). Thus it should be the responsibility of every company to increase its investment in the internal training of its workforce based on the profitability gains realized thanks to automation. The

public side could facilitate such initiatives with co-investment in the training programs through tax incentives.

Further Resources

- RockEU. "Robotics Coordination Action for Europe Report on Robotics and Employment," Deliverable D3.4.1, June 30, 2016.

- International Federation of Robotics. "The Impact of Robots on Productivity, Employment and Jobs," A positioning paper by the International Federation of Robotics, April 2017.

- Brynjolfsson, E., and A. McAfee. The *Second Age of Machine Intelligence: Work Progress and Prosperity in a Time of Brilliant Technologies.* New York: W. W. Norton & Company, 2014.

Issue:
Automation is often viewed only within market contexts.

Background

A/IS are expected to have an impact beyond market domains and business models. Examples of impact include safety, public health, and socio-political considerations of deploying A/IS. This impact will diffuse through the global society.

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Candidate Recommendation

To understand the impact of A/IS on society, it is necessary to consider both product and process innovation as well as wider implications from a global perspective.

Further Resources

- Pianta, M. *Innovation and Employment, Handbook of Innovation.* Oxford, U.K.: Oxford University Press, 2003.

- Vivarelli, M. "Innovation and Employment: A Survey," Institute for the Study of Labor (IZA) Discussion Paper No. 2621, February 2007.

Issue:

Technological change is happening too fast for existing methods of (re)training the workforce.

Background

The current pace of technological development will heavily influence changes in employment structure. In order to properly prepare the workforce for such evolution, actions should be proactive and not only reactive.

The wave of automation caused by the A/IS revolution will displace a very large amount of jobs across domains and value chains. The U.S. "automated vehicle" case study analyzed in the White House 2016 report *Artificial Intelligence, Automation, and the Economy* is emblematic of what's at stake: 2.2 to 3.1 million existing part- and full-time U.S. jobs are exposed over the next two decades, although the timeline remains uncertain. In particular, between 1.3 and 1.7 million heavy truck drivers are threatened. And this is not trivial, for the profession has symbolized in the collective imagination the manifestation of the American dream of empowerment, liberty, and social ascension whereby less-educated people could make it into the middle class.

The automation wave calls at least for higher investment and probably the need to reinvent active labor market programs in the coming decades. Such investment should logically be funded by fiscal policies targeting the capital. The 2016 White House report gave an interesting order of magnitude applied to the case of the United States: "increasing funding for job training in the U.S. by six-fold — which would match spending as a percentage of GDP to Germany, but still leave the U.S. far behind other European countries — would enable retraining of an additional 2.5 million people per year."

A/IS and other digital technologies offer real potential to innovate new approaches to job-search assistance, placement, and hiring processes in the age of personalized services. The efficiency of matching labor supply and demand can be tremendously enhanced by the rise of multi-sided platforms and predictive analytics. The case of platforms, such as LinkedIn for instance with its 470 million registered users, is interesting as an evolution in hiring practices.

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Tailored counseling and integrated re-training programs also represent promising grounds for innovation.

This, however, will not be enough. A lot will have to be done to create fair and effective life-long skill development/training infrastructure and mechanisms capable of empowering millions of people to viably transition jobs, sectors, and potentially geographies. A lot will also have to be done to address differential geographic impacts which exacerbate income and wealth disparities. Effectively enabling the workforce to be more mobile — physically, legally, and virtually — will be crucial. This implies systemic policy approaches which encompass housing, transportation, licensing, taxes, and, crucially in the age of A/IS, broadband access, especially in rural areas.

Candidate Recommendations

- To cope with the technological pace and ensuing progress of A/IS, it will be necessary for workers to improve their adaptability to rapid technological changes through adequate training programs provided to develop appropriate skillsets. Training programs should be available to any worker with special attention to the low-skilled workforce. Those programs can be private (sponsored by the employer) or public (offered freely through specific public channels and policies), and they should be open while the worker is in between jobs or still employed. Fallback strategies also need to be developed for those who cannot be re-trained.

- To lay solid foundations for the profound transformation outlined above, more research in at least three complementary areas is needed:

  - First, to devise mechanisms of dynamic mapping of tasks and occupations at risks of automation and associated employment volumes. This mapping of the workforce supply is needed at the macro, but also crucially at the micro, levels where labor market programs are deployed;

  - Integrated with that, more granular and dynamic mapping of the future jobs/tasks, workplace-structures, associated work-habits, and skill-base spurred by the A/IS revolution are also needed. This mapping of the demand side will be key to innovate, align, and synchronize skill development and training programs with future requirements.

