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Grand Societal Challenges in Information Systems Research and Education

Ideas from the ERCIS Virtual Seminar Series

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Foreword

In the 1980s, the United States tackled the rise of Japanese computer research, particularly their "5th Generation Computer," by introducing "Grand Challenges." Engineers and scientists were called to action to address particular challenges to keep the Unites States' competitive advantage. These Grand Challenges were revised by the National Science Foundation in 2009 but have remained largely the same over time.[1]

Grand Challenges are defined for disciplines (like information and communication technology[2] and health[3]) and for regions (like Canada[4] and South Africa[5]). The White House provides the several attributes that Grand Challenges feature[6]:

- They help create the industries and jobs of the future.
- They expand the frontiers of human knowledge about ourselves and the world around us.
- They help to address important problems related to energy, health, education, the environment, national security, and global development.
- They serve as a "North Star" for collaboration between the public and private sectors.

Grand Challenges for the information systems (IS) discipline are not new: Key issues in management information systems were published in 1984 (Dickson et al.), 1987 (Brancheau and Wetherbe), 1990 (Niederman et al.), and 1996 (Brancheau et al.) in *Management Information Systems Quarterly* (*MISQ*). In 2006 the topic of Grand Challenges in IS was reprised at a panel discussion at the European Conference on Information Systems (ECIS) in Göteborg, Sweden, was

[1] http://www.nsf.gov/cise/aci/taskforces/TaskForceReport_GrandChallenges.pdf.

[2] http://www.futurict.eu/.

[3] http://www.grandchallenges.org.

[4] http://www.grandchallenges.ca.

[5] http://www.gov.za/documents/download.php?f=104227.

[6] http://www.whitehouse.gov/administration/eop/ostp/grand-challenges.

repeated in 2011 at the International Conference on Information Systems (ICIS) in Shanghai, and is now gaining new momentum.

The Millennium Project is an independent and ongoing effort (http://www.millennium-project.org) that addresses 15 global challenges society faces today that cannot be solved by individuals in the short term. Prominent examples of the 15 challenges include how everyone on the planet can have sufficient clean water and a decent education. The dimensions of such challenges indicate that the IS discipline alone cannot solve the challenges, just as other disciplines cannot solve them alone. Solutions call for transdisciplinary and interdisciplinary efforts to which diverse disciplines must contribute.

It is our firm belief that IS can play a major role in contributing to solutions to grand societal challenges. Focusing on environmental challenges, researchers like Richard T. Watson (Watson et al. 2010), Nigel Melville (2010), and Steve Elliot (2011) advocate that the IS discipline has both the responsibility and the historic chance to demonstrate societal value by contributing to solutions that lessen the negative environmental effects of people's behavior. For example, the field of energy informatics has been established (Watson and Boudreau 2011) to investigate the design and use of information systems to improve energy efficiency through sensor networks in both businesses and private lives. Seidel et al. (2013) show that information systems can play a major role in facilitating sustainability transformations in organizations of various types. A recent call from vom Brocke et al. (2013) presents directives for IS research to leverage this position in contributing to grand societal challenges.

In keeping with the spirit of IS as a science of solutions to grand societal challenges, the European Research Center for Information Systems' (ERCIS) headquarters in Münster, Germany, and the ERCIS partner at the University of Liechtenstein have jointly organized a seminar series in which students are invited to provide their thoughts on how IS can contribute to the 15 societal challenges identified by the Millennium Project. The course has been offered over 3 years and has involved students from more than 30 nations. The course creates virtual multinational teams, and each of these teams is given the task of envisioning the role IS could play in contributing to a selected challenge. The Association for Information Systems (AIS) gave the course the AIS Award for Innovation in Teaching at the International Conference on Information Systems 2013 in Milan (ICIS 2013).

The students from the winter term 2011/2012 decided to continue working on their papers after the course was over, and each paper underwent a substantive review by colleagues. This book compiles the best papers from this course to stimulate further contributions of this kind. Dominik Heddier and Agata Materek collaborate on how IS can contribute to environmental sustainability, considering eco-efficiency, eco-equity, and eco-effectiveness. Dominic Steffen and Rajesh Srinivasan deal with the exponential growth of the human population and ask how IS can be used to align the global resources with the growing demand. Adrian Dolensky and Stefan Laube discuss e-participation as a way to make policymaking more sensitive to long-term global perspectives. How the benefits of ICT, which is ubiquitous in some parts of the world but all but absent in others, can be made available to everyone is the topic of Tomal K Ganguly and Klaus Fleerkötter's paper.

How decision support systems, key elements of IS research, can be used to improve the capacity to decide as the nature of work and institutions change is discussed by Marina Maschler and Asin Tavakoli. Manuela Weiss and Ekaterina Tarchinskaya discuss how IT can support changing the status of women around the globe, especially in the STEM field (Science, Technology, Engineering, and Mathematics), where the underrepresentation of women in the workforce can have negative effects on the efficiency and quality of the work. Nadine Székely explains how IS can support law enforcement officials in fighting "the dark side" as industrialization and the appearance of the Internet provide companies and individuals, including those in organized crime, with means to communicate and synchronize in real-time. Stefan Debortoli addresses the growing demand for energy as we move away from fossil fuels and seek to reduce power consumption, while governments invest increasing amounts of money in alternative green energy. Sandro Weber sketches out how IS can accelerate the diffusion of these ideas and innovations into practice. Finally, Nebojsa Milic and Krzysztof Oleszkiewicz take a look at the ethical difficulties global decisions bring to a world with more than 7.2 billion people and how IS can contribute to resolving them.

Although we reviewed and supervised the work, we kept the papers as original student papers and did not edit them ourselves. We want to acknowledge the effort our students have put into their tasks and also hope to illustrate the contribution we all can make as we start to think about how IS can contribute to solving grand societal challenges through IS research and practice. We hope you will feel as inspired as we do!

Our thanks go to all contributors for their effort and enthusiasm in working on this exciting and important topic. In particular, we recognize all of the supervisors of our seminar: Katrin Bergener, Elena Gorbacheva, Marcel Heddier, Andrea Herbst, Marco de Marco, Oliver Mueller, Stefan Seidel, Alexander Simons, Paolo Spagnoletti, and Theresa Schmiedel.

If you would like to get involved in a future seminar, we encourage you to visit our website at http://virtual-seminar.ercis.org.

Vaduz, Liechtenstein, July 2014 — Jan vom Brocke
Münster, Germany — Armin Stein
Münster, Germany — Sara Hofmann
Vaduz, Liechtenstein — Sanja Tumbas

References

Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly*, 34(1), 23–38.

Melville, N. (2010). Information systems innovation for environmental sustainability. *Management Information Systems Quarterly*, 34(1), 1–21.

Elliot, S. (2011). Transdisciplinary perspectives on environmental sustainability: A resource base and framework for IT-enabled business transformation. *MIS Quarterly*, 35(1), 1–13.

Watson, R. T., Boudreau, M.-C., Chen, A. J., & Sepúlveda, H. H. (2011). Green projects: An information drives analysis of four cases. *The Journal of Strategic Information Systems*, 20(1), 55–62.

Seidel, S., Recker, J., & vom Brocke, J. (2013). Sensemaking and Sustainable Practicing: Functional Affordances of Information Systems in Green Transformations. *MIS Quarterly*, 37(4), 1275–1299.

vom Brocke, J., Watson, R., Dwyer, C., Elliot, S., & Melville, N. (2013). Green Information Systems: Directives for the IS Discipline. *Communications of the Association for Information Systems (CAIS)*, 33(30), 509–520.

Preface

The primary concern of Information Systems (IS) research and education has been effective development and implementation of business IS. Without creating adequate benefits to business, investment in IS cannot be justified. However, as the Internet and smart phone technologies have proliferated and ERP has become standardized, the primary platform of IS is no longer internal business systems. It has become inevitable to research the societal impact of the global IS platform, and the term "IS" becomes to imply an "Information Society."

The benefits of IS have increased as the speed and capacity of information technology (IT) have increased, but the growth of IT's benefits has become marginal while the impact of malicious side effects have become more serious, potentially catastrophic and global. Therefore, it has become essential to change gears in IS research and education to pay special attention to establishing a fundamental foundation for sustainable progress.

First of all, IS should solve the problems it has caused, such as transnational cyber-crimes and cyber-terror like that Sony Pictures recently experienced. To identify the seriousness of IS's dark side and to develop preventive solutions, the Council of Association of Information Systems (AIS) has adopted the ICT-enabled Bright Society Initiative as a Grand Vision Project (in brief, the Bright ICT Initiative).

The key issues of the Bright ICT Initiative are related to the key global challenges, so the fifteen global challenges identified by the Millennium Project serve as a foundation for the Bright ICT investigation. Energy shortage and climate change are among these global challenges, and we must determine how IS can help to mitigate and adapt to climate changes. Next, the effect of IS on education and healthcare, particularly in underdeveloped regions, can be profound, and IT availability can be the platform of survival of people. We must also understand the impact of IS on employment and how it changes the nature of work in both developed and developing countries.

This book provides excellent discussions on these important issues.

2015–2016

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Chair Professor at Korea Advanced
Institute of Science and Technology
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Chapter 1
How Can Sustainable Development Be Achieved for All While Addressing Global Climate Change?

Dominik Heddier and Agatha Materek

1.1 Introduction

According to the United Nations Millennium Project, unsustainable growth may be the greatest threat to the future of humanity since the danger of nuclear annihilation during the Cold War (Glenn 2001). The Millennium Project revealed that in May 2011 the atmospheric CO_2 was the highest it had been in at least two million years. Since environmental sustainability is one of today's most important public issues (Dick and Kuo 2009), There has been increasing discussion about the role of information systems (IS), which has transformed the nature of businesses and improved the environmental performance of the organizations that are now under increasing pressure to implement sustainable practices (Dick and Kuo 2009). For instance, software is a critical enabling technology in nearly all aspects of climate change, from the computational models used to increase awareness of the impacts of society's activities on climate to the IS required to establish an effective carbon-neutral society (Easterbrook 2010). However, IS and IT have also contributed to organizations' environmental degradation. In order to counteract this development, the area of Green IT, which uses IS and IT to improve environmental performance, has emerged (Dick and Kuo 2009). In the IT industry, major hardware companies emphasize reusability and elimination of toxic chemicals through environmentally friendly designs, while IT service companies offer Green IT consultation to clients. So far, less attention has been paid to the potential of IT to enable environmental gains in the broad economy (Dedrick 2010).

Our research question is "How can IS contribute to environmental sustainability?" This paper is based on a comprehensive literature review and structured along a conceptual model that consists of three milestones of environmental sustainability: eco-efficiency, eco-equity, and eco-effectiveness (Chen et al. 2008).

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1.2 Literature Review

1.2.1 Research Methodology

We conducted a thorough literature review based on Vom Brocke et al. (2009) literature analysis framework. Our focus was on articles that deal with methods and concepts for which IS is either the source of or the solution to environmental sustainability problems. We scanned the 125 papers that matched our search criteria to verify that they matched the defined scope and conducted a forward and backward search, resulting in 34 relevant papers that we then synthesized and structured in the concept-driven framework (Webster and Watson 2002).

1.2.2 Literature Analysis and Synthesis

We use Dyllick and Hockerts' (2002) concept model to analyse the relevant articles. They identify three goals of sustainability: *eco-efficiency*, *eco-equity*, and *eco-effectiveness*. The three dimensions serve as a common framework by which to identify and organize the IS concepts that contribute to environmental sustainability. (Compare, e.g., Chen et al. 2008; Schmidt et al. 2009; Jenkin et al. 2011).

Eco-efficiency is achieved "by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's carrying capacity" (Dyllick and Hockerts 2002). Literally, then, efficiency means "doing more with less" (Chen et al. 2008).

Eco-equity describes the relationship between business and society (Dyllick and Hockerts 2002) that needs to be incorporated into the organizational value system in order to increase the number of organizations that follow eco-friendly strategies and processes, even in the absence of cost-efficiency (Chen et al. 2008). It refers to the "equity between peoples and generations and, in particular, the equal rights of all peoples to environmental resources" (Gray and Bebbington 2000).

Eco-effectiveness "aims to stop contamination and depletion, instead of only slowing down their speed, by directing individual and organizational attention to the underlying and fundamental factors of environmental problems and to make possible long-term prosperity through a fundamental redesign of the system" (Chen et al. 2008). Eco-effectiveness refers to increasing output with fewer natural resources consumed, improving Earth's health, and reducing greenhouse gases (Melville 2010).

1.2.3 IS Concepts Related to Eco-efficiency

Optimization Technologies. The huge information-processing capabilities of IS can be used to find optimal solutions to a wide range of problems. Energy savings—and, thus, reductions in carbon emissions—can be achieved by optimizing the

design and execution of operational processes. Production and maintenance optimization systems are popular examples in this area (International Telecommunication Union 2007; Hasan et al. 2009). Sbihi and Eglese (2009) elaborate on how optimization techniques from the operations research field, supported by real time IS, can help to achieve green logistic processes.

Intelligent Transport Systems (*also related to eco-effectiveness*). According to the World Resources Institute (2011), the transportation sector is responsible for 13.5 % of global greenhouse gas emissions. Most IS solutions in these fields are referred to as "Intelligent Transport Systems". An example is the smart parking applications that direct drivers to empty parking spaces, preventing long searches that use up unnecessary fuel and time. Dashboard displays can also be used to inform drivers about their fuel efficiency, prompting them to improve it (Deakin et al. 2009).

Emissions Trading Systems. Many countries ratified the directives of the Kyoto Protocol with market-based mechanisms for active trade of carbon emission certificates. A fixed amount of emission allowances forces CO_2 producers to reduce their emissions or buy costly allowances from the market (Department of Energy and Climate Change 2011; Melville 2010). An efficient and effective carbon market is a key element of a successful global climate regime (Bell and Drexhage 2005). IS can help by connecting local markets, leading to more efficient implementation of carbon emission limits and a reduction in carbon production.

Early-warning and Mitigation Systems (*also related to eco-equity*). Predicting likely losses after natural disasters like tsunamis, earthquakes, and volcanic eruptions requires immense calculating power, which is possible only with appropriate IS. Simulation, which uses historical data and correlations of variables, is a possible solution to this complex problem. Using a combination of historical data, such as probabilities and simulated events, and a policy strategy, it is possible to evaluate the damage and estimate the economic consequences of a particular hazard strategy (International Telecommunication Union 2007).

Decision Support Tools. Decision-makers around the world need to balance climate-related targets with other social, economic, and environmental goals (Burger et al. 2009; Lindseth 2004; Schreurs 2008). Decision-support tools like carbon accounting calculate carbon emissions and are already used for regulatory and corporate decision-making (Easterbrook 2010). Most concepts improve the decision-making process by using, for example, simulations, optimization methods, climate prediction and modelling systems, and intelligent transport systems.

Virtual Conferencing and Collaborating (*also related to eco-effectiveness*). Travelling (e.g., to meetings) has a significant carbon footprint. Information and communication technology (ICT) supports a relatively pollution-free virtual space for an extensive range of activities (Hasan et al. 2009). Potential IT solutions include teleconferencing, telecommuting, the virtual office, and group decision-support systems. Every per cent decrease in business travel that results from video- and audio-conferencing saves around a million tons of CO_2 emissions annually (International Telecommunication Union 2007).

Going Paperless (*also related to eco-effectiveness*). ICT has greatly decreased the use of paper in many areas. Paperless processing methods like e-business,

e-books, and online surveys (Hasan et al. 2009) help businesses to lower their carbon footprints by reducing the amount of paper used in daily operations and decreasing the need for physical storage space. Paperless processing enhances corporate sustainability practices and helps organizations to reach their corporate and environmental goals (Myers 2010).

1.2.4 IS Concepts Related to Eco-equity

Climate Modelling and Prediction. Climate modelling systems enhance the understanding of the climate system and aid in predicting future climates. A large array of modelling systems has been developed that often use highly sophisticated and complex models, challenging even the fastest speeds of the most powerful supercomputers (McGuffie and Henderson-Sellers 2001). The most common IS for climate modelling are global circulation models, which simulate the atmosphere, cryosphere, biosphere, and oceans to study the processes of climate change on a global scale and make projections (Easterbrook 2010).

Climate Data Collection and Remote Monitoring. Polar ice caps, glaciers, volcanoes, the ocean, and the atmosphere are the typical locations for climate research, but they are also inhospitable to human life, so they require remote monitoring and data collection using, for instance, ICT-equipped sensors (telemetry). In the last two decades wildlife telemetry research using the technologies of, for example, satellite tracking and archival logging technologies has increased (Hart and Hyrenbach 2009). Other technologies, such as aerial photography, satellite imagery, grid technology, and global positioning by satellite (GPS), have been widely used to track the slow and long-term movement of glaciers. Without IS contribution climate data collection, analysis, and remote monitoring would not be possible.

Educational Software. Many types of educational software serve as educational material about the Earth, its climate, and climate change for schools, universities, and Internet users. In most cases, the software is free and downloadable from the Internet websites. Two examples of climate change software are SimClimat (Gama and Risi 2008) and Educational Global Climate Modelling (Educational Global Climate Monitoring 2012).

Collective Intelligence Tools. Organizations have adopted a new generation of web tools, such as social networking; sharing of photos, videos, tags, and bookmarks; and wiki-based editing, which are often referred to as collective intelligence tools (Convertino et al. 2010). They use crowd-sourcing techniques (e.g., Mechanical Turk, Wikipedia, and Yahoo Answers) to improve the quality of evidence and analysis in many areas, including environmental sustainability, development, and climate change (Easterbrook 2010). Collective intelligence tools support learning and development in the field of sustainability, but they also promote climate-related events and initiatives, such as flash mobs to call attention to climate change.

1.2.5 IS Concepts Related to Eco-effectiveness

Sustainable Design and Management of IS. While IS can support environmentally friendly design in other areas, the design and management of the IS themselves can have a considerable impact on the carbon footprint. Zhang et al. (2011) propose an environmentally driven strategic analysis approach in which the environmental aspects of any project are covered as a set of requirements in addition to the classic business objectives and concrete application scenarios. An approach by Watson et al. (2011) suggests replacing customer orientation in IS design with innovation orientation based on a framework of four innovation drives: ubiquity, uniqueness, unison, and universality. Following this "4U framework" in the design phase should increase the resulting IS's eco-friendly and sustainable properties.

Measuring Environmental Sustainability. One of the most important challenges for environmental sustainability is its correct measurement, which requires expertise in several fields. The principles of sustainability measurement, which elucidate accepted methods for managing measurement in practice, create the needed links between disciplines while help organizations protect the global environment (Corbett et al. 2011). IS provides a common knowledge base for the organizational evaluation of environmental performance. For instance, an enterprise resource planning system is a basis for sustainability assessment and reporting processes because it assists organizations with the collection, processing, and sharing of extensive environmental impact and performance data (Chen et al. 2010).

1.3 Discussion

The literature review highlights several opportunities for IS to have a positive impact on global climate change. In this chapter we discuss how these improvements stand in relation to other efforts and whether society is willing to put in the necessary effort to achieve any mentionable impact at all. We begin with the possible downsides of some of the approaches mentioned in the literature review.

The initiative to create a "paperless" office using IS for digital documents might reduce overall paper demand and prevent deforestation, but this approach can be hindered by national regulations concerning document storage and archiving. For example, German legislation requires companies to store documents like contracts and end results for up to 10 years in paper form (HGB § 257, 4).

The intelligent transport systems currently in use can help reduce driving time and, thus, the emission of CO_2 gas, but the implementation of these systems is costly, and the money it requires might be spent more effectively elsewhere. One example of a measure with a higher investment-impact ratio is the extinguishing of underground coal fires around the world. Stracher and Taylor (2004) point out that there are underground coal fires in northern China of huge dimensions that contribute 2–3 % to the annual global emission of atmospheric CO_2, and there are many more of those fires burning around the world.

The climate certificate trade has currently become effectively useless because governments have flooded the markets with certificates. Currently the emission allowance for 1 ton of CO_2 costs only 6.23 € (EEX 2012), while environmentalists estimate a price level of more than 30 € would be necessary for companies to want to invest in more eco-friendly methods (Spiegel 2011).

Besides the actual usefulness or economy of these approaches, there is also the problem of willingness to change current behaviour. Dedrick (2010) identifies several barriers to implementing Green IT initiatives: For most companies Green IT solutions are too expensive and have no visible business value. In addition, the lack of governmental incentives and business leadership on Green IT prevents many from committing resources to sustainable IT initiatives. The absence of the will to change current unsustainable behaviour is reflected in the decision of the UN Climate Conference in Durban to adopt a universal legal agreement on climate change no later than 2015 (UNFCCC 2012).

1.4 Research Agenda

Having in mind all the factors that limit positive impacts of IS on climate, there is still a broad research area to explore. First, in order to understand the effects of Green IS and IT, more accurate and comprehensive measures of environmental impacts must be developed (Jenkin et al. 2011), including new research methodologies and metrics (Melville 2010). IS researchers can indirectly contribute to the implementation of Green IS and IT by taking a wider view of the whole system and considering how organizations can optimize a set of decisions—such as those related to hardware selection, system architecture, data centre design and location, and insourcing versus outsourcing—to "optimize a combination of performance, cost, and GHG emissions" (Dedrick 2010).

Future research also needs to examine the dynamics of environmental orientation in organizations, which influences attitudes and the acceptance of carbon-reducing technologies. It should concentrate on absorptive capacity, organizational learning, and social marketing theories to support and align employees' environment-friendly attitudes and behaviours in order to initiate environmentally related changes (Jenkin et al. 2011). This area requires further research in order to clarify the relationship between social issues and technology (Hasan and Alony 2011).

Research is still needed on how to increase the utility, usability, and user acceptance of e-tools to reduce the use of paper (Hasan et al. 2009) and on processes for providing decision support, including the operation of networks and intermediaries between the manufacturers and users of information for decision support. This research should include consideration of the most effective channels and organizational structures that should be applied for delivering information for decision support, how such information can be prepared to fit into individual, organizational, and institutional decision routines, and the factors that determine whether potentially useful information is actually used. One of the most

challenging areas for further research concerns how to overcome barriers to the use of decision-relevant information (National Research Council 2010).

Another future research field is the impact of government policy on IT investment and the consequences for carbon productivity (Dedrick 2010).

1.5 Conclusion

Green IS encompasses a large area of research and practice, with many methods, perspectives and measures. This paper addressed how IS can prevent or mitigate climate change that is due to global warming and several application areas in which IS are used to cope with climate change. Table 1.1 presents an overview of the concepts discussed in the paper and their roles as contributors to dealing

Table 1.1 Overview of IS concepts contributing to sustainable development and mitigating climate change (Millennium Project Challenge 1)

Sub concept: eco-dimension	IT artifact	Role of IT
Eco-efficiency	Intelligent transport systems	Reducing ecological impacts and resources intensity through energy-efficient and decision-supporting technologies
	Optimization technologies	
	Emission trading systems	
	Decision support tools	
	Early warning and mitigation systems	
	Virtual conferencing and collaborating	
	Going paperless	
Eco-effectiveness	Sustainable design and management of information systems	Increasing output with fewer resources consumed
	Intelligent transport systems	Supporting better environmental performance
	Virtual conferencing and collaborating	
	Going paperless	
	Environmental sustainability measures	
Eco-equity	Climate prediction and modeling	Providing comprehensive climate information chain
	Climate data collection and remote monitoring	Reducing risks of wealth losses and assuring sustainable development
	Early-warning and mitigation systems	Increasing awareness about climate change and environmental sustainability
	Educational software	
	Collective intelligence tools	

with the challenge of how sustainable development can be achieved for all while addressing global climate change using IS.