  - More policy research on the dynamics of professional transitions in different labor market conditions is required.

- To maximize intended impact, create necessary space for trial-and-error strategies, and to scale up solutions that work, implement robust, data-driven evidence-based approaches. These approaches should be based on experiments and centered on outcomes in terms of employment but also in terms of earnings. New forms of people-

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public-private partnerships involving civil society as well as new outcome-oriented financial mechanisms (social impact bonds, for instance) that help scale up successful innovations should also be considered.

- The next generation of highly qualified personnel should be ready to close skills gaps and develop future workforces. New programs should be offered possibly earlier than high school, to increase access to employment in the future.

Further Resources

- Executive Office of the President. Artificial Intelligence, Automation, and the Economy. December 20, 2016.

- Kilcarr, S. "Defining the American Dream for Trucking … and the Nation, Too," *FleetOwner*, April 26, 2016.

- OECD, "Labor Market Programs: Expenditure and Participants," *OECD Employment and Labor Market Statistics* (database), 2016.

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Section 2 — Privacy and Safety

The growing volumes of private sector data (mobile phones, financial transactions, retail, logistics) hold unique promise in developing more robust and actionable disease-monitoring systems that can be empowered by A/IS. However, concerns related to privacy, the ability of individuals to opt out, the cross-border nature of data flows, and the political and commercial power dynamics of this data are the key factors to consider in how to most equitably shape this domain.

Issue:

There is a lack of access and understanding regarding personal information.

Background

How to handle privacy and safety issues, especially as they apply to data in humanitarian and development contexts? Urgent issues around individual consent, potential privacy breaches, and potential for harm or discrimination regarding individual's personal data require attention and standardized approaches.

This is especially true with populations that are recently online, or lacking a good understanding of data use and the ambiguities of data "ownership," privacy, and how their digital access generates personal data by-products used by third parties.

According to the GSMA, the number of mobile Internet users in the developing world will double from 1.5 billion in 2013 to 3 billion by 2020, rising from 25% of the developing world population to 45% over the period. In Sub-Saharan Africa, just 17% of the population were mobile Internet subscribers in 2013, but penetration is forecast to increase to 37% by 2020—making the generation, storage, use, and sharing of personal data in the developing world an issue that will continue to gain gravity.

In the humanitarian sector, digital technologies have streamlined data collection and data sharing, frequently enabling improved outcomes. With a focus on rights and dignity of the populations served, practitioners and agencies have advocated for more data sharing and open data in the social good sector. Timely access to public, social sector, and private data will speed response, avoid collection duplications, and provide a more comprehensive summary of a situation, based on multiple data streams and a wider range of indicators.

However, there are inherent risks when multiple sources of data are overlaid and combined to gain insights, as vulnerable groups or individuals can be inadvertently identified in the process. The privacy threat is the most discussed risk: When is informed consent or opt-in really ethical and effective? Best practices remain an unresolved issue among practitioners when working with communities with fewer resources, low literacy, lower connectivity, and less understanding about digital privacy.

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The "do no harm" principle is practiced in emergency and conflict situations. Humanitarian responders have a responsibility to educate the populations about what will happen with their data in general, and what might happen if it is shared openly; there is often lack of clarity around how these decisions are currently being made and by whom. Remedial steps should include community education regarding digital privacy, as well as helping vulnerable groups become more savvy digital citizens.

There are perception gaps regarding what constitutes potential and actual harm stemming from data use practices. A collaborative consensus across sectors is needed on safeguarding against risks in data collection, sharing, and analysis — particularly of combined sets. From the outset, iterative, ethics-based approaches addressing data risk and privacy are key to identify and mitigate risks, informing better action and decision-making in the process.

Candidate Recommendation

Frameworks such as Privacy by Design can guide the process of identifying appropriate system and software requirements in early stages of design. Such frameworks also encourage proactive examination of harms and risks, seek to engage the data subject (e.g., consumer, user, stakeholders) in the design of the software, and recommend best practices and regulatory requirements (such as data minimization, accountability, transparency, options such as opt-in, opt-out, encryption) to be embedded into the system. *In addition:*

- Best practices such as Privacy Impact Assessments will assist with identification of data misuse cases at early stages of system/software design.

- Improving digital literacy of citizens should be a high priority for the government and other organizations.

- Governments should enforce transparency related to data collection, data ownership, data stewardship, and data usage and disclosure.