The concepts listed in Table 1.1 are only a fraction of the ways IS can contribute to the overlying challenge of climate change. The biggest challenge now is to convince humanity to make use of this huge potential.

References

Bell, W., & Drexhage, J. (2005). *Climate change and the international carbon market*. Winnipeg, Canada: International Institute for Sustainable Development.

Burger, N., Ecola, L., Light, T., & Toman, M. (2009). *Evaluating options for U.S. greenhouse-gas mitigation using multiple criteria*. Santa Monica, CA: RAND Corporation.

Chen, A. J. W., Boudreau, M.-C., & Watson, R. T. (2008). Information systems and ecological sustainability. *Journal of Systems and Information Technology, 10*(3), 186–201.

Chen, A. J., Watson, R. T., Boudreau, M. C., & Karahanna, E. (2010). An institutional perspective on the adoption of green IS. *Australasian Journal of Information Systems, 17*(1), 23–45.

Convertino, G., Grasso, A., Dimicco, J., Michelis, G. D., & Chi, E. H. (2010). Collective intelligence in organizations: Toward a research agenda. *Proceedings of ACM Conference on Computer Supported Cooperative Work* (pp. 613–614).

Corbett, J., Webster, J., Boudreau, M. C., & Watson, R. (2011). *Defining the role for information systems in environmental sustainability measurement*. Working Papers on Information Systems.

Deakin, E., Frick, T. K., & Skabardonis, A. (2009). Intelligent transport systems. *Access, 34*(1), 29–34.

Dedrick, J. (2010). Green IS: Concepts and issues for information systems research. *Communications of the Association for Information Systems, 27*(1), 143–185.

Department of Energy and Climate Change. (2011). *EU emissions trading system*. Retrieved April 01, 2012, from http://www.decc.gov.uk/en/content/cms/emissions/eu_ets/eu_ets.aspx.

Dick, G. N., & Kuo, B. N. (2009). The greening of organisational IT: What makes a difference? *Australasian Journal of Information Systems, 16*(2), 81–92.

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment, 11*(2), 130–141.

Easterbrook, S. M. (2010). Climate change: A grand software challenge. *Proceedings of the FSE/SDP Workshop on Future of software Engineering Research* (pp. 99–104).

Educational Global Climate Monitoring. (2012). *Global climate model* (*GCM*). Retrieved January 01, 2012, from http://edgcm.columbia.edu/.

EEX. (2012). *EU emission allowances, preise und handelsvolumen*. Retrieved April 01, 2012, from http://www.eex.com/de/Marktdaten/Handelsdaten/Emissionsrechte/EU%20Emission%20Allowances%20%7C%20Spotmarkt.

Gama, N., & Risi, C. (2008). *SimClimat: An educational software to simulate the climate*. Retrieved January, 2012, from http://www.lmd.jussieu.fr/~crlmd/simclimat/index_english.html.

Glenn, J. (2001). The millennium project: Challenges we face at the millennium. *Technological Forecasting and Social Change, 66*(2–3), 129–312.

Gray, R. H. & Bebbington, J. (2000): Environmental accounting, managerialism and sustainability: Is the planet safe in the hands of business and accounting? In: Advances in Environmental Accounting & Management. 1, p. 1–44.

Hart, K., & Hyrenbach, K. (2009). Satellite telemetry of marine megavertebrates: The coming of age of an experimental science. *Endangered Species Research, 10*, 9–20.

Hasan, H. M. & Alony, I. (2011): Suggesting a practical agenda for Green IS - Recent solutions within aframework of efficiency, information, and effectiveness. In N. Geri & Y. M. Kalman (Eds.), Proceedings of the 5th Israel Association for Information Systems (ILAIS) Conference (pp. 25–30).

Hasan, H., Ghose, A., & Spedding, T. (2009). IS solution for the global environmental challenge: An Australian initiative. *Proceedings of the Americas Conference on Information Systems* (*AMCIS*), San Francisco.

International Telecommunication Union. (2007). ICT s and Climate Change. Tech. Report. Jenkin, T. A., McShane, L., & Webster, J. (2011). Green information technologies and systems: Employees' perceptions of organizational practices. *Business and Society, 50*(2), 266–314.

Jenkin, T. A., Webster, J., & McShane, L. (2011). An agenda for "Green" information technology and systems research. *Information and Organization*, *21*(1), 17–40. Elsevier Ltd.

Lindseth, G. (2004). The cities for climate protection campaign (CCPC) and the framing of local climate policy. *Local Environment, 9*(4), 325–336.

McGuffie, K., & Henderson-Sellers, A. (2001). Forty years of numerical climate modeling. *International Journal of Climatology, 21*(9), 1067–1109.

Melville, N. (2010). Information systems innovation for environmental sustainability. *Management Information Systems Quarterly, 34*(1), 1–21.

Myers, R. (2010). *Going Paperless*. Retrieved May 02, 2012, from http://gettheinsideedge.com/cashmanagement/articles/going-paperless-randy-myers.aspx.

National Research Council. (2010). *America's climate choices. Panel on advancing the science on climate change.*. Washington DC: National Academy of Sciences.

Sbihi, A., & Eglese, R. W. (2009). Combinatorial optimization and green logistics. *Annals of Operations Research, 175*(1), 159–175.

Schmidt, N., Erek, K., Kolbe, L., & Zarnekow, R. (2009). Towards a procedural model for sustainable information systems management. *HICSS'09 42nd Hawaii International Conference on System Sciences* (pp. 1–10).

Schreurs, M. A. (2008). From the bottom up: Local and subnational climate change politics. *Journal of Environment & Development, 17*(4), 343–355.

Spiegel. (2011). *Schlapper Emissionshandel, Klimasünde zum Preis einer Pizza*. Retrieved April 1, 2012, from http://www.spiegel.de/wirtschaft/soziales/0,1518,802544,00.html.

Stracher, G., & Taylor, T.P. (2004). Coal fires burning out of control around the world: thermodynamic recipe for environmental catastrophe. *International Journal of Coal Geology, 59*(1–2), 7–17.

UNFCCC. (2012). *Durban Climate Change Conference—November/December 2011*. Retrieved April 1, 2012, from http://unfccc.int/meetings/durban_nov_2011/meeting.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut R., Cleven, A. et al. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search process. *Proceedings 17th European Conference on Information Systems 2009*, Verona.

Watson, R. T., Boudreau, M.-C., Chen, A. J., & Sepúlveda, H. H. (2011). Green projects: An information drives analysis of four cases. *The Journal of Strategic Information Systems, 20*(1), 55–62.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly 26*(2), xiii–xxiii.

World Resources Institute (WRI) in collaboration with United Nations Development Programme, United Nations Environment Programme, and World Bank. (2011). *World Resources 2010–2011: Decision Making in a Changing Climate - Adaptation Challenges and Choices*. Washington, DC: WRI.

Zhang, H., Liu, L., & Li, T. (2011). Designing IT systems according to environmental settings: A strategic analysis framework. *The Journal of Strategic Information Systems, 20*(1), 80–95.

Chapter 2
ICT-Applications to Align Global Resources with a Growing Population

Dominic Steffen and Rajesh Srinivasan

2.1 Introduction

More than 7 billion people populate the planet, and the UN (2012) projects that this number will rise to a staggering 9.4 billion or higher by 2050. Nearly a billion people are considered undernourished (FAO 2010), and sudden price spikes for food commodities in 2007 and 2008 alarmed the world (Piesse and Thirtle 2009; OECD/FAO 2011). Can we produce enough food to feed such a large number of people? It is imperative that we address this question.

In this context, information and communication technology (ICT) has transformed our way of life through innovations like personal computers, mobile telephony, the Internet, cloud computing, and social networks. Therefore, we look at the question from the perspective of Information Systems (IS) science and ask, "How can the application of ICT be used to align global resources with a growing population?" We performed a literature review to investigate how far and from which perspectives has this question been approached already.

This paper is organized as follows: The next section describes our literature review procedure. Then we analyse the underlying problem from the perspectives of demand and supply, introducing ICT applications that mitigate issues that arise from a growing population and investigating ICT applications that can help increase food production. As a result, we find that several types of ICT play a crucial role in: increasing the production efficiency and sustainability of agriculture, decision support, providing timely information about the market, geographical position and knowledge distribution.

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2.2 Literature Review

The best practice for conducting literature reviews is to document each step of the research process in order to demonstrate the methodology used so other researchers can recreate and replicate the process (vom Brocke et al. 2009; Webster and Watson 2002). With this process as a guiding principle, we discuss the research process for investigating our primary research question.

The paper addresses the question, "How can the application of ICT be used to align global resources with a growing population?" We began by investigating the underlying problem of food supply for a growing population, dividing the topic into supply and demand. For demand we concentrated on population-centric functions for growth and development, and for supply we concentrated on farmer-centric functions for resource growth. In the second stage of our research, we investigated how ICT could be applied to solving the underlying problem.

We used the academic search engines Business Source Premier, JSTOR, SpringerLink, and Google Scholar to find matches for the search query in titles, abstracts, keywords, and full texts. We performed searches using the search terms "population control", "population growth", "population growth food", "population ICT", "ICT agriculture", and "ICT food security". We assessed the first one hundred documents for relevance by analysing their titles and abstracts for a reference to indexing methodologies for population control and ICT (exact and approximate structure and substructure search). When this assessment was inconclusive, we analysed the full text. Articles that made no contribution to the problem were discarded.

2.3 The Challenge: Demand and Supply Side Perspective

Demand-side perspective. According to the most recent UN medium projections (UN 2012), the world's population will continue to grow at least until 2050, when the total number of people on the planet is expected to reach 9.4 billion, an increase of 2.4 billion over the 2011 population of 7 billion. Nearly all of this future growth will occur in the developing world—Africa, Asia (excluding Japan, Australia, and New Zealand), and Latin America—where the population is projected to increase from 4.5 to 8.2 billion between 1995 and 2050 (UN 2012).

In order to keep a balance between population and resource growth, each country must define population policies, defined as "deliberately constructed or modified institutional arrangements and/or specific programs through which governments influence, directly or indirectly, demographic change" (Demeney 2003). Malthus (1798) suggested solution was "to proportion the population to food, since the food could not be proportioned to population," but critics of this suggestion have argued that Malthus failed to foresee the potential technological improvements that would increase food production (Sen 1994). What's more, the nature of consumer demand is changing as consumers spend more, consume more, and have more choices than ever before. About 85 % of the increase in the global

demand for cereals and meat between 1995 and 2020 will occur in developing countries (Pinstrup-Andersen et al. 1999).

Supply-side perspective. About 925 million people in the world are undernourished (FAO 2010). In the short to medium term, high volatility in agricultural commodity markets are of major concern, as they have major implications for food security (OECD/FAO 2011). Price spikes in commodity markets occur as markets fail to match demand in the short term as a result of supply shocks like crop production shortfalls or unexpected surges in demand (OECD/FAO 2011). In the long term, a declining trend in global food production growth is expected (Trostle 2008; OECD/FAO 2011). While the global potential for agricultural production has been estimated to be sufficient to produce an affluent diet for 16–24 billion people (Koning 2008) or even more (Chalkley 1997), such a production level would be unsustainable. Pimentel et al. (1994) put the population limit under sustainable agricultural production at less than 2.

Land, water, nutrient resources (fertilizer), and energy are important input factors for agricultural production (OECD/FAO 2011; Koning 2008; Evans 2011). Drivers that have a direct impact on production efficiency include access to agricultural knowledge and advanced farming technologies (Koning 2008; Balaji and Meera 2007; OECD/FAO 2011), investment (OECD/FAO 2011; Koning 2008), access to markets and market information (Rao 2007; Singh 2006), and improved biotechnology (Chrispeels 2000; Serageldin 1999; Bruce 2011). Investment decisions and farmers' production targets are the result of profitability considerations, as higher prices increase farmers' desires to increase production, making investment in agriculture more profitable and, therefore, more available (Koning 2008).

2.4 Research Results

2.4.1 Demand Side

This section addresses population-centric functions and steps that can be taken to decrease population growth and inform the public about sustainable solutions and the need to make better decisions.

(**1**) ***ICT as a tool***. The main role of ICT is to enable communications and integrate technologies, enabling the user to create, access, store, and transmit information in the fields of economic and international development. The main function of ICT as a strategic tool for development is to facilitate access to and sharing of relevant information and knowledge. ICT strengthens the voices of poor, excluded, and disadvantaged groups and affects decision-making.

(**2**) ***Socially responsible functions***. As the population increases, a balance between the economy and the ecosystem is difficult to maintain. Socially responsibility benefits society at large through social economic development and poverty reduction. According to the demographic transition theory, rapid population growth happens in all societies at one time or another when improvements

in living conditions and health care lead to reduced death rates (Raleigh 1999). Economic growth also facilitates the reduction of poverty. The use of ICT in this function helps to create awareness and increase growth and development through improved decision-support systems.

(**3**) ***Universal healthcare functions***. Healthcare systems work on the principle of universal coverage for all members of society. When the composition of the population changes as a result of rapid growth, the needs of an increasing number of people of reproductive age must be met in order to enhance human potential and accelerate human achievement and development (Sachs and McArthur 2005). Meeting this need results in distribution of aid to future generations (e.g., maternal education and health in order to influence the well-being of the next generation and environmental sustainability) and the poor and disadvantaged segments of the population (e.g., addressing health inequalities and policies to improve the status of women) (Anand and Sen 2000).

(**4**) ***Environmental care functions***. With today's increasing human population, environmental changes and their costs have a pivotal role in growth and development. Changes to the ecosystem as a whole damage the environment in terms of climate, water shortages, deforestation, soil erosion, and decline in the level of biodiversity, so a slowing economy becomes inevitable. In addition, the rising danger of global warming from the ongoing greenhouse gas emissions is ever-increasing; according to most estimates, a rise in global temperature of four degrees Celsius is likely to occur during the twenty-first century (Knight 2010). What's more, deforestation not only adds to the CO_2 in the atmosphere but also destroys the plants and animals that occupy the ecosystem either permanently or temporarily.

2.4.2 Supply Side

Supply-side applications of ICT target production efficiency. We grouped applications that can improve production efficiency into two categories: Farmer-centric applications (points 1–3) and strategic applications (points 4–5).

(**1**) ***Knowledge distribution***. Sources of relevant knowledge for farmers are social and professional networks (Warren 2004; Rosskopf 2006), agricultural journals (Rosskopf 2006), private consultancy (Warren 2004; Rosskopf 2006), and public sector agricultural extension services (Richardson 2006; Munyua et al. 2008; Warren 2004; Rosskopf 2006). ICTs are a potentially convenient and efficient method of delivery of the knowledge contained in these sources (Warren 2004; Rosskopf 2006; Munyua et al. 2008). ICT-enabled knowledge distribution can take a number of forms. Time-tested methods of delivery are based on radio or television broadcasts of topics of relevance for the agricultural sector (Singh 2006), but knowledge can also be compiled into repositories and be distributed on static media like CDs and DVDs or made accessible through a website (Rao 2007;

Singh 2006; Munyua et al. 2008; Colle and Yonggong 2002; Flor 2002; Rosskopf 2006; Richardson 2006). Moreover, ICT-based systems can enable more interactive, less standardized queries in which farmers can send a query to an extension worker or agricultural expert (Singh 2006; Meera and Jhamtani 2004; Richardson 2006) using mobile text-message,[1] email,[2] telephone or VoIP,[3] website forms,[4] or in a video-conference[5] (Singh 2006; Balaji and Meera 2007; Rao 2007; Kumar 2005).

(**2**) ***Market information and access***. ICT-supported systems can connect farmers to markets efficiently (Rao 2007; Singh 2006) by providing accurate and timely market information on agricultural commodities and services that allow farmers to buy inputs and sell the outputs they produce (e-commerce) (Rao 2007). ICT can cut the transaction costs associated with information search (De Silva and Ratnadiwakara 2008), and the availability of market information empowers farmers against intermediaries through increased transparency (Singh 2006). E-commerce systems decrease costs for buyers and sellers by eliminating intermediaries and the costs attributed to them, increasing the profitability of the trades and the farmers' productivity as inputs become cheaper and outputs more profitable (Rao 2007). According to Rao (2007) and Singh (2006), another way e-commerce can benefit farmers is through demand aggregation, especially for rural, small-holder farmers who are not associated. Provision of market access to individual farmers may not be interesting to sellers of agricultural input because of the high cost and risk involved, but demand aggregation reduces risk and cost (). Therefore, e-commerce systems that provide demand aggregation connect farmers to input markets they could not access before and can increase their access to quality inputs at lower prices.

(**3**) ***Decision-support systems***. Decision-support systems enable farmers to make better, more informed decisions can lead to production-efficient use of input factors and increase production output (Newman and Lynch 2000). Fountas and Pederson (2005) described precision agriculture (PA) as a relatively recent farming technique that facilitates field management based on site-specific data, indicating targeted agricultural actions, such as fertilizer application or irrigation, on the subfield level. The main activities within the PA framework are data collection, data processing, and determination of quantities of input factors, so the benefits associated with PA are improved economic returns and a reduced environmental impact of farming activities. As the efficiency of inputs improves, a global benefit is realized as reduced use of inputs increases sustainability.

ICTs and other modern technologies, such as GPS, sensor systems (e.g., yield monitors, soil sensors) and automated application technologies, are important components of PA (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010).

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[1] e.g. RDA's AIS (Singh 2006).

[2] e.g. RDA's AIS (Singh 2006).

[3] e.g. Kisan Call Centers (Kumar 2005), Tamil Market (Plauché and Prabaker 2006).

[4] e.g. eChoupal (Singh 2006).

[5] e.g. n-logue (Rao 2007).

The system works through ongoing collection of data on soil composition (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010). Soil data can be collected by analysing soil samples in the lab, through locally deployed sensor systems, and remote sensing (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010). Another advantage of sensor systems, which can be deployed as networks, is the ability to produce real-time information (Panchard et al. 2007; Gebbers and Adamchuk 2010).

Another important sensor class, yield monitors installed in harvesting equipment (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010), analyse the quality of the output as it is harvested and relay the quality of the harvest with geographical information from GPS to facilitate input-output analyses (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010). PA software typically generates maps from the data (e.g., yield-maps, soil-composition maps); performs data filtering, statistical analysis, and record-keeping; and computes variable application rates (Fountas and Pedersen 2005; Gebbers and Adamchuk 2010). Farmers can retain the data and use the software locally, but some companies and government extension services have introduced Internet-based PA services that allow farmers to send data to a service provider who analyses the data and produces maps, application rates, and other agronomic recommendations (Fountas and Pedersen 2005).

(**4**) ***Agricultural research information systems***. Agricultural research information systems (ARIS) integrate and coordinate the flow of information and access to knowledge resources on scientific, technical, and research matters among national agricultural research institutions (Maru 2002). The benefits of a common information system in agricultural research, which are based on realised synergies, include improvements in research, management and coordination of research activities, access to information in national research institutions, and improved protection of intellectual property rights (Maru 2002). According to Singh (2006), a successful example is South Korea's Agricultural Information Service (AIS), developed and maintained by the country's Rural Development Administration (RDA), which connected and integrated South Korea's national institutes into a high-speed computer network. AIS supports researchers by providing a knowledge portal and facilitating interaction between researchers and agricultural experts, which results in an improved quality of research and facilitates collaborative projects. Farmers can access a database on agricultural technology information through a website or take Internet-based training courses. The system also connects farmers to researchers and experts through a customer-relationship-management system (CRMS), where farmers can consult experts using e-mail, mobile text-messages, or in virtual meeting rooms. AIS is a good example of an ARIS that supports and improves agricultural research and efficiently and quickly disseminates generated knowledge to users.

(**5**) ***Geographic information systems***. GIS are automated systems that capture, store, retrieve, analyse, and display geospatial data (Clarke et al. 1996; Flor 2002). GIS can be used to monitor the environmental sustainability of farming techniques, evaluate the efficiency of agricultural techniques, assess the state of food

security and vulnerabilities, and improve regional planning and crisis preparedness (Rao 2007; Stephenson 1997; Flor 2001). Data-gathering methods can range from crowd-sourced, distributed data-entry using mobile devices (Munyua et al. 2008; Arnquist 2009) to remote sensing.

The most important data sources are probably the data sets gathered in various institutions and organizations (Rao 2007), so access to the data and standardized formats to facilitate exchange are important issues (Rao 2007). GIS-based systems can be used to compile data on the use of input factors, farm management techniques, and output flows on the farm level, while aggregation of the data on a regional level allows the state of production and the efficiency of the farming techniques employed in a region to be assessed (Rao 2007). Another important area of use for GIS-based systems is in the assessment of food security vulnerability and crisis detection (Rao 2007; Stephenson 1997). Systems that help to identify potential risks and provide early warning allow policymakers to reduce vulnerabilities and plan a response to crises (Evans 2011).

On an international scale, the Food and Agriculture Organization of the UN and other international agencies operate and maintain a number GIS-based monitoring and early-warning systems (Rao 2007), the most important of which is probably the Global Information and Early Warning System on Food and Agriculture (GIEWS). Conceived and operated since 1975, it is the UN's major provider of information on food supply and demand (Food and Agriculture Organization n.d. 2011). The system continuously monitors food supply and demand in all countries, collecting and analysing information on global production of agricultural goods, stocks, food aid, and trade in agricultural commodities (Food and Agriculture Organization n.d.). The system uses this and other data to predict global food supply and demand and to calculate food import requirements.

2.5 Conclusion

Major changes in the global structure will follow as a consequence of population growth in the developing world, while the population of the developed countries will remain fairly stable. The essential question is whether the resources our planet provides can accommodate the growing number of people. When we last faced this problem, we had reached a production ceiling, but humankind was able to push the barrier further (Koning 2008). Since there is reason to believe that such a crisis may occur again, it is important to investigate how the application of ICT can mitigate the problems arising from a growing population by aligning resource consumption with rising demand.

We suggest that ICTs can support production growth in agriculture by providing farmers with access to knowledge on efficient production techniques and technologies and connecting them to agricultural experts. ICTs can also help farmers to use input factors efficiently and to optimize their production through information-driven decision-making.

Since access to the necessary technologies is expensive, and in the short-term bio-engineered crops and liberal uses of input factors may be better suited to increasing production quickly (Fountas and Pedersen 2005). However, with increasing factor costs and reduced hardware costs, information-driven decision-making will play an essential role in increasing the production efficiency and sustainability of agriculture in the future. ICT can be of strategic importance in improving agricultural research and streamlining the dissemination of generated knowledge to users. GIS-based solutions are already being used to monitor food security, evaluate production efficiency on a regional level, and provide early warning in order to detect and avert food security crises caused by unexpected shocks and improve reactions to crises.

All in all, ICTs, as catalysts of innovation, can play an important role in mitigating the problems that arise from an increasing demand for food and a production system that may have reached its limits of efficiency.

References

Anand, S., & Sen, A. (2000). Human development and economic sustainability. *World Development*, *28*, 2029–2049.

Arnquist, S. (2009). *In rural Africa, a fertile market for mobile phones*. New York Times.

Balaji, V., & Meera, S. (2007). ICT-enabled knowledge sharing in support of extension: Addressing the agrarian challenges of the developing world threatened by climate change, with a case. *E-Journal of SAT Agricultural*, *4*, 1–18.

Bruce, T. J. A. (2011). GM as a route for delivery of sustainable crop protection. *Journal of Experimental Botany*, *63*(2), 537–541.

Chalkley, K. (1997). Population growth and consumption. *Population Today, 25*(4), 4–5.

Chrispeels, M. J. (2000). Biotechnology and the poor. *Plant Physiology, 124*(1), 3–6.

Clarke, K. C., McLafferty, S. L., & Tempalski, B. J. (1996). On epidemiology and geographic information systems: a review and discussion of future directions. *Emerging Infectious Diseases, 2*(2), 85–92.

Colle, R. D., & Yonggong, L. (2002). ICT capacity-building for development and poverty alleviation, enhancing the role of agricultural universities in China. In *Third Asian Conference for Information Technology in Agriculture*, Oct 26 (pp. 67–74).

De Silva, H., & Ratnadiwakara, D. (2008). *Using ICT to reduce transaction costs in agriculture through better communication: A case study from Sri Lanka. LIRNEasia*.

Demeney, P. (2003). *Population policy, and concise summary*, no. 173, p. 62. Population council. Policy Research Division.

Evans, A. (2011). *Resource scarcity, climate change and the risk of violent conflict*. Background Paper, World Development Report (pp. 1–23).

FAO. (2010). *The state of food insecurity in the world 2010*. Rome, Italy: Addressing Food Insecurity in Protracted Crises.

Flor, A. G. (2001). ICT and poverty: The indisputable link. *Second Asian development forum* (pp. 11–14). Bangkok, Thailand: World Bank Publications.

Flor, A. G. (2002). *Information and communication opportunities for technology transfer and linkages*. Expert Consultation on Agricultural Extension, Research-Extension-Farmer-Market Linkages. FAORAP, Bangkok, 16.

The Global Information and Early Warning System on Food and Agriculture (GIEWS publications), 2011, Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/giews/english/giews_en.pdf [Accessed November 10, 2014].

Fountas, S., & Pedersen, S. (2005). *ICT in precision agriculture—diffusion of technology*. *ICT in agriculture* (pp. 1–15).

Gebbers, R., & Adamchuk, V. I. (2010). Precision agriculture and food security. *Science, 327*(5967), 828–831.

Knight, M. (2010) *Current emissions risk 'devastating' temperature rise, scientists warn—CNN.com. CNN.com—breaking news, U.S., world, weather, entertainment &video news.* http://www.cnn.com/2010/WORLD/europe/11/29/climate.four.degrees.warning/index.html.

Koning, N. (2008). Long-term global availability of food: Continued abundance or new scarcity? *NJAS—Wageningen Journal of Life Sciences, 55*(3), 229–292.

Kumar, D. (2005). *Information and communication technology (ICT) in Indian agriculture*. *General economics and teaching* (pp. 44–46).

Malthus, T. R. (1798). *An essay on the principle of population, as it affects the future improvement of society* (1st ed.). London: J. Johnson.

Maru, A. (2002). A normative model for agricultural research information systems. In *Proceedings of the Third Asian Conference for Information Technology in Agriculture. Asian Federation for Information Technology in Agriculture (AFITA)-Chinese Academy of Agricultural Sciences* (*CAAS*) (pp. 26–28).

Meera, S., & Jhamtani, A. (2004). *Information and communication technology in agricultural development: A comparative analysis of three projects from India*. AgREN Network Paper, no. 135.

Munyua, H., Adera, E., & Jensen, M. (2008). Emerging ICTs and their potential in revitalizing small scale agriculture in Africa. In *World conference on Agricultural Information and IT, IAALD AFITA WCCA 2008* (pp. 707–717).

Newman, S., & Lynch, T. (2000). Success and failure of decision support systems: Learning as we go. In *Proceedings of the American Society of Animal Science* (pp. 1–12). Indianapolis, Indiana, USA: American Society of Animal Science.

OECD/FAO (2011). OECD-FAO Agricultural Outlook 2011–2020.

Panchard, J., et al. (2007). Commonsense net: A wireless sensor network for resource-poor agriculture in the semiarid areas of developing countries. *Information Technologies & International Development, 4*(1), 51–67.

Plauché, M., & Prabaker, M. (2006). Tamil market: a spoken dialog system for rural India. In G. Olson & R. Jeffries (Eds.), *CHI EA '06 CHI '06 extended abstracts on Human factors in computing systems* (pp. 1619–1624). New York, NY, USA: ACM.

Piesse, J., & Thirtle, C. (2009). Three bubbles and a panic: An explanatory review of recent food commodity price events. *Food Policy, 34*(2), 119–129.

Pimentel, D., Harman, R., & Pacenza, M. (1994). Natural resources and an optimum human population. *Population and Environment, 15*(5), 347–369.

Pinstrup-Andersen, Per, RajulPandya-Lorch, & Rosegrant, M. W. (1999). *World Food Prospects: Critical Issues for the Early Twenty-First Century, Food Policy Report*. International Food Policy Research Institute, Washington, D.C.

Raleigh, V. S., (1999). World population and health in transition. *British Medical Journal*, *319*, 981–984.

Ramamritham, K., Bahuman, A., Duttagupta, S., Bahuman, C., & Balasundaram, S. (2006). Innovative ICT Tools for information provision in agricultural extension. In *Information and Communication Technologies and Development*, 2006. ICTD'06. International Conference on. IEEE, pp. 34–38.

Rao, N. (2007). A framework for implementing information and communication technologies in agricultural development in India. *Technological Forecasting and Social Change, 74*(4), 491–518.

Richardson, D. (2006). ICTs-transforming agricultural extension? In *Proceedings of CTA's Observatory on ICTs*.

Rosskopf, K. (2006). Vom Daten-zum Wissensmanagement: Wofür verwenden Landwirte einen Computer. In K.-O. Wenkel et al. (Eds.) *Land- und Ernährungswirtschaft im Wandel: Aufgaben und Herausforderungen für die Agrar- und Umweltinformatik, Referate der 26. GIL Jahrestagung*. Potsdam, Germany, pp. 225–228.

Sachs, J. D, McArthur, J. W. (2005). The millennium project: A plan for meeting the millennium development goals. *Lancet*, *365*, 347–353.

Sen, A. (1994). Population: Delusion and reality. *NY Review of Books, 41*, 62–71.

Serageldin, I. (1999). Biotechnology and food security in the 21st century. *Science, 285*(5426), 387–389.

Singh, S. (2006). Selected success stories on agricultural information systems. *Asia-Pacific Association of Agricultural Research* (*APAARI*), Bangkok, Thailand.

Stephenson, R. (1997). Disasters and the information technology revolution. *Disasters, 21*(4), 305–334.

Thysen, I. (2000). Agriculture in the information society. *Journal of Agricultural Engineering Research, 76*(3), 297–303.

Trostle, R. (2008). *Global agricultural supply and demand: Factors contributing to the recent increase in food commodity prices*. Washington, DC, USA: DIANE Publishing.

vom Brocke, J., Simons, A., & Niehaves, B. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search process. In *17th European Conference on Information Systems*, pp. 1–13.

Warren, M. (2004). Farmers online: drivers and impediments in adoption of Internet in UK agricultural businesses. *Journal of Small Business and Enterprise Development, 11*(3), 371–381.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, *26*(2), 3.

Chapter 3
How Can Information Systems Help to Make Policymaking Be More Sensitive to Global Long-Term Perspectives?

Adrian Dolensky, Stefan Laube and Elena Gorbacheva

3.1 Introduction

In the last decades several positive world trends have indicated that, in general, the world is getting healthier, better educated, richer, more peaceful, and better connected. However, many major global challenges remain, including climate change, organized crime, terrorism, corruption, the widening gap between rich and poor, and increasing economic insecurity. According to the Millennium Project, one way to tackle these problems is to improve decision-making on the individual, group, national, and institutional levels (Glenn et al. 2011). Governments and politicians play a major role in achieving long-term global goals by setting and implementing the right policies on a global scale, so the Millennium Project asks, "How can policymaking be made more sensitive to long-term global perspectives?"

Technological developments like the ongoing evolution of information and communication technology (ICT) and expansion of the Internet have accelerate the complexity of these issues, along with the number and extent of changes and globalization. Therefore, it is important to understand how technology, especially information systems (IS), can be used to inform policymaking and improve its long-term perspective.

This chapter focuses on the research question, "How can IS help to make policymaking more sensitive to long-term global perspectives?" and addresses, among other questions, how *e-participation* can be used to make policymaking more sensitive to long-term global perspectives, how IS can support *global cooperation in policymaking*, and the chance that such ongoing research topics as *resilience thinking* and *collective intelligence* will affect policymaking. In addition to summarizing the topic-related concepts identified in the literature, this study proposes a research agenda.

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3.2 Research Method

The research question (RQ) for our literature review was derived from challenge number five of the Millennium Project (Glenn et al. 2011) and adapted to the context of IS. The process by which papers were selected consisted of four steps, in accordance with the methodologies proposed by Randolph (2009) and Vom Brocke et al. (2009).

In the first step, we defined the search terms and created a mind map on the RQ, where we summarized our ideas. As a result, a set of thirteen search strings related to IS and policymaking resulted.

In the second step, we defined the scope of our search. We used such academic journal databases as Google Scholar, EBSCOhost, and Springer Link to perform the search and chose not to limit our search to top-ranked peer-reviewed IS journals because of the interdisciplinary nature of our RQ.

Next, we defined the population of results in order to make the overall number of articles for reviewing manageable. We evaluated the first twenty pages of Google Scholar and Springer Link and the first ten pages of EBSCO Host to limit the hits for each keyword to 700.

Table 3.1 Selected papers focusing on the IS-supported concepts contributing to making policymaking more sensitive to global long-term perspectives

Paper	Paper Nr.
Braess et al. (2005)	[P1]
Cockerill et al. (2009)	[P2]
Dolowitz and Marsh (2000)	[P3]
Edwards (1996)	[P4]
Gordon (2003)	[P5]
Gordon (2009)	[P6]
Guiraudon (2000)	[P7]
Keen (1981)	[P8]
Kreileman et al. (1996)	[P9]
Lampathaki et al. (2010)	[P10]
Larrain et al. (2000)	[P11]
Leach (2008)	[P12]
Lempert et al. (2004)	[P13]
Lempert et al. (2009)	[P14]
Macintosh (2004)	[P15]
McCartney (1988)	[P16]
Misuraca et al. (2011)	[P17]
Parr et al. (2003)	[P18]
Phang and Kankanhalli (2008)	[P19]
Rotmans et al. (2001)	[P20]
Tumer and Wolpert (2000)	[P21]

Finally, we evaluated the literature, identifying the potentially relevant papers as those that dealt with the RQ. We assumed that the term "long-term perspective" referred to "a time frame of one, two or three generations" (Rotmans et al. 2001), as even 30 years might not be long enough for our purposes. In the first round of the literature evaluation process, we read the papers' titles and, when a title was promising, we read the abstract. If both the title and the abstract suggested a paper's inclusion was justified, we read its conclusion as well. We excluded many papers that addressed policymaking from a long-term global perspective because they did not consider IS's contribution to the challenge. The papers we selected in the end either stated explicitly how IS contribute to the challenge or derived IS's contribution indirectly. We also extended the literature through a backward search of the articles chosen. The resulting list of twenty-one papers is presented in Table 3.1.

Analysis of the selected articles included identification of the papers' central issues and examination of the authors' lines of argumentation. As a result, we found seven IS-supported concepts that contribute to making policymaking more sensitive to long-term global perspectives. These concepts and related papers are presented in Fig. 3.1.

The next section discusses each concept in detail.

Paper	E-participation in e-democracy	Counter-counter-implementation	Policy transfer	Cooperation in policymaking	Resilience thinking	Collective intelligence	Predictive methods			
							Policy context analysis	Policy modelling	Policy simulation	Policy evaluation
[P1]						X				
[P2]								X	X	
[P3]			X	X						
[P4]								X	X	
[P5]							X			
[P6]							X			
[P7]			X	X						
[P8]		X								
[P9]								X	X	X
[P10]							X	X	X	X
[P11]		X								
[P12]					X					
[P13]							X	X	X	X
[P14]							X	X	X	X
[P15]	X		X							
[P16]		X								
[P17]	X					X	X	X	X	
[P18]					X					
[P19]	X									
[P20]			X	X		X				
[P21]						X				

Fig. 3.1 IS-supported concepts contributing to making policymaking be more sensitive to global long-term perspectives and the related papers

3.3 Results and Discussion

The first IS-supported concept that contributes to making policymaking more sensitive to long-term global perspectives refers to *e-participation*, the inclusion of the general public into the policymaking process with the help of IS. A growing number of government organizations use technology for this purpose, providing access to policy information and requesting comments from the public about it (Macintosh 2004). In order to ensure that a policy fulfils the requirements of as many people who are affected by it as possible, policymakers must reach the targeted group. IS offer a broad variety of solutions to meet this need (e.g., e-participation in online communities) by removing time and space constraints (Phang and Kankanhalli 2008). Such solutions should take into account how deeply citizens should be involved in the policymaking processes (be informed about a policy or be actively involved in its creation or implementation) and what information policymakers need from citizens and within what time frame. It is also important to evaluate the outcome of each e-participation project (See the passage on *Policy evaluation*, below).

The second IS-supported concept that contributes to making policymaking more sensitive to long-term global perspectives deals with policy *counter-implementation* (CI) and *counter–counter-implementation* (CCI). CI occurs when a policy implementation is sabotaged. As policymaking is deeply linked to political decisions (in both the public and the private sector), there will always be some kind of resistance. In relation to IS, counter-implementation might happen if, for example, people involved in policy implementation feel threatened by the change (Keen 1981). CCI is the tactic used to combat CI by analysing the scenarios of potential CIs and how they can be avoided before a project breaks down. Information is the key element of CCI, and IS can be assist considerably by reducing communication costs and enhancing information flow (Larrain et al. 2000). Setting up knowledge bases, which include the best practises on measures that have been applied successfully, can also help.

The third concept is related to *policy transfer*. Before introducing a policy, decision-makers usually determine whether a comparable policy in a similar environment (e.g., another country with a similar political and/or economic background) already exists, in which case all or part of it can be transferred and used. Technological developments make such a policy transfer process easier by offering new ways of communication and storing and accessing information, which has already resulted in increased occurrences of policy transfer (Dolowitz and Marsh 2000). Since such policy transfer can also fail, as there are many internal and external factors that influence its potential for success, the important questions concern which factors influence a policy's outcome and who should be involved in implanting a policy. Information can reduce the risk of policy transfer failures significantly, so the contribution of modern communication technologies supported by IS to the exchange of information on a global scale should not be underestimated.

The fourth IS-supported concept that contributes to making policymaking more sensitive to long-term global perspectives is that of *cooperation in policy-making*. One example of a Europe-wide long-term-oriented policy is the Schengen agreement. This agreement not only facilitates the creation of a single European market and travelling without border controls but also introduces within the agreement the Schengen Information System, which contains information about people who have violated the law (Guiraudon 2000). The availability of the system in all member states significantly eases the process of catching criminals. Other technological cooperation delineated in the agreement includes the finger-printing of asylum-seekers, which the IS-supported means of world-wide communication makes easier. The Schengen Information System, which does not require large investments of effort and money investments, helps to make cooperation in policymaking easier and cheaper by, for example, providing opportunities to conduct virtual meetings, which allows geographically separated teams to work together.

The fifth concept is *resilience thinking*, which refers to a society's resilience or response to shocks and ability to face change and reduce such uncertainties as risks, ambiguity, and ignorance (Leach 2008). Resilience thinking includes policies that affect how a society deals with natural disasters, catastrophes, and crises from a long-term global perspective. One important aspect of this concept is the need to raise society's awareness about the environmental change caused by humans and the need for more sustainable production and consumption. Here, IS can reveal the consequences of society's behaviour by means of rapid analyses of huge data sets and communication of the research results to policymakers and the wider public (Parr et al. 2003). Advanced IS tracking tools can also help to prevent or manage disasters.

The sixth concept considers *collective intelligence* (COIN), which refers to a large system that includes many connected actors with no centralized communication and control but a utility function that rates the histories of the full system (Tumer and Wolpert 2000). The goal of the COIN approach is to determine how the people involved should update their behaviour in order to get the best results possible (e.g., to avoid traffic jams). By using mass collaboration platforms and real-time visualisation, policymakers can create, learn, engage, and share group knowledge and adapt policies to make them more efficient. A good deal of information is already available, but it remains to be mapped to usable applications, and this is where IS can be of help in supporting global sustainable policy development.

The last concept reviews *prediction-based methods* that are relevant to (1) *policy context analysis,* (2) *policy modelling,* (3) *policy simulation, and* (4) *policy evaluation* (Lampathaki et al. 2010). These four domains were proposed within the CROSSROAD project, a support action project funded by the European Commission that is aimed at determining the key research challenges in the field of ICT for policy modelling and governance. The concepts of resilience thinking and COIN rely on real-time information that, when combined with information about the past, can be used to predict the future.

(1) *Policy context* analysis focuses on analytical and descriptive analysis of policy or analysis for the formulation of policies and proposals. IS facilitates such statistical methods as foresight, forecasting, and backcasting, which can analyse the past in order to develop short-term forecasts. One useful approach for policy analysis on issues within a 10-year horizon is the State of the Future Index (SOFI), which forecasts the results of today's actions (Gordon 2003) with the goal of improving the sensitivity of decision makers at the local, national, and global levels to long-term global perspectives.

The Real-Time Delphi Method is another forecasting approach for analysing policy contexts. In contrast to traditionally expensive and time-consuming Delphi studies, the Real-Time Delphi Method uses software to provide each participant with the responses of other participants and the reasoning for these responses in real time. This method supports mass collaboration and can be used to evaluate policy options from remote locations without unnecessary expenditure of time. Such IS tools play an important role in future policymaking, as IS facilitates policy intelligence (comparable with business intelligence), IS-driven decision analysis, gaming-based simulations in the context of policymaking (Misuraca et al. 2011), and process optimisation and control. Lempert et al. (2004) pointed out that long-term policy analysis using IS tools should help policy-makers to make systematic, grounded decisions.

(2) *Policy modelling* is another method that help to increase policy-makers' sensitivity to long-term global perspectives. Policy-makers can use models (made by researchers working with policy-makers) as simplified, abstract views of reality. Several studies have mentioned the importance of such collaboration for the success of policy-modelling (Cockerill et al. 2009; Kreileman et al. 1996; Lampathaki et al. 2010). Edwards (1996) suggested that such comprehensive modelling informs policy-makers about the structure and the extent of global problems, thereby supporting the decision-making process.

(3) The aim of IS-supported policy-making in the context of *policy simulation* is to gain feedback from artificial, yet realistic tests in order to choose the best policy option. For example, computer-based simulation models enable policy-makers to play 'what if' games, where they can evaluate various scenarios related to policy implementation (Cockerill et al. 2009). Simulation of social and political systems can be done via agent-based modelling, where agents are (for example) governments (Lempert et al. 2009).

(4) Several IS tools that support qualitative and quantitative methodologies for *policy evaluation* have already been developed. Policy evaluation uses scenario techniques to support the policy-making process at a strategic level (Lampathaki et al. 2010). Robust decision-making (RDM) refers to the practice of policy simulation and policy evaluation, where computers are used to create plausible long-term paths (scenarios), after which robust short-term policy options are identified using statistical computer algorithms. As a result of RDM, policy-makers are able to gain a systematic understanding of various scenarios so they can consider the differing consequences of feasible paths before they decide on a policy (Lempert et al. 2009).

3.4 Research Agenda

The literature review process made clear that the proposed concepts cannot address our main RQ fully (although they still provide valuable ideas on how IS can contribute to making policy-making more sensitive to long-term global perspectives). As a result, we developed additional RQs from the literature.

To what extent is the integration of population into political decisions beneficial for the policy-making process? E-participation in *e-democracy* is important for integrating the population into political decisions, but with the help of IS, such integration can become so easy that too many participants in policy-making would lead to endless debates. Another challenge arises with the need to ensure the security of IS that supports online voting during governmental elections.

Can policy transfer be simulated using (for example) modelling techniques? Further reviews on the best practices supported by IS are needed for such areas as *counter–counter-implementation* and *policy transfer*. Creating a policy-transfer database might be a reasonable idea, but we found no such idea during the literature review. However, several other IS for political cooperation have already been implemented, among which is the Schengen Information System. Since policy transfer can be misleading, prior *simulation* might be useful.

Can a global IS that supports politics and is implemented in multiple countries become a basis for making decisions in the context of global resilience? Our main finding from the literature is that cooperation between governments with the help of IS yields significant possibilities. IS can be of great value in the communication and coordination of policy-making between countries. As a next step, we suggest implementation of a global IS to support policies that are useful for groups of countries. However, further research is required on how to collect and integrate data from multiple countries into a single IS. A global IS could be an integrated collective intelligence system that supports cooperation in politics and policy-making. However, data security and the influence of national cultures remain problems and require further investigation.

We found four sub-areas of research on using IS to make policy-making more sensitive to long-term global perspectives in the literature: *policy context analysis*, *policy modelling*, *policy simulation*, and *policy evaluation* (Lampathaki et al. 2010).

Policy context analysis deals with predicting the future and evaluating its impacts and implications using such methods as foresight, forecasting, and backcasting. *Policy modelling* incorporates findings from various scientific domains and research areas related to the creation of computer models. It usually refers to specific fields of application (e.g., climate change) and uses such approaches as system dynamics, game theory, and mathematics. *Policy simulation* is a powerful method for making short- and long-term predictions. It involves the creation of computer models that stand in for social systems in order to evaluate social interdependencies. Such computer-assisted social simulations are influenced by physics, computer science, and mathematics. Finally, *policy evaluation* involves the

assessment of policy impacts in order to explain why policy instruments perform differently than they were supposed to perform. Policy evaluation can be used to derive best practices or feedback for policy-making. There are several frameworks on how policy evaluation should be implemented (e.g., Mark et al. 2000), but research on policy evaluation is still in progress (Lampathaki et al. 2010).

We believe that predictive methods supported by IS can be a powerful driver in making policy-making more sensitive to long-term global perspectives. The ongoing research in such fields as mathematics and computer science regularly delivers new prediction-based methods. Now it is important to identify which of them predict the future in the context of policy-making in the most accurate way.

3.5 Conclusion

A long-term perspective and a global context are the two most vital aspects of modern policy-making. There are numerous challenges associated with these requirements, and it is important to know whether IS can support the concepts that are intended to address these problems. This study analysed several areas of global and long-term policy-making and the role of IS in their support in order to derive three primary conclusions.