- Organizations should be held accountable for data misuse, financial loss, and harm to the reputation of the data object if data is mishandled. This requires that organizations have appropriate policies and agreements in place, that terms and conditions of the agreements are clearly communicated with the data object and that data misuse cases and legitimate use cases are well-defined in advance.

Further Resources

- For more on responsible data use, please see the section "Personal Data and Individual Access Control."

- For more on responsible data use, see the Responsible Development Data Book. Oxfam also has a responsible data policy that provides a field-tested reference.

- Example Use Case from GSMA: When Call Data Records (CDRs) are used to help in the response to the Ebola outbreak, mobile operators wish to ensure mobile users' privacy is respected and protected and associated risks are addressed.

- van Rest J., D. Boonstra, M. Everts, M. van Rijn, R. van Paassen. "Designing Privacy-by-Design," in *Privacy Technologies and Policy,* edited by B. Preneel, and D. Ikonomou. Lecture Notes in Computer Science, vol. 8319. Berlin, Germany: Springer, 2012.

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Section 3 — Education

It is essential to increase the awareness, critical understanding, and attitudinal values of undergraduate and postgraduate students related to sustainable human development and its relationship with A/IS, so that they are prepared to assume their responsibilities in the solution of the current global social crises. Current and future leaders should be educated in macro-ethics and not only in micro-ethics.

Shared narratives, generated by awareness, education, and standard evaluative models are the best pathway to generating the global support necessary to meet these challenges. Programs fostering awareness, education, and analytical and governance models should address the opportunities and risks of A/IS in development contexts.

Issue:

How best to incorporate the "global dimension of engineering" approach in undergraduate and postgraduate education in A/IS.

Background

A/IS presents a unique opportunity for narrative and policy construction in educational institutions. Where norms exist, they are taught in schools. Thus, physics majors learn the "standard" theories and equations of physics.

The same is true in other disciplines. However, where standards are either absent or in the process of development in a sector, what is most appropriately included in undergraduate and graduate curriculum is less clear. That is the case for a number of areas in the digital world, including A/IS. Thus, educators and other parties involved in curriculum development should consider the opportunity to craft curricula that will make their students aware of this absence of standards, and also encourage the exploration of various practices as candidates for "best practices" and their possible further elevation to standards in AI technology and policy.

Candidate Recommendations

The understanding of the global dimension of engineering practice should be embedded in A/IS curricula. *Specifically:*

- Curriculum/core competencies should be defined and preparation of course-material repositories and choice of the most adequate pedagogical approaches should be established.

- The potential of A/IS applications should be emphasized in undergraduate and graduate programs specifically aimed at engineering in international development and humanitarian relief contexts as well as in the training programs preparing technical professionals for work in the international development and humanitarian sectors.

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- Increased awareness on the opportunities and risks faced by Lower Middle Income Countries (LMICs) in the use of A/IS for sustainable development and humanitarian purposes is critical. Ignoring these opportunities and risks will further divide the opportunities for development across the globe. A/IS presents an opportunity to potentially reduce these differentials that ultimately strain social fabric and economic systems.

Further Resource

- Global Dimension in Engineering Education Project (GDEE).

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Section 4 — Equal Availability

For A/IS to be adopted in an atmosphere of trust and safety, greater efforts must be undertaken to increase availability of these resources.

Issue:

AI and autonomous technologies are not equally available worldwide.

Background

Equitable distribution of the benefits of A/IS technology worldwide should be prioritized. Training, education, and opportunities in A/IS worldwide should be provided particularly with respect to underdeveloped nations.

Candidate Recommendations

Working with appropriate organizations (e.g., the United Nations) stakeholders from a cross-sectional combination of government, corporate, and non-governmental organization (NGO) communities should:

1. Engage in discussions regarding effective A/IS education and training.

2. Encourage global standardization/ harmonization and open source software for A/IS.

3. Promote distribution of knowledge and wealth generated by the latest A/IS, including formal financial mechanisms (such as taxation or donations to effect such equity worldwide).

4. International organizations, government bodies, universities, and research institutes should promote research into A/IS technologies that are readily available in developing countries, for example, mobile lightweight A/IS applications (taking advantage of the widespread use of increasingly affordable Internet-enabled phones in developing contexts) and culture-aware systems.

5. National and international development cooperation agencies and NGOs should draw attention to the potential role of A/IS in human and sustainable development.

Further Resources

- Hazeltine, B., and C. Bull. *Appropriate Technology: Tools, Choices, and Implications.* New York: Academic Press, 1999.

- Akubue, A. "Appropriate Technology for Socioeconomic Development in Third World Countries." *The Journal of Technology Studies* 26, no. 1 (2000): 33–43.