First, IS can support global and long-term policy-making that deals with particularly complicated issues, such as disasters and climate change. *Resilience*, one of the keywords proposed in this paper, shows how policies influence how society deals with unexpected situations. Resilience requires deep insights about the future, and IS can enhance prediction-based methods for *policy context analysis, policy modelling, policy simulation,* and *policy evaluation*.

Second, until now policy decision-makers have been a small group of people. We propose that approaches like *e-participation* could help decision-makers to get feedback from all relevant target groups on various policy activities, which would ensure that a policy meets the requirements of those who are most affected by it.

Third, there are few areas in which no policy has been established in at least one country. It is logical to reuse or adapt these policies in a process called *policy transfer*. One example of how IS support the use of a policy in many countries is the Schengen Information System developed within the Schengen agreement. The core idea of the Schengen Information System is to help all of the signatory countries to know what the others are doing in certain areas (e.g., what criminals they are looking for), which makes the decision-making process more efficient. Such *collective intelligence* helps security organizations but can be also applied in areas like transport organisation and optimisation.

We find the creation of one integrated IS for several countries to be the most exciting topic for future research. We believe that integrated policies are needed in order to face long-term global problems. These integrated policies can be created only if there is an integrated view on the world, which can be facilitated by IS.

By using IS for cooperation and coordination, the time and space usually required for policy-making can all but disappear. Thus, IS can be of great value in making policy-making more sensitive to long-term global perspectives.

References

Braess, D., Nagurney, A., & Wakolbinger, T. (2005). On a paradox of traffic planning. *Transportation Science, 39*(4), 446–450. doi:10.1287/trsc.1050.0127.

Cockerill, K., Daniel, L., Malczynski, L., & Tidwell, V. (2009). A fresh look at a policy sciences methodology: Collaborative modeling for more effective policy. *Policy Sciences, 42*(3), 211–225. doi:10.1007/s11077-009-9080-8.

Dolowitz, D. P., & Marsh, D. (2000). Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance, 13*(1), 5–23. doi:10.1111/0952-1895.00121.

Edwards, P. N. (1996). Global comprehensive models in politics and policymaking. *Climatic Change*, *32*(2), 149–161. Retrieved from http://www.springerlink.com/index/M950J6027250521Q.pdf.

Glenn, J., Gordon, T., & Florescu, E. (2011). *2011 State of the future* (1st ed.). The Millennium Project.

Gordon, T. J. (2003). State of the Future Index (SOFI): A method for improving decision making that affects the future. *21st century opportunities and challenges: an age of destruction or an age of transformation* (p. 37).

Gordon, T. J. (2009). The Real-Time Delphi Method. *Futures Research Methodology Version*, *3*.

Guiraudon, V. (2000). European Integration and migration policy: vertical policy-making as venue shopping. *JCMS: Journal of Common Market Studies, 38*(2), 251–271. doi:10.1111/1468-5965.00219.

Keen, P. G. W. (1981). Information systems and organizational change. *Communications of the ACM*, *24*(1), 24–33.

Kreileman, E., Leemans, R., & Alcamo, J. (1996). Global models meet global policy: How can global and regional modellers connect with environmental policy makers? What has hindered them? What has helped? *Science, 6*, 255–259.

Lampathaki, F., Koussouris, S., Charalabidis, Y., Asjounis, D., Mouzakitis, S., Passas, S., et al. (2010). State of the art. In F. Lampathaki, S. Koussouris, Y. Charalabidis, & D. Asjounis (Eds.), *ICT for governance and policy modelling*. CROSSROAD White Paper.

Larrain, F. B., Sachs, J. D., & Warner, A. (2000). A structural analysis of Chile's long-term growth: History, prospects and policy implications*. *Growth (Lakeland)*, (January).

Leach, M. (2008). Re-framing resilience: a symposium report. In *Symposium a quarterly journal In modern foreign literatures*.

Lempert, R., Popper, S., & Bankes, S. (2004). *Shaping the next one hundred years: new methods for quantitative, long-term policy analysis*. *Technological forecasting and social change* (Vol. 71). Santa Monica: RAND. doi:10.1016/j.techfore.2003.09.006.

Lempert, R., Scheffran, J., & Sprinz, D. F. (2009). Methods for long-term environmental policy challenges. *Global Environmental Politics, 9*(3), 106–133. Retrieved from http://www.mitpressjournals.org/doi/abs/10.1162/glep.2009.9.3.106.

Macintosh, A. (2004). Characterizing e-participation in policy-making. In *Proceedings of the 37th Annual Hawaii International Conference on System Sciences, 2004*. *00*(C), p. 10. doi:10.1109/HICSS.2004.1265300.

Mark, M. M., Henry, G., & Julnes, G. (2000). *Evaluation: an integrated framework for understanding, guiding, and improving policies and programs* (p. 400). San Francisco: Jossey-Bass.

McCartney, G. (1988). Implementing computer-based systems. In *Proceedings of the 16th Annual ACM SIGUCCS Conference on User Services—SIGUCCS '88* (pp. 117–122). doi:10.1145/62548.62581.

Misuraca, G., Broster, D., & Centeno, C. (2011). Digital Europe 2030: Designing scenarios for ICT in future governance and policy making. *Government Information Quarterly*. doi:10.1016/j.giq.2011.08.006.

Parr, T. W., Sier, A. R. J., Battarbee, R. W., Mackay, A., & Burgess, J. (2003). Detecting environmental change: science and society-perspectives on long-term research and monitoring in the 21st century. *The Science of the Total Environment*, *310*(1–3), 1–8. doi:10.1016/S0048-9697(03)00257-2.

Phang, C. W., & Kankanhalli, A. (2008). A framework of ICT exploitation for e-participation initiatives. *Communications of the ACM, 51*(12), 128. doi:10.1145/1409360.1409385.

Randolph, J. (2009). A guide to writing the dissertation literature review. *Practical Assessment Research Evaluation*, *14*(13). Retrieved from http://www.mendeley.com/research/guide-writing-dissertation-literature-review-1/.

Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution. *World, 03*(01), 17.

Tumer, K., & Wolpert, D. H. (2000). Collective Intelligence and Braess' Paradox. In *Proceedings of AAAI 2000*. Morgan Kauffman.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search proccess. In *ECIS 2009* (pp. 1–13). Verona.

Chapter 4
Making the Global Convergence of ICT Available for Everyone

Tomal K Ganguly and Klaus Fleerkötter

4.1 Introduction

In 2011, the pace in the development of information and communication technology (ICT) seemed to peak, but the convergence phenomenon can still be described as a first-world trend. While the majority of citizens of North America, Australia, and Europe have Internet access, the world average is only every third person. In Africa, Internet penetration plunges as low as 11 %.[1]

While access to the Internet may not be as directly valuable as goals like eliminating hunger or curing disease, the converging applications in information and communication can accelerate the improvement of the human condition. Across the globe, agile protestors are overthrowing non-democratic governments by organizing via social media that uses ICT channels, and national legislations are facing empowered citizens while struggling with regulating the Internet. Inhabitants of the world grow together by means of digital communication and information and establish the first genuine digital democracies. Unrestricted information access supports and enables democratization, learning environments, and free speech, but this global convergence renders national regulation almost powerless. While, on one hand, this development routinely defies governmental censorship, it also imposes new kinds of threats that defy current law enforcement structures. Governments of leading countries in technological development criticize regimes that try to inhibit their citizens' communication connections and information access while also trying to establish similar censorship infrastructures under the cover of preserving intellectual property rights.

This outline demonstrates how the global convergence of information and communication affects a wide range of technological and social topics. This article

[1] http://www.internetworldstats.com/stats.htm.

J. vom Brocke et al., *Grand Societal Challenges in Information Systems Research and Education*, SpringerBriefs in Information Systems,
DOI 10.1007/978-3-319-15027-7_4

assesses the emerging themes in this area and the opportunities, threats, and challenges that these developments create.

The remainder of the article is structured as follows: first we describe our literature review approach. Then we discuss the emergent themes regarding global convergence. Finally, we propose a research agenda that could guide further research.

4.2 Literature Review

The Millennium Project is a report that identifies trends and issues that lead to global challenges. The present paper analyses how ICT can contribute to the challenge of making ICT available to everyone.

The framework (Fig. 4.1) explains the procedure that our research followed and shows the bridge between information and communication regarding the opportunities and threats of internet access and its availability to citizens. Moreover, it highlights which technological developments might help to close the gap and build an expedient bridge (Fig. 4.1).

A literature review seeks to uncover the sources relevant to a topic under study, so it makes a vital contribution to the relevance and rigor of research (vom Brocke et al. 2009). We searched among several databases: ACM Digital Library, Business source premier, EBSCOhost, Elsevier, JSTOR, and IEEE. The review can be characterized as focusing on research application, integrating various research areas, and having a neutral perspective and a target audience of general scholars (Cooper 1988). The literature review followed a procedure in which search results matching the respective topic ("hits") were saved to a project database; the hits were then analysed based on evaluation of their titles, abstracts, and summaries and, if

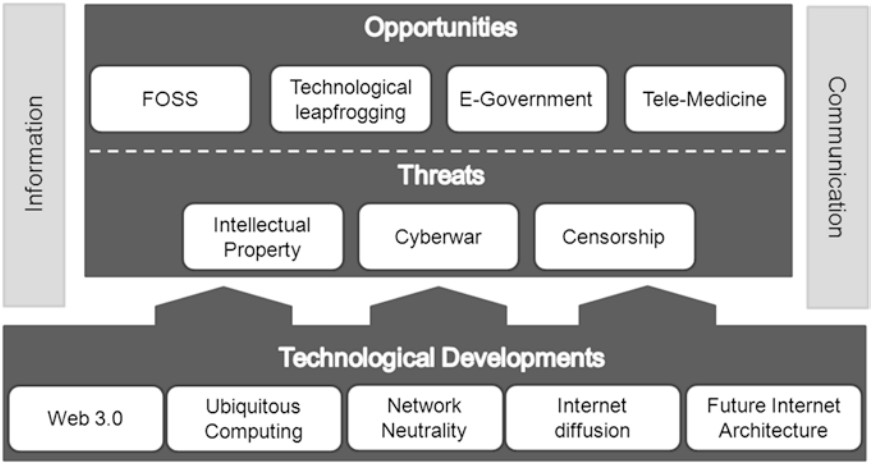

Fig. 4.1 Conceptual framework

they were valuable for the purposes of this review, they were catalogued based on a tag-based taxonomy ("evaluated"); and articles that addressed the core research interest were synthesized and marked as "reviewed".

4.3 Results and Discussion

(**1**) ***Opportunities***. Developing countries set trends in applications, revenue models, and cost-saving approaches, especially for mobile networks (Khalil and Kenny 2008). ICT has immense potential to facilitate this development through, for example, *technological leapfrogging*, which bypasses some of the processes of accumulation of human capabilities and fixed investment in order to narrow the gaps in productivity and output that separate industrialized and developing nations (Steinmueller 2001). The developing world is well-equipped to use modern technologies or even to become the lone adopter of such products (Chen 1999) because of the unavailability of an established technology and the ambitions and aspirations of the developing world (Prakash 2005; Malairaja 2003). However, opinions vary concerning whether technological leapfrogging is possible beyond the mobile phone phenomenon and whether it is key to the successful development of countries that sometimes lack even basic sanitation facilities (Steinmueller 2001).

Digital government or *electronic government* (e-Government) has emerged as a new form of interaction between the state and the citizens with the purpose of improving government performance and processes (Andersen et al. 2010). The key principles of e-Government initiatives include transparency, participation, and collaboration. A certain level of trust in the electronic interaction with the government must underpin these key principles and requirements. The intention to use e-Government depends on access and skills, since skills are an important element in terms of how the population uses the Internet—whether for general use, online purchases, or online information searches.

The healthcare industry claims to be one of the first service industries to introduce the use of ICT in electronic health services (e-Health), which began with telephone-based medical consultations and grew from there (Houghton 2002). e-Health is also the focus of the European health policy, which has led to a significant increase in health insurance cards and e-services like reimbursement and the electronic transmission of prescriptions. Telemedicine, an important part of the European healthcare agenda, has attracted considerable attention from the participating countries (Denz 2008).

(**2**) ***Threats and Requirements***. The regulation of cyberspace via *Internet censorship* is an important topic that has been linked to the topics of democracy, free speech, and privacy. Internet censorship is primarily defined as state-controlled Internet filtering (e.g., South Korea's blocking of pro-North Korean sites, India's blocking of sites of groups that foment domestic conflict, blocking search results from the Chinese Google website or Wikileaks). Actually, access to the unrestricted Internet cannot be found in any country in the world (Tariq 2006). The

states find new and more sophisticated techniques to restrict some of the Internet activities, and the motives, scope, and effectiveness of Internet censorship vary widely from country to country (Boyle 1997).

The convergence of media and digital content into a realm of common communication tends to exacerbate the *intellectual property* problem because of issues like the impermanence, multiplication, and heterogeneity of communication sources (ICT 2005). The property of ideas and their expression is hard to maintain in cyberspace in the forms in which they are usually protected (e.g., patents, trademarks, copyrights). Dynamic content can be modified in minutes, so it is difficult to preserve its integrity in order to claim property rights to it. The same applies to the varying formats in which digital content may be available. Legal issues in this area are complicated by the fact that some media formats, such as sound files, are covered by rules specific to the media (Okediji 2004). Another example of the complex nature of such issues is the legal claims of websites in respect to the display of their content (e.g., images) through search engines. The heterogeneous nature of digital collections often leads to confusion in terms of copyright infringements, such as the when one considers whether a print publication is allowed to add the work of freelance writers to an electronic database.

Because of its relative novelty, the vulnerability of the Internet has yet to undergo a complete assessment in terms of evaluating the threat of *cyberwar*. Each target infrastructure requires a much more detailed analysis of normal rates of failure and response, the degree to which critical functions are accessible from public networks, and the level of human control, monitoring and intervention in critical operations (Sommer 2001). The amount of damage caused by the launch of cyber-attacks imposes high economic costs in relation to the comparatively minor cost of launching such an attack (Ramsaroop 2003). Opportunity costs (e.g., lost sales or lower productivity) make up a large proportion of the cost of cyber-attacks and viruses (Lewis 2002).

(**3**) ***Technological Developments***

Ubiquitous Computing. Ubiquitous computing is based on Weiser's (1991) vision of the human world merging with virtual content, and computers vanishing into the background. Making this vision a reality involve a multitude of purpose-specific devices, such as communication micro-chips, pads, wall screens, and smartphones, that are connected in a ubiquitous network and provide content in ways suited for their specific purposes. Therefore, devices must be aware of their and their user's environment and be physically and cognitively available (Banavar and Bernstein 2002; Waller and Johnston 2009). This development is enabled by inexpensive hardware, small-form factors, and advanced human interfaces.

For global convergence, ubiquitous computing serves the goal of availability and provides access to digital information content and communication channels that are embedded in the contexts of prospective users, lowering entry barriers and learning curves. Its real-world application would be driven by falling prices, improved hardware performance, and the ability to connect to services through a variety of networks (Islam and Fayad 2003; Lyytinen and Yoo 2002). However, it

requires a large-scale, diffuse service infrastructure that can integrate a multitude of requirements and a large-scale understanding of how to adapt and understand technology (Lyytinen et al. 2004).

Web 3.0. Although researchers have not yet agreed upon a precise scientific definition, "Web 3.0 represents an evolutionary shift in how people interact with the web, and vice versa" (Green 2011). Certain themes are emerging to form the next-generation web, which provides information tailored to the individual user's needs, location, and identity. This web is likely to be a semantic Web that is not only readable by humans but also understandable and traversable for machines (Green 2011). Manual definitions of the relationships between types of content make complex information searches and aggregations more feasible than do text mining and AI algorithms, which are comparably slow and long-running (Berners-Lee and Hendler 2001).

While Web 2.0 is user-centric, Web 3.0 will be personal, as the correspondence between the retrieved information and the user's need is improved by leveraging the social graph—that is, the user's contacts. Web 3.0 also takes into account the properties of ubiquitous computing (embedded virtuality, mobility of computing; Green 2011) and may become a "web of things", where not only users and services but also a multitude of autonomous devices communicate transparently, connecting appliances that share and consume data. Rich Internet applications form the heart of the dynamic, data-centric Web 2.0, but the mobile web emerges in Web 3.0 with interconnected applications, mobile websites, and a swarm of new types of devices that act as user interfaces. With the properties of collective intelligence, Web 3.0 may also have a positive influence on learning and organizational development (Green 2011).

Information Infrastructure. Network neutrality refers to the principle of an information network that treats all data packets equally (Schuett 2010) and does not favour one application over others (Wu 2003). Network neutrality is important if long-term public interest in having an innovative communication infrastructure, where services can build in natural competition, is to be achieved (Wu 2003). Standing against this effort are the short-term interests of ISPs, which (because of their control over the "last mile" to the customer) act as selective gatekeepers.

A recent example is the mobile Internet market: Because wireless network providers block voice-over-IP packets by employing deep packet inspection, they use their control power over the end user's technology to block competitors (e.g., Skype). Ensuring that the tools that enable information and communication are available to as many humans as possible poses several requirements on a feasible Internet architecture. We derived requirements from the emerging themes introduced in the literature and aligned them to six architecture goals, classified according to Paul et al. (2011).

In the next-generation Internet, security will be a part of the architecture rather than being overlaid on top of the original architecture (Paul et al. 2011). Confidential message exchange between parties (e.g., humans, devices, and services) that can trust each other is a necessary prerequisite for global communication, which requires user-centric privacy and identity management. Research

suggests the use of secure cryptographic identities (e.g., in resource-oriented networking) that enables identity-based access control on the level of packets (per-packet attribution) to be enforced throughout a network (e.g., Security Architecture for Networked Enterprises (SANE)).

Another architecture requirement is reliable *content delivery mechanisms* that ensure that information content is persistent, available, authenticated, and provided with preserved integrity for all users. The scarce bandwidth available at the transnational backbone must also be used effectively—that is, with the highest throughput and lowest latency. On the state-of-the-art Internet, content distribution networks (CDN) serve static (i.e., cacheable) content to fasten load times (Paul et al. 2011). Future Internet Assembly (FIAs) will make use of highly distributed content nodes (e.g., next-generation CDNs) and peer-to-peer delivery (e.g., next-generation peer-to-peer, swarming architecture), both of which will be aware of their underlying topology and the location of peers (e.g., swarming architectures, provider-aided distance information systems), resulting in fewer costly ISP transits and shortened content routes (Paul et al. 2011; Poese et al. 2012; Bell and Walker 2011).

Other requirements include architectures like delay-tolerant networks (DTN) and mobile ad hoc networks (Kumar 2009) for areas where Internet connections and power supply are flaky and routes between mobile devices are temporarily unavailable, fault-prone, or subject to long delays. These *challenged network environments* are defined as "heterogeneous network environments where continuous end-to-end connectivity cannot be assumed" (Paul et al. 2011). In addition, *management control frameworks* that prohibit censorship and ensure network neutrality must be found. Finally, in order to achieve network neutrality, manageable content policies and network path optimization, with regard to overall network efficiency, the *internetworking layer* must be redesigned to improve scalability, mediation between user-defined content policies, and ISP-based performance optimizations.

Basic ICT markets must be established in order to facilitate competition and enable foreign competitors to invest in local infrastructure. To ensure that ICT is used to its full potential, regulatory institutions are needed for broadcast infrastructure and content—either combined or split (Khalil and Kenny 2008)—that examine and leverage the impact of ICT and drive change and privatization (Jussawalla 1999). Such regulations may include the liberalization of state-owned monopolies or policies of open economies and export-oriented investment in technology, providing the basis for long-term economic growth, as has been observable in Asian countries (Jussawalla 1999). Regulation also includes the reformation of mechanisms of spectrum allocation for wireless communication, which is best handled through property rights (Khalil and Kenny 2008).

The objective of this paper is to answer the question concerning how the global convergence of ICT can work for everyone. While seeking to close the gap between information and communication (Fig. 4.1), one must find the opportunities, threats, and requirements and define which solutions fit best. While one cannot say that there is only one right answer, focusing and narrowing down the opportunities and threats reveals some of the most plausible topics.

In defining the opportunities, threats, and requirements, we find that the IT area is important but should not be the sole focus. We try to link the thoughts of the Millennium project with other fields, such as the political view, the judicial view, and the socio-cultural aspects of the issues. Combining those four areas, we identified the topics of Free and open-source-software (FOSS), technological leapfrogging, e-Government, and Tele-Medicine. While looking for best-practice methods among these areas, we must also consider the threats that are related to the four areas and that are also linked to other problems throughout the project work. Intellectual property, cyberwar, and censorship were identified as threats, while intellectual property can also be seen as an opportunity.

We narrowed the topics to five that may give an answer to the question posed for the literature review. The main point was to define areas that are important to our ability to connect the world. We listed critical issues within these points, such as issues within the topics of internet diffusion and network neutrality, as well as technological concepts that can address them. Although we are setting a good pace in achieving global connectivity, future technologies—such as a new internet architecture that optimizes bandwidth usage but also installs centralized censorship possibilities—may also slow our ability to overcome these critical issues. We highlighted the cross-disciplinarily of these issues by bringing together the views and aspects of IT, politics, law, and socio-culture.

We developed an overall method and framework to add the technological developments of Web 3.0, ubiquitous computing, network neutrality, internet diffusion, and future internet architecture. We combine these developments with the opportunities of FOSS, technological leapfrogging, e-Government and tele-medicine while considering at the same time the threats and requirements of intellectual property, cyberwar, and censorship.

4.4 Research Agenda

Performing a literature review on the topic presented here uncovered a gap in the research on the global convergence of information and communication: Although the areas presented here are already adequately covered, research on the core nature of global convergence is missing. Therefore, our conceptualization can serve as a basis from which to outline future research's attempts to strengthen the links between the socio-cultural factors and information systems to improve the future global state. Interdisciplinary collaboration from diverse disciplines, such as politics, law, computer science, and socio-culture, will be necessary in this effort.

Many questions are yet to be answered, including how to find a working balance between preventing censorship and governmental control of access to content against the need to preserve value for cultural minorities (which is likely to require a filtering infrastructure). The question of internet diffusion and the role of governments in this process will become even more important as Internet penetration increases in the near future.

A possible model for a diffusion process that is cost-effective and that preserves the public interest in an innovative infrastructure could be *technology transfer through governmental incentives for open source*. Openness of interfaces and platforms is an essential prerequisite for establishing a global infrastructure like the internet. Therefore, developed countries should set incentives for the domestic technology markets to pursue open source. The more open source components are developed (and, consequently, the more open interfaces are used), the more developing countries can benefit from this technology, save costs, and leapfrog their development by extending on the state of the art. In addition, open source teams can help to achieve the transfer of knowledge into developing regions, support the externalization of first-world knowledge, and enable a global virtual and physical exchange of professional talent. Finally, private competition in developing countries' markets is enhanced because suppliers can build on available commons like the FOSS infrastructure components.

4.5 Conclusions

According to Khalil and Kenny (2008), and as confirmed by the findings of our literature review, developing countries will set the trend in applications, revenue models, and cost-saving approaches, especially for mobile networks. We created a framework that can serve as a guideline to answering the question concerning how the global convergence of information and communication technologies can work for everyone. We focused not only on IT but also on aspects of politics, law, and socio-cultural issued, combining them with current affairs. In seeking to close the gap between information and communication (Fig. 4.1), we had to consider other important areas, such as threats and requirements, to give a shape to the framework.

Future research should improve the framework and detail it to the point at which it can be evaluated and include other findings to round it out. The developed framework should be seen as a basis from which to provide an answer to the questions concerning to connect the people all around the world using tools, considering the opportunities and threats that are present, and taking into account the challenges and complexity of the task.

References

Andersen, K. N., Henriksen, H. Z., Medaglia, R., Danziger, J. N., Sannarnes, M. K., & Enemærke, M. (2010). Fads and facts of e-government: A review of impacts of e-government (2003–2009). *International Journal of Public Administration*, *33*(11), 564–579.

Banavar, G., & Bernstein, A. (2002). Software infrastructure and design challenges for ubiquitous computing applications. *Communications of the ACM*, *45*(12), 92–96.

Bell, S., & Walker, S. (2011). Futurescaping infinite bandwidth, zero latency. *Futures*, *43*(5), 525–539. Elsevier Ltd.

Berners-Lee, T., & Hendler, J. (2001). Publishing on the semantic web. *Nature, 410*(6832), 1023–1024.

Boyle, J. (1997). Foucault in cyberspace: surveillance, sovereignty, and hard-wired censors. *University of Cincinnati Law Review 66*, 177.

Chen, Z. (1999). Adoption of new technology by a lagging country: Leapfrogging or no leapfrogging? *Pacific Economic Review, 4*(1), 43–57.

Cooper, H. M. (1988). Organizing knowledge syntheses: A taxonomy of literature reviews. *Knowledge in Society*, *1*(1), 104–126. Springer: Netherlands.

Denz, M. D. (2008). Sustainable telemedicine: Paradigms for future-proof healthcare. *European Health Telematics Association, 1*.

Green, M. (2011). Better, smarter, faster: web 3.0 and the future of learning. *Training + Development*, *65*(4), 70–72.

Houghton, J. (2002). *Information technology and the revolution in healthcare*. Victoria University of Technology, Centre for Strategic Economic Studies, Melbourne. www.cfses.com.

Islam, N., & Fayad, M. (2003). Toward ubiquitous acceptance of ubiquitous computing. *Communications of the ACM*, *46*(2), 89–92. Association for Computing Machinery, Inc, One Astor Plaza, 1515 Broadway, New York, NY, 10036–5701, USA.

Jussawalla, M. (1999). The impact of ICT convergence on development in the Asian region. *Telecommunications Policy, 23*(3–4), 217–234.

Khalil, M., & Kenny, C. (2008). The next decade of ICT development: Access, applications, and the forces of convergence. *Information Technologies & International Development, 4*(3), 1–6.

Kumar, M. (2009). Distributed computing in opportunistic environments. *Ubiquitous Intelligence and Computing*, 1–1. Springer.

Lewis, J. A. (2002). Assessing the risks of cyber terrorism, cyber war and other cyber threats. *Center for Strategic & International Studies*.

Lyytinen, K. J., & Yoo, Y. (2002). Issues and challenges in ubiquitous computing. *Communications of the ACM, 45*(12), 62–65.

Lyytinen, K. J., Yoo, Y., Varshney, U., Ackerman, M., Davis, G., Avital, M., et al. (2004). Surfing the next wave: design and implementation challenges of ubiquitous computing. *Communications of the Association for Information Systems, 13*(1), 40.

Malairaja, C. (2003). Learning from the Silicon Valley and implications for technological leapfrogging the experience of Malaysia. *International Journal of Technology Management and Sustainable Development, 2*(2), 73–95.

Okediji, R. L. (2004). Development in the information age: issues in the regulation of intellectual property rights, computer software and electronic commerce. *UNCTAD-ICTSD, 9.*

Paul, S., Pan, J., & Jain, R. (2011). Architectures for the future networks and the next generation internet: A survey. *Computer Communications*, *34*(1), 2–42. Elsevier B.V.

Poese, I., Frank, B., Ager, B., Smaragdakis, G., Uhlig, S., & Feldmann, A. (2012). Improving content delivery with PaDIS. *IEEE Internet Computing*, *16*(3), 46–52.

Prakash, G. (2005). Leapfrogging into the knowledge era: Use of ICT for development. *IMR Conference* (pp. 47–56).

Ramsaroop, P. (2003). Cybercrime, cyberterrorism and cyberwarfare. Pan American Health Organization.

Schuett, F. (2010). Network neutrality: A survey of the economic literature. *Review of Network Economics*, *9*(2). doi:10.2202/1446-9022.1224.

Sommer, J. S. (2001). Against cyberlaw. *Berkeley Technology Law Journal, 15*(3), 1145–1232.

Steinmueller, E. (2001). ICTs and the possibilities for leapfrogging by developing countries. *International Labour Review, 140*(2), 193–210.

Tariq, O. (2006). Internet censorship: the end of digital libertarianism? *London School of Economics.*

vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search process. *17th European Conference on Information Systems* (pp. 1–13).

Waller, V., & Johnston, R. B. (2009). Making ubiquitous computing available. *Communications of the ACM*, *52*(10), 127.

Weiser, M. (1991). The computer for the 21st century. *Scientific American*, *265*(3), 94–104. New York.

Wu, T. (2003). Network neutrality, broadband discrimination. *Journal on Telecommunications & High Technology Law, 2*(1), 141–175.

Chapter 5
How Can the Capacity to Decide Be Improved as the Nature of Work and Institutions Change?

Marina Maschler and Asin Tavakoli

5.1 Introduction

Trans-institutional decisions are often slow, inefficient, and ill-informed. The Gartner Group (Gartner 2011) identified the "top 10 strategic technologies for 2011", which included social analytics, context-aware computing, and ubiquitous computing. Human decision-making is already dealing with these IT trends. Especially during the last 3 years of the 2008 financial crisis, decision-making by computer systems gained a foothold in financial markets. These automated decisions and trades are driven by the interplay among legislative measures, increased competition between execution venues, and improvements in information technology (Avellaneda and Stoikov 2008). High-frequency trading, one of the key developments stemming from this technological advance, has become a significant feature of modern financial markets (OICV-IOSCO 2011). However, the automated decisions and actions of such systems can lead to unforeseen events, like the 'flash-crash' that took place on 6 May 2010 (Fischer 2011). The Millennium Project's challenge number nine deals with this conflict between the human decision-making process and the use of information technology to make decisions.

Such grand challenges have not yet been addressed in the field of information systems (IS) research. The IS community is more focused on individual researcher's agendas, deprioritizing such large joint research endeavours as global challenges (Winter and Butler 2011). This article identifies the contributions to the ninth global challenge that have already been made and, based on these contributions, discussions two research questions:

1. What are the major topics in IS that can contribute to the ninth global challenge?
2. How should IS researchers address the problems described in the ninth global challenge?

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5.2 Literature Review

5.2.1 Pre-identification of Relevant Topics

Technology offers a huge range of opportunities for connecting computers and humans. Decision support systems (DSS), as a special kind of IS, organize data, information, and models to help improve human decisions. DSS support the decision-maker with the objective facts that may be needed. For example, in large organizations or nations like the UN, decision-making can be improved by showing how visions, missions, goals, strategies, and objectives are linked. An initial summary of the ninth global challenge shows that many areas must be addressed to solve it. Table 5.1 provides an overview of the sub-problems contained in the ninth challenge.

5.2.2 Research Approach

A literature review has been conducted based on vom Brocke et al. (2009) to analyse the available contributions of the IS discipline to these sub-problems.

Table 5.1 Sub-problems of the ninth challenge

Global challenge sub-problems	Sub-problem description	Source
Limited capacity to decide	The human ability to analyze and synthesize the available information in a timely fashion is limited. A result of this is the requirement to reduce decision-making time. Besides, the ability to make timely strategic decisions becomes necessary	The Millennium Project (2011)
Information overload	The increasing amount of available information leads to excessive choice proliferation. Besides, the number and complexity of choices increases. In addition, more and more information sources are made accessible	The Millennium Project (2011)
Increasing number of stakeholders	The number of stakeholders involved in a single decision is steadily increasing. Topics of interest are therefore group decision-making, trans-institutional decision-making, and from a political context also governmental decision-making	Glenn and Gordon (2001)

The focus of the search words is on the decision-making realm and related areas. A concept-centric approach to the literature review is aligned with Webster and Watson (2002). The sub-sections are organized around the sub-problems, after which major concepts and artefacts (if possible) that are addressed by the IS realm are presented.

5.2.3 Literature Search Results

5.2.3.1 Sub-problem: Limited Capacity to Decide

In general, discussing and analysing DSS was popular among IS researchers during the 1980s and 1990s. Sixteen of thirty-six relevant papers describe at least the architecture, the functions, the implementation or a framework for DSS (e.g., Adelman 1991; Alter 1977; Finlay and Forghani 1998; Kersten 1985; Wang and Shen 1989; Sauter and Schofer 1988). In addition, there are a few publications about the theory behind DSS (Arnott 2004; Kasper 1996).

Another group of papers deals with specific types of DSS (Mendonça 2003; Xu et al. 2008), and there are also studies about special types of DSS, such as knowledge-based DSS (Elam and Henderson 1983; Jacob and Pirkul 1992). This special type of IS takes specific knowledge to simulate human expert consulting and uses the concepts of knowledge engineering (Elam and Henderson 1983).

The sub-problem 'limited capacity to decide' refers to the challenge of accessing the most relevant information among irrelevant information and information pollution in order to take the right decision (Orman 1984). Decision-making, as well as its representation, is often an intricate process (Srinivas and Shekar 1997). As Yadav and Khazanchi (1992) mentioned, decision-makers are always involved with understanding, formulating and understanding problems, but they are constantly confronted with limited information capabilities (Yadav and Khazanchi 1992). As a solution, decision-makers could use external IS to access external data. To make the right decision, it is also important to get internal data (Walters et al. 2003).

The results of the studies that deal with the question concerning the degree to which a DSS influences and limits managers in their capacity to decide have shown that managers with high-quality DSS make better decisions with a generic tool like Microsoft Excel (Lilien et al. 2004; Riedel and Pitz 1986).

5.2.3.2 Sub-problem: Increasing Number of Stakeholders

The literature identified as relevant to this topic can be divided into five groups. In the first group are publications that provide a general overview of the topic (Buchanan and O'Connell 2006; Fjermestad and Roxa 1998). The second group contains publications that deal with group characteristics like communication synchronicity (Benbunan-Fich et al. 2003), or that deal with the effects of group

size and spatial arrangements (Cummings et al. 1974) or group composition (Daily et al. 1996) on group decision-making performance or decision-making quality.

Papers in the third group analyse techniques that could be used in the group decision-making process to enhance performance. Examples of such techniques are problem structuring and modelling (Barki and Huff 1985), decisional guidance (Limayem and DeSanctis 2000), and aspiration-led and quasi-satisficing paradigms for eliciting user's preference (Lewandowski 1989). Researchers in this group also explore techniques to overcome certain problems in decision-making groups. For example, researchers have looked at the personal preferences problem in group settings (Farris et al. 1975), decisions under threats (Gladstein and Reilly 1985), and situations that require fast and flexible decision-making (Mendonça 2003). From a leadership perspective, research has been conducted on group decision approaches (Miner 1979). Technology support is also a prominent research area in the area of group decision-making. Groups that use technology performed better than those that did not (Daily et al. 1996). Others had similar results using adaptive structuration theory building on the research findings of a twenty-year-long project (DeSanctis et al. 2008). Moreover, it has been empirically shown that technology-supported groups develop project agendas that are more closely related to the requirements of the team members (Dennis et al. 2003). The additional use of expert systems outperforms the use of systems in individual settings (Nah et al. 1999). Zigurs et al. (1988) took a closer look at group processes, identifying influence behaviour as a major variable, while El-Shinnawy and Vinze (1998) identified polarization and persuasive argumentation in group settings as important factors.

The fourth group of publications deals with GDSS. From a historical perspective some authors began with computer-supported decision-making in groups using a UNIX-based PDP11 to support the interactive process with technology (Steeb and Johnston 1981). Others showed that GDSS help groups that are communicating face-to-face perform better (Smith and Vanecek 1990). The concept of GDSS has also been aligned with other available systems, such as by combining them with knowledge management systems to improve results (Jacob and Pirkul 1992). The prevailing finding of the literature search deals with media choice in GDSS (Sarker et al. 2010).

The fifth set of publications focuses on practically relevant topics, such as specific professions and industries. (Choudhury et al. 2006; Finnegan and O'Mahony 1996).

5.2.3.3 Sub-problem: Information Overload

The literature that is relevant to this topic can be divided into two groups. In the first group are publications that deal with information overload that affects individual people (Jones et al. 2004), how the complexity of messages affects user behaviour (O'Reilly III 1980), how decision-makers' perceived information overload is associated with higher satisfaction and lower performance (Turetken and Sharda 2001, 2004), how visualization of web search results leads to less information overload, how information overload affects decision quality

(Paul and Nazareth 2010), and the relationship among information processing, information complexity, and time pressure.

In the second group are publications that deal with groups of people who are collaborating. Grise and Gallupe (1999) designed an idea regulator to regulate the flow of information ideas with higher levels of complexity, while Paul and Nazareth (2010) concluded that there is a relationship among information processing, information complexity, and time pressure.

5.3 Discussion

Referring to the first research question, the IS discipline deals with the capability of IS to improve the effectiveness and efficiency of human organizations. The discipline seeks to obtain knowledge about the productive application of IT in the organization and to perform research on the development and use of IS for managerial purposes. Hevner et al. (2004) argued that both behavioural and design science research are necessary for this purpose. From the global challenges perspective, Sidorova et al. (2008) identified IS as a supportive academic discipline because DDS, among other research areas, has been extensively researched).

The sub-problem *limited capacity to decide* was a significant topic during the 1980s and 1990s. Publications about architectures and frameworks for developing DSS are the most frequent, and some researchers aligned DSS with the social and political situation. As for *information overload*, the second sub-problem, the literature search showed that the topic has been addressed from both an individual and a group perspective and that some researchers have focused on specific information-overload situations, such as those that occur when one performs a web search. The literature that is relevant to the sub-problem *increasing number of stakeholders* can be divided into six groups: topic overview, group characteristics, group decision-making techniques, group decision approaches, GDSS, and practice.

Clearly, the IS discipline addresses many topics in the decision-making realm. Many publications, as a detailed analysis of the sub-problems has shown, have focused on technical or methodological approaches and frameworks to develop such systems. Some researchers also included human beings as individuals or as groups in order to determine which of their characteristics influence the decision-making process or need to be adjusted to the DSS. From a methodological perspective, the majority of studies analysed were conducted by empirical research, while only a small were intended to contribute to theory-building.

5.4 Research Agenda

To address the second research question, a research agenda is presented to guide future IS research in supporting the resolution of the ninth global challenge. The aim of the research agenda is to derive sharp and insightful questions for research

to consider that are aimed at solving the ninth challenge from an IS perspective (vom Brocke et al. 2009). As the IS discipline has addressed the first three sub-problems—limited capacity to decide, increasing number of stakeholders, and information overload—they are not be taken into consideration for a future research agenda.

Governmental decision-making is a general topic that IS research has not covered. One research question could be "How can governments collaborate and come to joint decisions quickly?" Referring to the example of the financial crisis, the ability of governments or larger groups to come to faster decisions could be an advantage in such circumstances.

Other examples of apparently never-ending discussions that lead to no result are the ongoing debate about the national debt of some states in the European Union and the issue of the education sector, where every European country has its own study programmes, regulations, and fees. Politicians are discussing the solutions or actions to take for these issues, but the decision-making process is slow, opaque, and inefficient. One problem in this decision process is that every state wants to have the best solution for its own situation, which usually implies disadvantages for the other participants in the discussion (Egeberg 1999). Part of this challenge could be addressed in research that seeks to answer questions like "How can groups like the European Union or NGOs collaborate in the decision-making process to avoid locally optimal decisions in favour of globally optimal decisions?" Thinking in a larger, trans-institutional context, the European Union could benefit from scale effects, to which IS research could contribute meaningfully in support of global joint decision-making.

A closer look at research about trans-institutional decision-making reveals a gap in the research about trending technologies like cloud computing. A possible research question is "To what degree can IT trends like cloud computing and real-time analysis support trans-institutional decision-making?"

Another topic is the cultural background of decision-making, which has to be considered when taking joint decisions. Whether a group decision is to be made by decision-makers from different countries with different backgrounds must be considered during the discussion phase. In this area, research questions like "What role does the cultural background of a decision-maker in a group decision process play?" or "How can the cultural and social aspects of decisions be implemented in DSS?" can provide input to the ninth global challenge.

In summary, IS can help master the problems of complexity and speed in the decision-making process, and IS research is on track to resolve the ninth global challenge. The discipline should use the plethora of empirical findings in the extant literature to create theories that will strengthen the core of this research area. While researchers began with a focus on the technical and informational support of these processes, they have also started to take the specific characteristics of individuals and groups into account. This is the right direction to take to cover challenge number nine as a whole.

5.5 Conclusion

This article took a close look at how the IS discipline can support the ninth global challenge, identified by the Millennium Group. The literature review provides an overview of the sub-problems of the challenge and describes the most relevant IS-related papers. However, only a limited set of journals and conferences was searched, and most of the resulting papers refer to core IS values. To take a broader view, a broader set of journals and conferences should be reviewed using a quantitative content analysis, rather than the qualitative content analysis employed for this paper, in order to identify additional gaps in the research (Indulska et al. 2011).

This paper proposed a research agenda based on the literature review and the subsequent discussion of the topics identified in the review. While the IS discipline has addressed the sub-problems analysed here, the research area of trans-institutional decision-making is of particular import as an area that could affect the response to such crises as the 2008 financial crisis by providing better information quality and transparency without being influenced by automatic decisions made by poorly programmed systems.

Clearly, the IS discipline addresses a plethora of topics related to the ninth global challenge, although some areas, such as trans-institutional decision-making and governmental decision-making, have not been addressed. The IS discipline can help to resolve the ninth global challenge more comprehensively by widening its scope to include these problems.

References

Adelman, L. (1991). Experiments, quasi-experiments, and case studies: A review of empirical methods for evaluating decision support systems. *IEEE Transactions on Systems, Man, and Cybernetics*, *21*(2) 293–301.

Alter, S. (1977). A taxonomy of decision support systems. *Sloan Management Review*, *19*(1) 39–56.

Arnott, D. (2004). Decision support systems evolution: Framework, case study and research agenda. *European Journal of Information Systems, 13*(4), 247–259.

Avellaneda, M., & Stoikov, S. (2008). High-frequency trading in a limit order book. *Quantitative Finance, 8*(3), 217–224.

Barki, H., & Huff, S. L. (1985). Change, attitude to change, and decision support system success. *Information & Management, 9*(5), 261–268.

Benbunan-Fich, R., Hiltz, S. R., & Turoff, M. (2003). A comparative content analysis of face-to-face vs. asynchronous group decision making. *Decision Support Systems, 34*(4), 457–469.

Buchanan, L., & O'Connell, A. (2006). A brief history of decision making. *Harvard Business Review, 1*, 32–41.

Choudhury, A. K., Shankar, R., & Tiwari, M. K. (2006). Consensus-based intelligent group decision-making model for the selection of advanced technology. *Decision Support Systems, 42*(3), 1776–1799.

Cummings, L. L., Huber, G. P., & Arendt, E. (1974). Effects of size and spatial group on arrangements decision making. *The Academy of Management Journal, 17*(3), 460–475.

Daily, B., Whatley, A., Ash, S. R., & Steiner, R. L. (1996). The effects of a group decision support system on culturally diverse and culturally homogeneous group decision making. *Information & Management, 30*(6), 281–289.

DeSanctis, G., Poole, M. S., Zigurs, I., DeSharnais, G., D'Onofrio, M., & Gallupe, B., et al. (2008). The Minnesota GDSS research project: Group support systems, group processes, and outcomes. *Journal of the Association for Information Systems, 9*(10/11), 551–608.

Dennis, A. R., Garfield, M. J., & Adoption, G. (2003). The Adoption and use of GSS in project teams: Toward more participative processes and outcomes. *Management Information Systems Quarterly, 27*(2), 289–323.

Egeberg, M. (1999). Transcending intergovernmentalism? Identity and role perceptions of national officials in EU decision-making. *Journal of European Public Policy*, *6*(3), 456–474

El-Shinnawy, M., & Vinze, A. S. (1998). Polarization and persuasive argumentation: A study of decision making in group settings. *Management Information Systems Quarterly, 22*(2), 165–198.

Elam, J. J., & Henderson, J. C. (1983). Knowledge engineering concepts for decision support system design and implementation. *Information & Management, 6*(2), 109–114.

Farris, D. R., Sage, A. P., & Member, S. (1975). Introduction and survey of group decision making with applications to worth assessment. *IEEE Transactions on Systems, Man, and Cybernetics, 1*(3), 346–358.

Finlay, P. N., & Forghani, M. (1998). A classification of success factors for decision support systems. *Journal of Strategic Information Systems, 7*, 53–70.

Finnegan, P., & O'Mahony, L. (1996). Group problem solving and decision making: An investigation of the process and the supporting technology. *Journal of Information Technology, 11*, 211–221.

Fischer, J. (2011). *Am Börsenparkett dominieren heute Software-Programme das Geschehen. Format*. Retrieved December 20, 2011, from http://www.format.at/articles/1133/528/304498/am-boersenparkett-software-programme-geschehen.

Fjermestad, J., & Roxa, S. (1998). An assessment of group support systems experimental research: Methodology and results. *Journal of Management Information Systems, 15*(3), 7–149.

Gartner. (2011). *Gartner identifies the top 10 strategic technologies for 2011*. Retrieved December 20, 2011, from http://www.gartner.com/it/page.jsp?id=1454221.

Gladstein, D. L., & Reilly, N. P. (1985). Group decision making under threat: The tycoon game. *Management, 28*(3), 613–627.

Glenn, J. C., & Gordon, T. J. (2001). The millennium project: Challenges we face at the millennium. In *Technological Forecasting and Social Change* (Vol. 66). New York: Elsevier.

Grise, M.-L., & Gallupe, R. B. (1999). Information overload: Addressing the productivity paradox in face-to-face electronic meetings. *Journal of Management Information Systems*, *16*(3), 157–185.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems. *MIS Quarterly, 28*(1), 75–105.

Indulska, M., Hovorka, D. S., & Recker, J. (2011). Quantitative approaches to content analysis: Identifying conceptual drift across publication outlets. *European Journal of Information Systems*, *21*(1), 49–69. Nature Publishing Group.

Jacob, V. S., & Pirkul, H. (1992). A framework for supporting distributed group decision-making. *Decision Support Systems, 8*(1), 17–28.

Jones, Q., Ravid, G., & Rafaeli, S. (2004). Information overload and the message dynamics of online interaction spaces: A theoretical model and empirical exploration. *Information Systems Research, 15*(2), 194–210.

Kasper, G. M. (1996). A theory of decision support system design for user calibration. *Information Systems Research, 7*(2), 215–232.

Kersten, E. (1985). NEGO—group decision support system. *Information & Management, 8*, 237–246.

Lewandowski, A. (1989). SCDAS—Decision support system for group decision making: Decision theoretic framework. *Decision Support Systems, 5*, 403–423.

Lilien, G. L., Rangaswamy, A., Van Bruggen, G. H., & Starke, K. (2004). DSS effectiveness in marketing resource allocation decisions: Reality vs perception. *Information Systems Research, 15*(3), 216–235.

Limayem, M., & DeSanctis, G. (2000). Providing decisional guidance for multicriteria decision making in groups. *Information Systems Research, 11*(4), 386–401.

Mendonça, D. (2003). Decision support for improvisation: Prospects, challenges and opportunities. In *Proceedings of the International Conference on Information Systems* (pp. 1–15). Seattle.

Miner, F. C, Jr. (1979). A comparative analysis of three diverse decision making approaches. *The Academy of Management Journal, 22*(1), 81–93.

Nah, F. H. (Fiona), Mao, J., & Benbasat, I. (1999). The effectiveness of expert support technology for decision making: individuals versus small groups. *Journal of Information Technology*, *14*(2), 137–147.

OICV-IOSCO. (2011). Regulatory issues raised by the impact of technological changes on market integrity and efficiency. In *Regulation* (pp. 1–60). Madrid.

Orman, L. (1984). Fighting information pollution with decision support systems. *Journal of Management Information Systems*, *I*(2), 64–71.

O'Reilly, C. A, I. I. I. (1980). Individuals and information overload in organizations: Is more necessarily better? *The Academy of Management Journal, 23*(4), 684–696.

Paul, S., & Nazareth, D. L. (2010). Input information complexity, perceived time pressure, and information processing in GSS-based work groups: An experimental investigation using a decision schema to alleviate information overload conditions. *Decision Support Systems*, *49*(1), 31–40. Elsevier B.V.

Riedel, S. L., & Pitz, G. F. (1986). Utilization-oriented evaluation of decision support systems. *IEEE Transactions on Systems, Man, and Cybernetics, 16*(6), 980–996.

Sarker, S., Sarker, S., & Valacich, J. S. (2010). Media effects on group collaboration: An empirical examination in an ethical decision-making context. *Decision Sciences, 41*(4), 887–932.

Sauter, V. L., & Schofer, J. L. (1988). Evolutionary development of decision support systems: Important issues for early phases of design. *Journal of Management Information Systems, 4*(4), 77–92.

Sidorova, A., Evangelopoulos, N., Valacich, J. S., & Ramakrishnan, T. (2008). Uncovering the intellectual core of the information systems discipline. *Management Information Systems Quarterly, 32*(3), 467–482.

Smith, J. Y., & Vanecek, M. T. (1990). Dispersed group decision making using nonsimultaneous computer conferencing: A report of research. *Journal of Management Information Systems, 7*(2), 71–92.

Srinivas, V., & Shekar, B. (1997). Strategic decision-making processes: Network-based representation and stochastic simulation. *Decision Support Systems, 21*(2), 99–110.

Steeb, R., & Johnston, S. C. (1981). A computer-based interactive system for group decision making. *IEEE Transactions on Systems, Man, and Cybernetics, 11*(8), 544–552.

The Millennium Project. (2011). *Global challenges facing humanity*. Retrieved October 20, 2011, from http://www.millennium-project.org/millennium/Global_Challenges/chall-09.html.

Turetken, O., & Sharda, R. (2001). Visualization support for managing information overload in the web environment. *Proceedings of the International Conference on Information Systems* (pp. 1–12). New Orleans.

Turetken, O., & Sharda, R. (2004). Development of a fisheye-based information search processing aid (FISPA) for managing information overload in the web environment. *Decision Support Systems*, *37*(3), 415–434.

vom Brocke, J., Alexander, M., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search proccess. In *ECIS 2009* (pp. 1–13). Verona.

Walters, B. A., Jiang, J. J., & Klein, G. (2003). Strategic information and strategic decision making: The EIS/CEO interface in smaller manufacturing companies. *Information & Management*, *40*, 487–495.

Wang, H. F., & Shen, S. Y. (1989). Group decision support with MOLP applications. *IEEE Transactions on Systems, Man, and Cybernetics, 19*(1), 121–126.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *25*(2), xiii–xxiii.

Winter, S. J., & Butler, B. S. (2011). Creating bigger problems: Grand challenges as boundary objects and the legitimacy of the information systems field. *Journal of Information Technology, 26*(2), 99–108.

Xu, Z., Yuan, Y., & Ji, S. (2008). A decision analysis framework for emergency notification. In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008)* (pp. 1–9). IEEE.

Yadav, S. B., & Khazanchi, D. (1992). Subjective understanding in strategic decision making. *Decision Support Systems, 8*, 55–71.

Zigurs, I., Poole, M. S., & DeSanctis, G. L. (1988). A study of influence in computer-mediated group decision making. *Management Information Systems Quarterly, 12*(4), 625–644.

Chapter 6
The Role of Information Technologies in Changing the Status of Women to Improve Human Conditions

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6.1 Introduction

Experiences all over the world have shown that women drive development, and holding them back has an adverse impact on economic growth (Dlodlo 2009). The level of social and political development is also affected by the level of women's contribution to society (Best and Maier 2007). Therefore, those societies that discriminate by gender pay a high price in terms of their ability to grow and reduce poverty (Sharma 2003).

The meaning of quality differs in different parts of the world, especially between developed countries and developing countries (Glenn and Gordon 2001). In developing countries equality refers to reducing the number of women who are living in poverty and situations of violence, increasing women's literacy and education rates, providing access to resources and financial aid, and increasing women's participation in public and professional life (Glenn and Gordon 2001). Best and Maier (2007) argue that long-standing gender inequalities in developing countries lead to a gap that is difficult to close. As for developed countries, despite great progress, industrialized nations are also far from reaching gender equality, as wage gaps and limited access to executive power pose unique problems (Glenn and Gordon 2001). Even in developed countries, women represent far less than half of a nation's use of intellectual capital, skilled labor, and economic contribution (Leahy and Yermish 2002).

The international community sees information and communication technologies (ICT) as the most effective tool in the context of strengthening gender development and economic development almost simultaneously (Best and Maier 2007). Many results have demonstrated that it can be a vital tool in triggering a revolutionary change that is beneficial to both women and men (Dighe and Reddi 2006; Hafkin and Huyer 2006). Hence, the goal of this paper is to identify existing theories and the state-of-the art in this field.

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6.2 Literature Review

The objective of our literature review was derived from challenge number five of the Millennium Project (Glenn et al. 2001) and adapted to the context of IS. The review follows a method presented by Watson and Webster (2002), which focuses on journal and conference publications because of their traditionally high quality and timeliness. The review followed three steps:

(1) *Defining a research basis.* We chose Science Direct and EBSCO Business Source Premier as a starting point for the analysis. The search covers an unrestricted timeframe and sought the keywords "information technology" and "woman" in the papers' titles, abstracts, and keywords (Table 6.1).
(2) *Extracting and categorizing relevant research.* Our search yielded 297 articles, of which 245 articles were published in Science Direct and 52 were published in EBSCO Business Source Premier. Among these articles we identified 20 candidate articles that focus on the role of women in correlation with IT and that cover either the aspects of women's roles that are supported by IT or the aspects of women's roles in IT. Among these 20 articles, 12 were from Science Direct, and 8 were from EBSCO Business Source Premier.
(3) *Analyzing the research.* It was apparent that, among these 20 relevant studies, ICT was usually described as a diverse set of technological tools and resources (Nath 2001; Pattanaik 2005) and as a tool to get human voices heard (Shirazi 2011), challenge long-standing inequalities, open up new perspectives, and raise awareness about inequity (Mbarika et al. 2007; Nath 2001; Pattanaik 2005; Sandys 2005; Shirazi 2011).

Three main perspectives are prevalent in the IS literature: *gender and technology, gender in the IT workplace,* and *empowerment.* The gender and technology category includes papers that deal with problems of digital divide, female-friendly IT design, and women's perceptions of IT. The Gender in the IT workplace category covers a broad range of barriers that women experience at their workplaces as well as barriers that prevent them from entering the IT industry. The empowerment category groups the kinds of empowerment that come from IT: social-economic, political, economic, and psychological empowerment.

Table 1 Research approach

	Science direct	EBSCO business source premier
Source	All sources	All sources
Time frame	All years	All years
Search term 1	Woman	Woman
Search field 1	TITLE-ABSTR-KEY	TITLE
Search term 2	[AND] "information technology"	[AND] "information technology"
Search field 2	TITLE-ABSTR-KEY	TITLE

6.3 Results and Discussion

Having identified papers that are relevant to the role of women and IT in conjunction with the three broad categories to which the papers belong, the next step is to describe the current state of our research topic in the literature. A qualitative approach to the categories of *gender and technology*, *gender in the IT* workplace, and *empowerment* of women identifies subtopics for each of these categories. Since the categorization of our results has a hierarchical structure, our descriptions begin with the high-level category (e.g., *gender and technology*) before delving more deeply into the category.

6.3.1 Gender and Technology

Women's perception of IT. New technology is often portrayed as a male domain (Dlodlo 2009; Wasserman and Richmond-Abbott 2005). Researchers explain that those gender-specific differences have their origins in the fact that women have traditionally constructed a more distant relationship to technology than men have and have underestimated their usage skills (Kelan 2007; Rasmussen and Håpnes 1991; Wasserman and Richmond-Abbott 2005). Socio-cultural and religious influences and preconceptions about women's ability to understand and manipulate technology hinder women from actively engaging in the use of ICT (Bimber 2000; Dlodlo 2009; Wasserman and Richmond-Abbott 2005).

Female-friendly IT design. Researchers argue that technology may be "gendered by design" because men's values have been institutionalized in the technology through its creators, embedding a cultural association with masculine identity in the technology itself (Bimber 2000; Kaminski and Reilly 2004; Kelan 2007). Especially the Internet is biased toward men because of gender inequality in the professions that produce Internet technologies, the commercial success of male-oriented pornography, and so on (Bimber 2000). ICT and its content—designed by men in the English language and without considering women's interests, concerns, perspectives, and required information—create a significant obstacle for women, especially in the developing world (Dlodlo 2009; Parmentier and Huyer 2008; Sandys 2005).

Within this context are two main perspectives on female-friendly IT design: that which views women as users of IT design and that which is concerned with women as designers of IT. Fountain (2000) highlights that women as users have the power to shape IT design. However, the influence of users, although important and far-reaching, is limited; designers fashion technology more deeply, pervasively, and fundamentally. In this regard, women are poorly represented as IT designers and experts, so research should pay attention to the potential role women might play as designers in the information-based society (Fountain 2000; Wajcman and Lobb 2007).

Gender digital divide. Studies on the digital divide address who (e.g., individuals, organizations/communities, societies/countries/world regions) uses what attributes (e.g. income, education, geography, age, profitability, sector) to connect to what kind of technology (e.g., phone, Internet, computer) and how they do it (e.g., pain access, usage, real impact) (Hilbert 2010, 2011). Adoption of gender analysis regarding ICT developments sheds light not only on the digital divide between developed and developing nations but also on a gender divide between men and women in terms of access to, usage of, and benefits of ICTs (Best and Maier 2007; Brännström 2011; Dighe and Reddi 2006; Hilbert 2011; Sandys 2005; Wasserman and Richmond-Abbott 2005). As available statistical data show, in developing countries women are less likely than men are to use ICTs (Brännström 2011; Dighe and Reddi 2006; Huyer 2005; Sandys 2005), leading related research to conclude that a gender digital divide exists and poses a severe threat to women (Hafkin and Huyer 2006; Hilbert 2011). However, our findings also indicate that the digital divide is closing, and in some countries like Kenya the process is rapid (Brännström 2011). Other case studies and research papers show that ICTs hold the promise of empowering women (Hafkin and Huyer 2006; Hu 2003; Sandys 2005; Sharma 2003). In any case, the extant literature is inconclusive, arguing either that ICT is a threat to women or that it is a unique opportunity for empowerment.

6.3.2 Gender in the IT Workplace

Barriers to entering the IT field. The literature presents two dominant viewpoints about the barriers to women's entering the IT field. As Trauth (2002, p. 99) argues, one perspective "focuses on the presumption of inherent differences between women and men to explain the perception of IT as a male domain […]." Social influences during childhood and adolescence, such as parents, media, race, ethnicity, and socio-economic status, influence girls' choices in many ways and constrain their education and career decisions later (Fountain 2000; Kaminski and Reilly 2004; Kelan 2007; Sanders 2005). Research has found that women perceive the IT workplace negatively, as a field for "geeks and nerds" (Gürer and Camp 2002; Kelan 2007; Rasmussen and Håpnes 1991; Wentling and Thomas 2009). Women also frame the work as difficult, isolated, unattractive, and lacking the necessary social interaction and work-family balance (Armstrong et al. 2007; Kelan 2007; Wentling and Thomas 2009). Other impediments are the general lack of role models and networking opportunities (Armstrong et al. 2007; Ballard et al. 2006; Fountain 2000; Medeiros 2005; Riemenschneider et al. 2006; Wentling and Thomas 2009).

Barriers while working in the profession. The fact that the number of women in IT field is declining has triggered discussions about how to retain those who are currently employed (Armstrong et al. 2007). The literature that explores workplace conditions has identified several barriers for women who work in the IT profession, including discrimination (Armstrong et al. 2007; Panteli et al. 2001;

Riemenschneider et al. 2006; Stevens 2009), lack of respect (Riemenschneider et al. 2006; Stevens 2009), lack of consistency (e.g., lack of consistency at the organizational level; lack of consistency in how supervisors treat employees) (Riemenschneider et al. 2006), promotion barriers (Armstrong et al. 2007; Riemenschneider et al. 2006), work-family conflict (Armstrong et al. 2007; Gürer and Camp 2002; Riemenschneider et al. 2006; Stevens 2009), work stress (Riemenschneider et al. 2006), difficulty into keeping up with the pace of the IT industry (Kelan 2007), and lack of confidence (Stevens 2009). Only a little research has been conducted about male IT employees, their perceptions, and opinions in regard to the shortage of women in their profession (Kelan 2007).

Work conditions for women in IT. There is a tendency for women to be at a disadvantage compared to men in terms of their terms and conditions of employment (Panteli et al. 2001). Researchers claim that women are consistently paid less than men are for similar work, even after years of education and experience (Armstrong et al. 2007; Baroudi and Igbaria 1995; Dubnoff and Kraft 1986; Klawe and Leveson 1995; Panteli et al. 2001; Roan and Whitehouse 2007; Wright and Jacobs 1994) and that it is more difficult for women than men to advance in their careers, especially to managerial jobs, because they are more likely than men are to interrupt their careers, to work part-time, and to work under short-term contracts. (Armstrong et al. 2007; Fountain 2000; Panteli et al. 2001). Exclusion from male-dominated social networks in the organization is a particular obstacle in terms of gaining skills, job leads, and mobility in the organization (Trauth et al. 2003), and it limits women's ability to build technical skills and knowledge (Trauth et al. 2003). Working long hours and the need for continuous learning in order to keep up with changes in the field and required skills make it nearly impossible to balance work and family obligations (Armstrong et al. 2007; Fountain 2000). We also included in this sub-topic research that identifies women's attitudes toward such work conditions and barriers. Trauth et. al. (2003) distinguish three types of women in this regard: those who tend not to focus on the fact that they are women, those who accept the uneven playing field, and those who have experienced the uneven playing field and are willing to speak up about it.

6.3.3 Empowerment of Women

Addressing the gender dimensions of access, need, and use of ICT is central to women's empowerment in the area of ICT. As Nath (2001) explains, effective initiatives and projects have to take women's needs and concerns regarding ICTs into account in order to ensure that women and men benefit equally.

Socio-economic empowerment. Relevant research about socio-economic empowerment deals with a variety of topics in the context women's use of ICTs. Under the topic of socio-economic empowerment, we included articles that discuss women's empowerment in the realms of education, health care, and violence against women. Combinations of traditional and new ICTs are applied in

education in order to support the education and training of women and girls in formal and informal learning, distance education, and establishing e-learning centers. Sandys (2005) argues that education initiatives that focus on women in poor communities or on computer literacy have already demonstrated the value of ICT for women.

There is vast potential for ICT to facilitate global, regional, and national health initiatives for women. Organizations like Satellife[1] and HealthNet[2] have successfully provided medical information and connected medical specialists to developing countries. ICT is an effective tool in disseminating information about women's health, including sexual and reproductive rights and health (Sandys 2005). ICT can also help women to fight against violence. For example, ICT can be used to foster awareness about the many forms that violence against women can take on the Internet and to develop a community that can respond to these issues. By using ICT, women's groups can participate in the development of policies, legislation, and other actions to combat the exploitation of women and girls (Sandys 2005).

Political empowerment. Women and their organizations have pioneered strategic and empowering uses of ICT to promote women's rights (Sandys 2005). For example, Shirazi observes that "blogging in Iran has helped repressed and marginalized groups reach out, including women's and human rights activists, ethnic and religious minorities and Iranian youth to get their voices heard and to challenge the long-standing univocal government and Islamic religious authorities […]." Women in Zambia use mobile phones to keep informed about court hearings in order to mobilize women to meet at the courthouse to advocate for women's rights (Keifer-Boyd 2011). ICT in this context is used as a tool to promote women's rights, keep them informed, and help them to challenge authorities.

Economic empowerment. There is an evidence that internationally outsourced jobs like medical transcription work and software services have made a considerable difference in women's work opportunities in developing countries (Sandys 2005). For instance, women hold positions in most telephone operating companies in India (Valk and Srinivasan 2011). ICT also has the power to make time and distance less significant, so women can work from anywhere and at any time, even if they have young children, and become financially independent and empowered (Nath 2001). Jiyane and Mostert (2010) point out that ICT supports businesswomen in South Africa by connecting them with business partners. Another powerful application of ICT is as a part of knowledge networking—that is, electronic commerce that refers not only to "selling products and services on-line, but also to the promotion of a new class of ICT-savvy women entrepreneurs in both rural and urban areas" (Nath 2001).

Psychological empowerment. The psychological dimension of empowerment refers to women's sense of self-value and self-appreciation (Keifer-Boyd 2011). Hu (2003) defines psychological empowerment as "a motivational construct

[1] http://www.satellife.org.

[2] http://www.healthnet.org.

manifested in four cognitions: meaning, competence, self-determination, and impact […].” This definition suggests that frequent use of IT at work raises women’s confidence, self-assurance, and innovativeness and provides them with a significant amount of influence and control at their workplaces. ICT’s psychological impact applies not only to the work environment but also to everyday life (Keifer-Boyd 2011).

6.4 Research Agenda

The results of the literature review suggest the need for future research on the impact of the changing status of women with regard to information systems on the improvement of the human condition. Generally speaking, there is little research on how the changing status of women in conjunction with IT can improve overall human conditions. Most of the papers in our review are concerned with the conditions women are currently under in the IT field, or they provide information about problems and challenges with regard to the role of women and IT. The impact of empowering women with IT about the human condition and about how entire human communities can benefit from the changing status of women by means of IT is only a side note in these articles. Hence, based on the current status of the literature, we propose three questions to further the research.

(1) *How can the changing status of women by means of ICT improve human conditions?* Most of the extant research investigates the current status of women in IT or how IT can change their current status. However, a shift should be made to question how women’s changing status by means of ICT can improve human conditions.
(2) *How can the changing status of women by means of ICT improve human conditions in accordance with regional considerations?* The Millennium Project (2011) distinguishes the problems that women experience according to whether they live in Africa, Asia and Oceania, Europe, Latin America, or North America. Our literature review also showed that the role of women and IT issues can be differentiated based on whether they live in developed countries or developing countries. Further elaboration is needed in order to clarify how improvement of certain regional problems can affect overall human conditions.
(3) *What negative impact might the changing status of women by means of IT have on human conditions?* Every coin has two sides, and so far most papers have focused on the positive influence of IT. Additional research on the problems that might occur with regards to the role of women and IT topic would be useful because it has far reaching consequences on team work, virtualization of working practices and work-life balance.

6.5 Conclusion

This literature review provides both quantitative and qualitative insights into the current state of research on how IT contributes to the changing role of women. We believe that understanding the current body of knowledge is the first step to realizing how the impact of IT on the status of women might affect the human condition. Unfortunately, the extant literature illustrates the possible consequences for society but does not provide sufficient empirical evidence. This literature review provides evidence that research has not answered the main question of how the changing status of women can help improve the human condition and how information systems can influence this process. Thus, this study serves as a starting point for future research in this field.

This review has some limitations. First, the scope of our review is a limitation, as articles found in Science Direct and EBSCO Business Source Premier tend to have a technical focus. Therefore, initial research that considers a non-technical focus—that is, research in the social or psychological sciences—is necessary in order to validate and, if needed, to broaden the extracted discussions and trends. Second, other researchers may have come up with different classifications than ours, especially in relation to the category of empowerment. We do not claim that the present literature review is exhaustive but only that it presents an initial categorization of the trends and ongoing discussions.

We see the category of *gender and technology* as a comparatively new trend in the overall discussion of women and IT, whereas *gender in the IT workplace* and *empowerment* have been topics of discussion since the early 1990s, although the results of empowerment initiatives have not been discussed in depth. Further research in the areas of gender and technology and the results of empowerment initiatives is needed.

References

Armstrong, D., Riemenschneider, C., Allen, M., & Reid, M. (2007). Advancement, voluntary turnover and women in IT: A cognitive study of work–family conflict. *Information & Management, 44*(2), 142–153.

Ballard, J., Scales, K., & Edwards, M. A. (2006). Perceptions of information technology careers among women in career development transition. *Information Technology, Learning, And Performance*, *24*(2), 1–9. Springer.

Baroudi, J. J., & Igbaria, M. M. (1995). An examination of gender effects on career success of information systems employees. *Journal of Management Information Systems*, *11*(3), 181–201.

Best, M. L., & Maier, S. G. (2007). Gender, culture and ICT use in rural south India. *Gender, Technology and Development, 11*(2), 137–155.

Bimber, B. (2000). Measuring the gender gap on the Internet. *Social Science Quarterly, 81*(3), 1–10.

Brännström, I. (2011). Gender and digital divide 2000–2008 in two low-income economies in Sub-Saharan Africa: Kenya and Somalia in official statistics. *Government Information Quarterly*, *29*(1), 60–67. Elsevier Inc.

Dighe, A., & Reddi, U. V. (2006). *Women's literacy and information and communication technologies: Lessons that experience has taught us*. New Delhi: Commonwealth Educational Media Centre for Asi.

Dlodlo, N. (2009). Access to ICT education for girls and women in rural South Africa: A case study. *Technology in Society*, *31*(2), 168–175. Elsevier Ltd.

Dubnoff, S., & Kraft, P. (1986). *Gender discrimination in the computer industry' (mimeo), Dept of Sociology*. Binghamton: SUNY.

Fountain, J. (2000). Constructing the information society: Women, information technology, and design. *Technology in Society, 22*(1), 45–62. doi:10.1016/S0160-791X(99)00036-6.

Glenn, J. C., & Gordon, T. J. (2001). The Millennium project: Challenges we face at the Millennium. *Technological Forecasting and Social Change, 66*(2–3), 129–312.

Gürer, D., & Camp, T. (2002). An ACM-W literature review on women in computing. *ACM SIGCSE Bulletin*, *34*(2), 121–127. ACM.

Hafkin, N., & Huyer, S. (2006). *Cinderella or Cyberella? empowering women in the knowledge society*. Bloomfield: Kumarian Press.

Hilbert, M. (2010). The manifold definitions of the digital divide and their diverse implications for policy responsibility. In *The 38th Research Conference on Communication, Information and Internet Policy* (pp. 1–16).

Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum*, *34*(6), 479–489. Elsevier Ltd.

Hu, S. (2003). Effects of expectancy-value, attitudes, and use of the Internet on psychological empowerment experienced by Chinese women at the workplace. *Telematics and Informatics, 20*(4), 365–382.

Huyer, S. (2005). Women, ICT and the information society: Global perspectives and initiatives. In *CWIT 05 Proceedings of the International Symposium on Women and ICT Creating Global Transformation* (pp. 5–9).

Jiyane, V., & Mostert, J. (2010). Use of information and communication technologies by women hawkers and vendors in South Africa. *African Journal of Library, Archives and Information Science, 20*(1), 53–61.

Kaminski, J. A. M., & Reilly, A. H. (2004). Career development of women in information technology. *SAM Advanced Management Journal*, *69*, 20–30. SAM society for advancement management.

Keifer-Boyd, K. (2011). African women and ICTs: Investigating technology, gender and empowerment. *Journal of International Women's Studies*, *12*(1), 212–217.

Kelan, E. K. (2007). "I don't know why"—Accounting for the scarcity of women in ICT work. *Women's Studies International Forum, 30*(6), 499–511.

Klawe, M., & Leveson, N. (1995). Women in computing: Where are we now? *Communications of the ACM*, *38*(1), 29–32.

Leahy, K. B., & Yermish, I. (2002). Information and communication technology: Gender issues in developing nations. In *Informing Science + IT Education Conference Proceedings*. Santa Rose: Informing Science Institute.

Mbarika, V. W., Payton, F. C., Kvasny, L., & Amadi, A. (2007). IT education and workforce participation: A new era for women in Kenya? *The Information Society*, *23*(1), 1–18.

Medeiros, C. (2005). From subject of change to agent of change: women and IT in Brazil. In *CWIT 05 Proceedings of the International Symposium on Women and ICT Creating Global Transformation*.

Nath, V. (2001). Empowerment and governance through information and communication technologies: Women's perspective. *The International Information & Library Review, 33*(4), 317–339.

Panteli, N., Stack, J., & Ramsay, H. (2001). Gendered patterns in computing work in the late 1990s. *New technology, Work and Employment, 16*(1), 3–17.

Parmentier, M. J. C., & Huyer, S. (2008). Female empowerment and development in latin america: Use versus production of information and communications technology. *Information Technologies & International Development, 4*(3), 13–20.

Pattanaik, D. (2005). Engendering knowledge networks—empowering women through ICT. In *CWIT 05 Proceedings of the International Symposium on Women and ICT Creating Global Transformation* (pp. 2–6).

Rasmussen, B., & Håpnes, T. (1991). Excluding women from the technologies of the future?: A case study of the culture of computer science. *Futures*, *23*(10), 1107–1119. Elsevier.

Riemenschneider, C.K., Armstrong, D. J., Allen, M. W., & Reid, M. F. (2006). Barriers facing women in the IT work force. *ACM SIGMIS Database*, *37*(4), 58–78. ACM.

Roan, A., & Whitehouse, G. (2007). Women, information technology and "waves of optimism": Australian evidence on "mixed-skill" jobs. *New Technology, Work and Employment*, *22*(1), 21–33. Wiley Online Library.

Sanders, J. (2005). Gender and technology in education: A research review.

Sandys, E. (2005). Gender equality and empowerment of women through ICT. *United Nations, Division for the Advancement of Women*. Retrieved from http://www.un.org/womenwatch/daw/public/w2000-09.05-ict-e.pdf.

Sharma, U. (2003). *Women empowerment through Information Technology*. New Delhi: Authors Press.

Shirazi, F. (2011). Information and communication technology and women empowerment in Iran. *Telematics and Informatics*, *29*(1), 45–55. Elsevier Ltd.

Stevens, H. (2009). The professional fate of woman engineers in the computer sciences: Unexpected reversals. *Sociologie du Travail, 51*, e15–e33.

The Millennium Project. (2011). *The millennium project global futures studies & research*.

Trauth, E. M. (2002). Odd girl out: An individual differences perspective on women in the IT profession. *Information Technology & People, 15*(2), 98–118.

Trauth, E. M., Nielsen, S. H., & von Hellens, L. A. (2003). Explaining the IT gender gap: Australian stories for the new millennium. *Journal of Research and Practice in Information Technology, 35*(1), 7–20.

Valk, R., & Srinivasan, V. (2011). Work–family balance of Indian women software professionals: A qualitative study. *IIMB Management Review*, *23*(1), 39–50. Elsevier Ltd.

Wajcman, J., & Lobb, L. A. P. L. (2007). The gender relations of software work in Vietnam. *Gender, Technology and Development, 11*(1), 1–26.

Wasserman, I. M., & Richmond-Abbott, M. (2005). Gender and the internet: Causes of variation in access, level, and scope of use. *Social Science Quarterly*, *86*(1), 252–270.

Watson, R. T., & Webster, J. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *26*(2), xiii–xxiii.

Wentling, R. M., & Thomas, S. (2009). Workplace culture that hinders and assists the career development of women in information technology. *Information Technology, Learning, and Performance Journal, 25*(1), 25–42.

Wright, R., & Jacobs, J. (1994). *Gender inequality at work*. London: Sage.

Chapter 7
How Can Transnational Organized Crime Networks Be Stopped from Becoming More Powerful and Sophisticated Global Enterprises?

Nadine Székely

7.1 Introduction

In 1994 the Secretary-General of the United Nations, Boutros Boutros-Ghali, referred to transnational crime as having been "organized along relatively simple lines and involv[ing] a limited number of activities" (Boutros-Ghali 1994, p. 1). Today, however, their areas of activity have grown to include trade in nuclear technology and human organs (Boutros-Ghali 1994).

Shelly (1995) emphasized that transnational organized crime organisations undermine the laws of the nation-state through corruption and that trafficking in nuclear materials threatens the state. In addition, Shelly emphasized that the transnational organized crime organisations of the twenty-first century are no longer interested in stable states since they generate their profits from the chaos of wars and conflicts, so they cooperate with terrorist organisations (Shelley 2006). In fact, the support of terrorist groups can be seen as one of the main activities of transnational organized crime organisations (Guymon 2000).

This paper investigates how transnational organized crime networks can be defeated through the use of information systems (IS). The paper starts with a literature review to determine the current state of research on the topic. The first part of the literature review, which shows how transnational organized crime organisations can be characterised, is followed by an overview of the typical activity areas of transnational organized crime. The last part of the literature review deals with the question concerning known ways to defeat transnational organized crimes. Then the results of the literature review are discussed to show the current contribution of IS to the topic, and the last part of the paper presents suggestions for future research in this field.

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7.2 Literature Review

7.2.1 Research Method

This paper focuses on the question concerning what transnational organized organisations are doing and how they can be precluded from getting more power. I conducted a structured literature research with search words that stem from the domains of IS and organised crime, followed by a backward search. To get a better overview of the papers I found and to cluster them, I created a framework based on the papers' topics (cf. Table 7.1), which framework is reflected in the structure of this paper.

7.2.2 Characteristics of Transnational Organized Crime Organisations

Donald R. Cressey described organized crime in 1969. Based on his work, von Lampe (2003) developed a model (Fig. 7.1) that shows how organized crime stands in relation to the government, society, and (illegal) markets. Today's research sees networks as the ideal structure for transnational organized crime organisations (Williams and Godson 2002), since network structures can adapt to

Table 7 1 Clustering of relevant papers

Topic		Relevant paper
Characteristics		5
Activity areas		3
Means against TOCs	Legal regulations	1
	Crime detection	5
	Preventive methods	6
	Cooperation	1

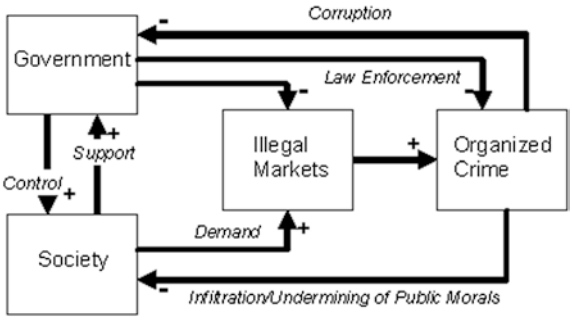

Fig. 7.1 "Cressey Model" (von Lampe 2003)

a continuously changing world (Klerks 2001) and they minimize the risk for the organisations since they are difficult to defeat (Williams and Godson 2002).

Through globalisation, global opportunities and pressure in traditional areas of operation forced organized crime organisations to become transnational (Williams and Godson 2002). Criminal organisations take advantage of globalisation's opening of frontiers and national economies (Williams and Godson 2002; Boutros-Ghali 1994), so their success depends "increasingly on their capacity to act transnationally" (Williams and Godson 2002, p. 342).

Transnational organized crime organisation have high levels of flexibility and the ability to adapt methods and techniques to changes quickly (Williams and Godson 2002), which requires that they use the latest information and communication technologies (ICT) (Etges and Sutcliffe 2008) to, for example, identify leaks in their own contexts and to find potential police informants (Etges and Sutcliffe 2008).

7.2.3 Main Activity Fields

Transnational organized crime organisations are active in several fields. According to Europol (2006), *violence* against persons or property and *corruption* are often connected to other areas of crime Other areas of activity include the *facilitating crime*, which includes counterfeiting of documents in support of illegal immigration; *money laundering*; trafficking in *illegal markets*, the focus of which is goods that are not available legally, such as prohibited or regulated goods (e.g., drugs) and stolen goods; and *fraud*, which includes credit card fraud and non-payment of VAT (Europol 2006). Other areas in which organized crime organisations are active are *human trafficking*, especially the trafficking of women for commercial sex, and *intellectual property theft* and *counterfeiting* (especially Chinese criminal enterprises), while criminal Turkish groups focus on the trafficking of drugs, people, and nuclear material (Williams and Godson 2002). The Internet provides a contact platform for organized crime organisations to offer their services, including the exploitation of children and human trafficking (Etges and Sutcliffe 2008). The services are paid for with e-currencies, which provide anonymity to both buyer and seller and are also used by the crime organisations to launder money (Etges and Sutcliffe 2008).

7.2.4 Means Against Transnational Organized Crime

There are several ways to combat transnational organized crime, the first of which is clear laws and regulations that declare which activities are unlawful and what punishment transgressors can expect. Methods to investigate and prevent crimes must recognize that transnational crimes often affect several states, so cooperation between the states and their law enforcement agencies plays an important role.

The United Nations convention against transnational organized crime (2004) was signed in 2000. This convention asks the signatory states to ensure that

domestic laws against transnational organized crime are established as a way to combat transnational organized crime (Guymon 2000).

Forensic methods play an important role in investigating crimes, especially when there are no eyewitnesses (Afanasyev et al. 2011). P. Kevin Smith, VP of North American sales at LTU Technologies defined digital forensics as "the investigation of digital data, be it on a hard drive or over a network or the web used for investigative purposes" (Miller 2007, p. 40). Although there are already tools in this area, new tools are needed since the current tools cannot cope with the enlarging targets (Golden and Vassil 2006).

In addition to the states, software companies can assist in combatting crime. The Business Software Alliance (BSA) fights against piracy (Nykodym and Taylor 2004) using ICT, and companies support the Child Exploitation Tracking System (CETS), which helps in the search of exploited children (Etges and Sutcliffe 2008).

Combatting crime means not only reacting to crime but also being proactive. Therefore, law enforcement agencies need early information about possible crimes in order to establish good strategies (Verfaillie and Beken 2008; Williams and Godson 2002) through broad data collection and analysis and the extensive use of intelligence sources (Williams and Godson 2002).

The characteristics of transnational organized crimes, such as networked crime, transnational crime, and complex crime, are similar to the nature of the new threats against states that appeared after the Cold War (Dunn Cavelty and Mauer 2009), so the methods used to forecast such threats can also be used in the fight against transnational organized crime. Methods of monitoring criminal activities include "geospatial predictive analysis, data-mining technologies, project management-based approaches and social network analysis" (Dunn Cavelty and Mauer 2009, p. 130). Through the use of data-mining technologies, links and patterns in data sets can be identified. For example, traffic and travel analyses can detect patterns and identify likely areas of new activity (Williams and Godson 2002). The success of social network analysis was evident in 2010, when a boss of an Italian mafia organization was traced down through his Facebook logons (cf., e.g., Wise 2010).

Transnational organized crime organisations use the Internet as a contact platform for their businesses (Etges and Sutcliffe 2008). The use of the Internet for criminal activities can be defeated through regulation. Franklin (2010) discussed the difficulties inherent in implementing such regulation and summarized several possible approaches, including the kind of state regulation that China imposes, where Internet use within China's boarders are monitored and censored by the government (Franklin 2010). The main question here concerns how to regulate the Internet without the state's being accused of being a 'big-brother' (Franklin 2010, p. 68). Franklin also suggested other multi-stakeholder participatory models, keeping in mind that the Internet is not created by an external institution but is built by its users (Franklin 2010). Franklin also questioned, however, whether it was even possible to regulate the Internet within any borders.

Afanasyev et al. (2011) presented an approach to combatting transnational organized crime using digital forensic methods. In the digital world, there is nothing like DNA or fingerprints in the physical world. They proposed to introduce a

new network-layer capability that would allow authorized parties to identify the physical machine that sent a particular packet via the Internet so law-enforcement agencies could map traffic over the internet back to the physical source device.

7.3 Discussion on Results

The previous section summarized results of the literature review on the topic of transnational organized crime. The literature review revealed that IS play three roles in this area: as a communication tool for transnational organized crime organizations, as a new field for criminal activities and a support for existing activities, and as a support for law enforcement agencies that investigate and prevent crimes.

Etges and Sutcliffe (2008) mentioned the use of the IT by transnational crime organisations. Combating these organizations' use of IT is difficult, but once participants are found, their communications can be monitored to prevent future crime. Etges and Sutcliffe (2008) also wrote about how the Internet makes it possible for criminals to offer their services transnationally and how they use the Internet to launder money through the use of e-currencies. Franklin (2010) discussed several ways to regulate the Internet but found no perfect solution and even asked whether it is possible.

Information technology, particularly calculation power, is also used by law enforcement. For example, geospatial predictive analysis is possible only when the required calculations and simulations are done by a computer.

Figure 7.2 summarizes the areas in which IS plays a role in connection with transnational organized crime. Next, these areas are analysed and ideas for further research are developed.

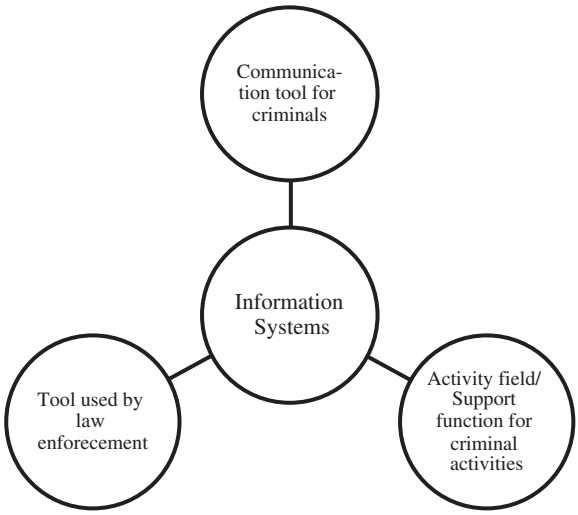

Fig. 7.2 Information systems in connection with transnational organized crimes

7.4 Research Agenda

7.4.1 Areas of Further Research

IS influences transnational organized crime as a communication tool for criminal organisations, as a new field of activity and a support for existing fields of activity for criminal organisations, and as tool to combat criminal organisations. These areas suggest useful approaches for future research.

7.4.2 Communication Tool for Criminals

The communication tools transnational organized crime organizations use are the same tools that legal enterprises use. Therefore, the question concerning how to regulate things that are available to everybody so they cannot be used for criminal purposes is a particularly difficult one. Future research should investigate to what degree it is possible use ICT to identify criminal communication in order to disable it.

If regulation is not possible, monitoring becomes more important. Therefore, the approach Afansayev et al. (2011) identified should be examined in more detail to find methods to monitor criminals while securing the privacy rights of the general public. In connection with data privacy is the topic of data security, which must also be covered by the chosen tools.

7.4.3 Support of Criminal Activities

The Internet supports all kinds of activities, and criminal enterprises are no exception. If regulation of the Internet is not possible, ways of scanning the Internet and finding suspicious pages using search algorithms should be examined.

The broader field of information technology and its role as a support for criminal activities was not examined in detail as part of this paper, so further research should determine whether special means to combat one or more fields of criminal activity are already being used and how they can be enhanced to support the fight against transnational organized crime.

7.4.4 Supporting Law Enforcement

Section 7.4 discussed several methods for predicting criminal actions through pattern analysis and simulations, but further research is needed to focus on the algorithms that are necessary to do such analysis. Future research should also

determine which new technologies, such as in-memory technology, can be used to enhance the success of such methods and what new technologies may include new possibilities to create predictions. In general, then, future research in this area should focus on how the existing analysis can be executed faster and how it can be enhanced through better technical solutions.

Besides supporting the prediction of crimes, IS are used to investigate crimes. In this area digital forensics and the tools that are used to examine digital evidence are important, but the tools that currently exist are not sufficient (Golden and Vassil 2006). Future research should look into the requirements of such new tools and how to build them.

7.5 Conclusion

The aim of this paper was to review the existing research results on the question concerning how IS can help to keep transnational organized crime networks from becoming more powerful. The paper examined how transnational organized crime organisations are characterized in the literature and summarized the main fields of activity in which these organizations engage. The last part of the literature review focused on papers that have addressed way to combat transnational organized crime and identified legal regulations, crime detection, preventive methods, and cooperation.

The results of the literature review were summarized to three main areas where IS play a role: as a communication tool for the criminals, as new field of activity for them, and as a support tool for the law enforcement. Based on these three areas, several areas for future research were developed.

References

Afanasyev, M. et al. (2011). Privacy-preserving network forensics. *Communications of the ACM*, *54*(5), 78. Retrieved September 6, 2011 from http://portal.acm.org/citation.cfm?wdoid=1941487.1941508.

Boutros-Ghali, B. (1994) Transnational crime. *Vital Speeches of the Day*, *61*(5), 130.

Dunn Cavelty, M., & Mauer, V. (2009). Postmodern intelligence: Strategic warning in an age of reflexive intelligence. *Security Dialogue*, *40*(2), 123–144. Retrieved September 29, 2011 from http://sdi.sagepub.com/cgi/doi/10.1177/0967010609103071.

Etges, R., & Sutcliffe, E. (2008). An overview of transnational organized cyber crime. *Information Security Journal: A Global Perspective*, *17*(2), 87–94. Retrieved October 21, 2011 from http://www.tandfonline.com/doi/abs/10.1080/19393550802036631 .

Europol, (2006). *EU organised crime threat assessment 2006* (p.26). Retrieved January 3, 2012 from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:EU+Organised+Crime+Threat+Assessment+2006#0.

Franklin, M. I. (2010). Digital dilemmas: Transnational politics in the twenty-first century. *Security*, *xvi*(ii), 68.

Golden, G. R. I., & Vassil, R. (2006). Next-generation digital forensics. *Communications of the ACM*, *49*(2), 76–80. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20715682.

Guymon, C. L. D. (2000). International legal mechanisms for combating transnational organized crime: The need for a multilateral convention. *Berkeley Journal of International law*. *18*, 53. Retrieved October 21, 2011 from http://heinonlinebackup.com/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/berkjintlw18&section=7.

Klerks, P. (2001). The network paradigm applied to criminal organisations : Theoretical nitpicking or a relevant doctrine for investigators? Recent developments in the Netherlands. *Defense, 24*(3), 53–65.

von Lampe, K. (2003). *The Use of Models in the Study of Organised Crime* (pp. 1–14). Retrieved from www.organized-crime.de.

Miller, R. (2007). The truth is in there. *EContent*, *30*, 30–43.

Nykodym, N., & Taylor, R. (2004). The world's current legislative efforts against cyber crime. *Computer Law & Security Report*, *20*(5), 390–395. Retrieved October 21, 2011 from http://www.sciencedirect.com/science/article/pii/S0267364904000706.

Shelley, L. (2007). The unholy trinity: Transnational crime, corruption and terrorism. In U. Gori and I. Paparela. *Invisible Threats: Financial and Information Technology Crimes and National Security*. Amsterdam, Berlin, Oxford, Tokyo, Washington, D.C. (NATO series): IOS Press, 2007, pp. 100–107.

Shelley, L. (1995). Transnational organized crime: An imminent threat to the nation-state. *Journal of International Affairs*, *48*. Retrieved October 21, 2011 from http://www.questia.com/googleScholar.qst?docId=5000275997.

Verfaillie, K., & Beken, T. V. (2008). Proactive policing and the assessment of organised crime. *Policing: An International Journal of Police Strategies & Management, 31*(4), 534–552.

Williams, P., & Godson, R. O. Y. (2002). Anticipating organized and transnational crime. *Crime, Law and Social Change, 37*, 311–355.

Wise, A. (2010). Mafia Boss betrayed by Facebook. In *ABC News*.

Chapter 8
How Can Growing Energy Demands Be Met Safely and Efficiently?

Stefan Debortoli and Nadine Székely

8.1 Introduction

A United Nations survey identified environmental sustainability as the most important issue of the future (Watson et al. 2010). In particular, meeting the world's growing energy demands safely and efficiently is one of fifteen global challenges identified by The Millennium Project (2011).

While technology provides the electricity we need to live an affluent lifestyle, technology creates carbon emissions that affect the environment (Watson et al. 2008). The information technology (IT) sector contributes to the growing demand for energy especially with the ongoing production of new mobile devices, but information systems (IS) has also been one of the major enablers of productivity growth in many countries and, as such, has helped save resources (Watson et al. 2008). Since the root cause of global warming is fossil fuel consumption (Hoffert et al. 2002), Watson et al. (2010) establish a new subfield of IS, energy informatics, that they define as being "concerned with analyzing, designing, and implementing systems to increase efficiency of energy demands and supply systems" (p. 24). They express the core idea with a simple formula:

$$Energy + Information < Energy$$

Watson et al. (2010) present an integrated framework that incorporates all elements of an energy supply and demand system with an information system at its heart, containing flow networks, sensor networks, and sensitized objects. They identify nine IS research questions, all of which deal with dimensions of the energy informatics framework. This paper elaborates on the IS issues that are related to the supplier side, as depicted in Watson's (2010) energy informatics framework, by focusing on a single research question:

How can an information system integrate supply and demand data to increase energy efficiency?

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To address this question, a literature review to identify existing concepts and the current state of the research in this field is conducted. Then the findings are discussed and gaps in the research are identified and evaluated. Next, a future research agenda is presented which the IS academic community should carry out in order to change the world for the better in terms of meeting its growing energy demands safely and efficiently.

8.2 Literature Review

8.2.1 Literature Search

There are always two parties involved in an energy consumption transaction, a supplier and a consumer (Watson et al. 2010), both of which must be involved equally in order to manage energy efficiency effectively. This paper focuses on the supplier side by investigating the possible effects if the supplier uses various sources of data to understand the customer.

To address the body of knowledge on this topic, all articles published from 2000 to 2011 in the top six journals in the field of IS (*MIS Quarterly*, *European Journal of Information Systems*, *Information Systems Journal*, *Information System Research*, *Journal of AIS*, and *Journal of MIS*) listed by the Association for Information System (AIS) have been searched. Seventeen papers were published between 2000 and 2011, among which only one was considered relevant after applying a full text search on "energy efficiency," "energy demand data," "energy supply data," "demand side management," and "smart grid." Therefore, the search strategy was extended to papers outside the six journals. A second search wave with the same keywords led to a huge amount of results, so the search terms were changed to "energy efficiency AND green IS," "energy efficiency AND information systems," and "energy efficiency AND smart metering." These searches resulted in more than 800 papers, among which not even a dozen were considered relevant. However, two major concepts for leveraging IS to increase energy efficiency were extracted from these papers: demand side management and smart grid technologies. Another literature review on only these two topics refined the results and provided more detailed insights.

The following sections discuss the identified concepts in depth and suggest other concepts that may be researched in the future.

8.2.2 Demand Side Management

During the height of the oil crisis of the 1970s, many electricity utilities introduced demand side management (DSM) with the intention of lowering the customers' energy consumption (Bloom 2010). In a broad sense, DSM refers to

modifying customer energy use, while in a more narrow sense, DSM programs are designed to lower energy consumption (Masters 2004). Even though it is against the utilities' logical strategy of selling more energy, they have since promoted energy-efficient products and technologies intensively. The utilities did not change their strategy because of their benevolence, but lowering the overall energy consumption was an essential step for keeping the Kyoto protocol targets and was less expensive than building new power plants to keep up with the growing demand (Bloom 2010; Geller and Attali 2005). A study by the US Department of Energy revealed that DSM helped to reduce energy consumption in the 1990s by a third.

The first introduction of DSM was in the 1970s, but experts agree that we are currently again in time of aggressive DSM activity (Bloom 2010). There has never been such a high level of governmental funding for the purpose of energy independence, the use of clean green power, and the shift to low-power-consuming electronic devices.

Andrew (2010) states that peak energy periods are the major and most cost-intensive issue in energy production. The problem with electrical energy is that it cannot be stored effectively for times when higher capacities are required; peak times have to be supplied by the power plants directly, without the possibility of using energy produced previously. Andrew (2010) identifies three fundamental components for an effective DSM program (p. 30):

Education and communication

Smart grid technologies

Voluntary curtailment of use

Education and communication is essential if a DSM program is to work effectively, as the best energy-efficient technology does not save the same amount of energy as a well-founded education (Andrew 2010). Today's information systems play a major role in educating consumers by providing internet-based resources for learning about energy-saving practices through program websites, frequently asked questions (FAQs), e-mail newsletters, discussion forums, social media initiatives, and more. Besides providing how-to instructions, such information systems can motivate lower energy consumption by providing specific and challenging goals in combination with public commitment (Graml et al. 2011). Other elements of education and communication include support for repeated behavior through prompts and reminders and learning by doing through immediate feedback—a combination of descriptive and injunctive feedback (Graml et al. 2011). Through social networks, consumer can connect to other people who are also concerned about saving energy and learn about their consumption behavior (Zhang 2012).

Smart grid technologies are another component that can lead to a drastic reduction in energy consumption. Since smart grid technologies have already been identified as one of the major concepts in the literature review, Sect. 8.2.3 is fully dedicated to this topic.

While DSM has many positive aspects and effects (Auffhammer et al. 2007; Geller and Attali 2005). Geller and Attali (2005) identified nine major criticisms and collected responses to them. One of the most common criticisms was the claim that the rebound effect abolishes all energy savings—that is, that reduced

energy costs that are due to low-power devices and subsidized prices increase the demand for other energy services, such as heating, refrigeration, and lighting, when consumers change their behavior because of the lower costs. Several studies have tried to accept or reject the hypothesis of the rebound effect (Auffhammer et al. 2007; Loughran and Kulick 2004), but researchers have not yet concluded whether the effect exists.

DSM is a means for increasing energy efficiency that has been around for more than 40 years. The core idea does not necessarily require information systems in order to function, but IS heavily supports the educational component of DSM.

8.2.3 Smart Grid Technologies

"Smart grid" describes the use of information technologies in energy supply systems (Potter et al. 2009). Smart grid technologies are advanced sensors and communication technologies that improve the use of assets, improve reliability, and enable a wider range of services (Potter et al. 2009). Examples of smart grid technologies are smart meters, which are "advanced meters that identify consumption in more detail than conventional meters and communicate via a network back to the utility for monitoring and billing purposes" (Darby 2010; Farnworth and Castilla-Rubio 2008). One key feature of smart grid technologies their ability to leverage demand side data in order to make better operational supply decisions. This concept is highly related to and interconnected with DSM, but when DSM was introduced forty years ago, the required technology was not available to integrate demand and supply data in almost real-time.

Potter et al. (2009, p. 1) collects some defining features for smart grids:

A smart grid provides an interface between consumer appliances and the traditional assets in a power system (generation, transmission, and distribution).

This two-way communication allows individual customers to control their energy consumption and empowers the operator to control the households' loads, which enables a more agile system behavior.

A smart grid is at least semi-autonomous.

The use of intelligent systems allows the utilities to respond automatically to power-related changes observed by sensor networks, without any human interaction. This capability facilitates much faster reactions to interruptions and other emergency situations. Jansen and Green (2011) describe this behavior as an outage management system (OMS).

A smart grid optimizes the assets of the power system.

Smart grids help to ensure optimal power flows and improve reliability. By communicating peak demand periods and applying dynamic pricing (i.e., charging higher prices during peak hours) based on the system load, smart grids ensure that consumers reduce energy consumption during peak demand periods. This trend lowers overall costs for the utilities since the need for flexible and expensive power generation is reduced dramatically.

A smart grid supports the integration of distributed energy generation into the conventional centralized power system.

Improved communication from two-way metering allows a more intelligent incorporation of decentralized power production (i.e., by connecting residential, commercial, or industrial local energy-generation equipment) into the centralized power system. Thus, the customer could be a supplier as well as a consumer.

Smart grid technologies collect data about the reality in energy distribution systems, measuring the energy that has been consumed and capturing power quality and power outages (Johnson 2010). This capability implies the potential for deriving a huge volume of data from the energy network that must then be turned into meaningful information by means of a central hub for information exchange. Johnson (2010) envisions this hub as a kind of meter data manager, the core responsibilities of which are reading data from the network and feeding information to the network operations and business management by developing the context that surrounds the data. An example is the collection of data about power quality from the smart meter, including issues related to power quality, such as voltage sag problems or overstressed sections of the infrastructure, which would be vital data for the utility (Johnson 2010). The meter data manager also encourages customer interaction by providing personalized power-usage information and mechanisms for economical energy choices through web-based portals.

Johnson's (2010) vision has the meter data manager acting as a central, real-time data transfer and information exchange system that uses all available data sources to provide information to multiple operational and business applications, thereby providing a number of benefits (Johnson 2010, p. 48):

Proactive incident management
Proactive management of power quality
Improvement in the efficiency of asset use
Integration of green energy sources into any part of the network
Consumer engagement in the energy efficiency value chain

Many researchers have identified the use of smart grid technologies as a requirement for lowering the carbon footprint by integrating renewable energy sources into the supply stream (Gobble 2011). Realizing this vision is a challenge by itself, as many studies show. Several countries already have smart grid pilots installed and running since many of the required technologies—such as low-cost sensors to measure network performance and low-cost communications to route that information to consumers, utilities, and distributors—already exist (Gobble 2011).

Another challenge is the integration of smart grids into aging transmission networks while ensuring continued system reliability and security. Although new wind and solar power plants have been integrated into the existing infrastructure, the re-use of currently existing cables is desired, but Gobble (2011) cites an interview with Greenpeace Germany as saying that this is possible only with intelligent systems.

Even though most of the required technology and many pilots exist, more intensive research in the area of intelligent control systems is required, as is

research on the security-related aspects of these systems (Gobble 2011). For instance, an attack by a Trojan horse called Stuxnet targeted communications and controls at energy infrastructures (Davies 2010), which some reports said targeted a nuclear power plant in Iran. Because of those kinds of occurrences, researchers seek to determine whether the benefits of smart grids are worth the associated risk (Davies 2010).

Smart grid technologies are essential for increasing energy efficiency since these technologies close the gap between demand data and supply data. Other effects are new business models like dynamic pricing, which are not currently possible to any detailed extent. However, unresolved issues remain regarding data security in the smart grid that must be the subject of future research initiatives.

8.3 Discussion and Research Agenda

Based on current knowledge about the two fundamental concepts for bringing demand and supply data together, IT can make two contributions: measuring data directly on the customer side and distributing it to the supplier to managing the offer as part of the overall idea of smart grid technologies, and generating education and awareness. DSM can leverage IT to meet these goals.

Smart grid technologies can consider only real-time data in applying new revenue schemes like dynamic pricing in peak periods, while DSM uses no customer-specific historical or real-time data. Table 8.1 categorizes the identified concepts in a temporal context and shows that future data is completely neglected in the attempt to match energy demand and supply.

Today's advanced information technologies and IT trends could lead to a better match between energy demand and supply by predicting future energy consumption. One aspect of such as system would be the use of historical data, which might or might not be personalized with smart grid technologies that identify existing energy usage patterns, such as a household's average cooking time or an individual's average sleeping time. The required data is already available at a granular level through data collection with smart grid technologies. Scientists at the University of Applied Sciences in Münster were even able to conclude which movie a household is watching by analyzing the transmitted data from smart meters (Greveler et al. 2011).

The interconnection of smart grid technologies and other technological concepts, such as the Internet of Things, could influence the short-term forecasts of energy demands. The Internet of Things is a concept in which each real-world object is connected to its environment via sensor networks and wireless communication devices. The dependencies of real-world objects could be automatically

Table 8.1 Considered data types and concept

Considered data	Historical	Real-time	Future
Concepts	DSM, SGT	SGT	–

Table 8.2 Considered data types and concepts #2

Considered data	Historical	Real-time	Future
Concepts	DSM, SGT	SGT	Usage pattern detection, internet of things technologies

analyzed and the upcoming energy demand predicted and reported to the energy provider. A typical scenario could be the combination of geographical information about the resident of a house and the previous usage patterns of electrical appliances. For example, the resident typically goes home from work at 6:00 p.m., and the smart meter detects a typical "cooking-pattern" on weekdays at 7:00 p.m., so the power supplier is notified about the likely upcoming energy consumption.

Table 8.2 shows that future energy consumption could be predicted by detecting use patterns, leveraging historical data, and incorporating new technologies, such as the Internet of Things. However, several obstacles must be overcome in order to enable the future data prediction. First, the Internet of Things technologies must take the step from the visionary or at least roughly implemented concepts to a mature, globe-spanning application. To accomplish this goal, ICT hardware, software, and reference architectures must be developed further, which might be of interest to IS scholars, computer scientists, and electrical engineers.

Second, intelligent algorithms that can detect historical usage patterns and predict future energy demands must be developed. The application of new technologies, such as in-memory computing, could be leveraged in order to improve the demand forecast even more.

Third, all the collected data, independent of the temporal condition, must be treated carefully in order to address privacy and security issues and come up with the most effective, reliable, and trustworthy concept.

8.4 Conclusion

This paper contributes to the emerging body of research on the integration of supply and demand data by means of information systems in order to increase energy efficiency. A literature review revealed existing concepts related to the integration of energy demand and supply data. The two major concepts identified are DSM and smart grid technologies. However, both concepts consider, at best, only historical or real-time data, while future data could be taken into consideration in order to providing accurate forecasts of energy demands. The required predictive data could be collected through the sophisticated use of new information technologies, such as the Internet of Things, and by applying mature usage-pattern-analysis algorithms sped-up by in-memory technologies. However, further research needs to be done in the field of forecasting future energy demand, including development of the required algorithms, hardware, software, and reference architectures and resolving privacy and security issues. These research topics are not only for IS scholars but also for computer scientists and electrical engineers.

References

Andrew, J. W. (2010). The future is now: The new face of demand side management. *Management Quarterly, 51*(1), 1–29.

Auffhammer, M., Blumstein, C., & Fowlie, M. (2007). Demand-side management and energy efficiency revisited. *Energy Journal, 29*(1), 174–185.

Bloom, S. (2010). A New Dawn for Demand-Side Management. Electrical Wholesaling, (August).

Darby, S. (2010). Smart metering: What potential for householder engagement? *Building Research & Information, 38*(5), 442–457.

Davies, S. (2010). Internet of energy. *Engineering & Technology, 5*(16), 42–45.

Farnworth, E., & Castilla-rubio, J. C. (2008). *SMART 2020: Enabling the low carbon economy in the information age*. Report by The Climate Group on Behalf of the Global eSustainability Initiative (GeSI).

Geller, H., & Attali, S. (2005). *The experience with energy efficiency policies and programmes in IEA countries: Learning from the Critics*. Paris: IEA Information Paper.

Gobble, M. M. (2011). Building the smart grid in Europe. *Research-Technology Management, 54*(2), 2–8.

Graml, T., Loock, C.-M., Baeriswyl, M., & Staake, T. (2011). Improving residential energy consumption at large using persuasive systems. In *ECIS 2011 Proceedings*. Paper 184. (pp. 1–15).

Greveler, U., Justus, B., & Löhr, D. (2011). Hintergrund und experimentelle Ergebnisse zum Thema "Smart Meter und Datenschutz", 1–5.

Hoffert, M. I., Caldeira, K., Benford, G., Criswell, D. R., Green, C., & Herzog, H. et al. (2002). Advanced technology paths to global climate stability: Energy for a greenhouse planet. *Science* (New York, N.Y.), 298(5595), 981–987.

Jansen, H., & Green, D. (2011). Building the framework to accelerate smart grid benefits. *Powergrid International, 16*(7), 46–49.

Johnson, B. Y. P. (2010). The meter data manager: A starting point for an information-driven utility. *Powergrid International*, *15*(8), 1–46 (August).

Loughran, D. S., & Kulick, J. (2004). Demand side management and energy efficiency in the United States. *Energy Journal, 25*(1), 19–44.

Masters, G. M. (2004). *Renewable and efficient electric power systems*. Hoboken: Wiley.

Potter, C. W., Archambault, A., & Westrick, K. (2009). Building a smarter smart grid through better renewable energy information. *IEEE/PES Power Systems Conference and Exposition, 2009*, 1–5.

The Millennium Project. (2011). How can growing energy demands be met safely and efficiently? Retrieved from http://www.millennium-project.org/millennium/Global_Challenges/chall-13.html

Watson, R. T., Boudreau, M. -C., Chen, A. J., & Huber, M. (2008). Green is: Building sustainable business practices. *Information Systems*, 1–15. Athens, GA: Global Text Project.

Watson, R. T., Boudreau, M. -C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly, 34*(1), 23–38.

Zhang, Y. (2012). IT enabled environmentally friendly consumption: IT features addressing challenges in consumer decision making. In *ECIS 2012 Proceedings*. Paper 233. (pp. 1–11).

Chapter 9
How Can Scientific and Technological Breakthroughs Be Accelerated to Improve the Human Condition?

Sandro Weber

9.1 Introduction

Technology has often been the driving force in changing the nature of work, but not only the nature of work. From the miracle of the microchip to the divine practice of cloning, the human imagination for technical ingenuity often creates revolutions that outpace society's evolution (Barbian 2003), which can be both empowering and disturbing (Buechner and Balog 1998). The goal of challenge 14 of the Millennium Project is to extract the positive, empowering effects of technologies and use them to improve the human condition. The core of the challenge lies in the question concerning how the breakthroughs of these technologies can be accelerated by means of information systems (IS).

This article first provides an overview of the most important technologies that affect the human condition and then explains how these converging technologies are interrelated and how their use can be improved by means of IS. The results of the literature review are discussed in Sect. 9.1, and the last part of the article offers a research agenda for research fields found during the literature review.

9.2 Related Work

This chapter describes the six increasingly interconnected megatrends Roco and Bainbridge (2003) identified in the field of technology. These megatrends are aligned with the converging technologies and the most important technologies regarding the challenge, and their contribution to the human condition is highlighted.

The term "converging technologies" refers to the convergence of nanotechnology, biotechnology, information technology, and new technologies based on cognitive science. It brings together four previously separate domains of science

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and technology and unites non-traditional conceptions of reality with useful applications. Biotechnology—not only genetic engineering, but all of it—is evolution in action, while information technology is mind embodied in machines. Nanotechnology, in part because it concerns the domain just above that where quantum events take place, demonstrates that the world consists of mechanisms, not mysteries, and cognitive technologies drag human beings themselves under the atomic force microscope to offer the many means by which humans will augment and alter themselves in future decades. Once the technology is used to transform ourselves, it becomes more relevant to our hopes and beliefs than any ancient myth could be (Bainbridge 2007). Convergence can create intelligent systems and environments to improve everyone's quality of life and create access for people with special needs. For example, a combination of wireless technology and nanoscale sensors could allow blind people to walk alone and even to drive (Roco 2008).

9.2.1 Nanotechnology

The societal dimensions of nanotechnology have been a concern since the establishment of the National Nanotechnology Initiative. The workshops on this topic were dominated by visions of applications of nanotechnology in industries from automobiles to space exploration (Scheufele and Lewenstein 2005). Nanotechnology proponents expect that it will offer solutions to key problems, especially those that developing countries face (Invernizzi and Foladori 2005). Several influential articles have claimed that nanotechnology can resolve most of the United Nations' Millennium Development Goals (Invernizzi and Foladori 2005) by making fleets of medical nanorobots smaller than a human cell that can to eliminate cancer, infections, clogged arteries, and even old age (Merkle 2001). Surgeries may be performed internally, and non-invasive procedures could be performed by programmed motes. Dozens of companies are currently developing nanotechnological ways to deliver drugs to specific sites, thus enhancing effectiveness while minimizing side effects. Another use of nanotechnology is improving chemotherapy by using nanopowders and tubes that specifically target tumour sites (McGrady et al. 2010).

In addition to developing computers much more powerful than today's and new medical capabilities that will heal and cure cases that are now viewed as hopeless, this new and very precise way of fabricating products will also eliminate the pollution from current manufacturing methods. Molecular manufacturing will make exactly what it is supposed to make, no more and no less, eliminating pollutants (Merkle 2001). Nanotechnology will be especially important for the developing world because it has the potential to perform work at a small scale (Invernizzi and Foladori 2005). While nanotechnology could also be used to do great harm (Merkle 2001), this article concentrates on its positive capabilities that provide powerful means to improve the human condition.

9.2.2 Biotechnology

Biotechnology can produce new materials that could facilitate daily life, such as clothing that automatically adjusts to changing temperatures and weather conditions (Roco and Bainbridge 2003). This field also promises a revolution in agriculture by providing the means to develop plant species that are resistant to diseases and pests and more tolerant of drought and temperature changes. Craig Venter is creating the first artificial life form by building a synthetic chromosome. New forms of photosynthesis could create hydrogen instead of oxygen and new microbes could be created to eat the plaque that can build up between neurons and reduce brain activity in the elderly (Glenn et al. 2011).

9.2.3 Information Technology

Information technology is mind embodied in machines (Bainbridge 2007). The bit-based language (0 and 1) has allowed expanding communication, visualisation, and control of intellectual power (Roco and Bainbridge 2003). Information technology is primarily a component and an enabler of the other science areas.

9.2.4 Cognitive Science

The term "cognitive science" indicates that the study of mind in itself is a worthy scientific pursuit. It is more of a loose affiliation of disciplines than a discipline of its own. An important pole is occupied by artificial intelligence, so the computer model of the mind is a dominant aspect of the field. The other affiliated disciplines are linguistics, neuroscience, psychology, sometimes anthropology, and the philosophy of mind. Each discipline would give a different answer to the question of what is mind or cognition (Varela et al. 1991).

Fodor's monograph, "The Modularity of Mind," (1983) has had a dramatic impact on all of the cognitive sciences. The essence of Fodor's position is that the human mind is best viewed as a distinction between the central system, which is responsible for rational thought and the "fixation of belief," and the modular input systems, one for each of the senses, that feed the central system. An input system translates a sensory stimulus into a format that the central system can recognise so it can be used in cognition: If I *smell* smoke in the kitchen, I may believe that the toast is burning; if I also *see* flames emerging from the toaster, I may believe that breakfast is going to be less palatable than usual (Karmiloff-Smith 1994).

The challenge lies in the question concerning how IS can support the development of the technologies described above, such as by establishing converging technologies informatics to use existing data better and advance communication among the scientists involved in various technologies. There are separate efforts

in each emerging technology, so the synergy created by such development would support converging technology development in areas like new discoveries, design, and manufacturing, and would address common environmental, health, and ethical implications. Converging technologies informatics would also help to close the gap between the creation of new knowledge in research and policy decisions by improving information transfer and framing of new technologies (Roco 2008).

Bioinformatics is defined as research, development, and/or application of computation tools and approaches to expanding the use of biological, medical, behavioural, or health data, including tools used to acquire, store, organize, archive, analyse, or visualize such data (Cummings and Temple 2010). Computations biology, which provides additional possibilities, especially in education, is defined as the development and application of analytical and theoretical methods, mathematical modelling, and computation simulation techniques to the study of biological, behavioural, and social systems (Cummings and Temple 2010).

Nanoinformatics is a collection of multi-disciplinary approaches to cataloguing, correlating, and modelling nanomaterial properties. CaNanoLab is an early example of a nanobioinformatics portal that is dedicated to fostering the rapid dissemination of nanobiological information across the scientific community. Nanobioinformatics studies are complex because they must simultaneously deal with the large dispersion of chemical formulations of nanobiomaterials (ranging from polymer to metal oxide particles), the lack of a common language across contributing disciplines, and the lack of a low-level language that can be used across nanoparticles. A structure-based annotation and analysis of nanobioparticles could help to cross-analyse their properties (Gonzalez-Ibanez et al. 2009).

Given the range of devices and applications that may be generated and addressed, the development of novel and advanced core characterization and nanomanufacturing technologies will be a requisite strategy for realizing the potential underlying nanotechnological development. The new nanotechnologies can be used to achieve a true coalescence of nanoscience and nanotechnology, which will ultimately benefit the human condition by using the building blocks and fundamental findings of nanoscience to develop systems based on the fusion of biology, nanotechnology, and informatics, with embedded intelligence and emergent behaviour (Ho et al. 2006). Nanoinformatics can also accelerate the introduction of nano-related research and applications into clinical practice, leading to an area that could be called “translational nanoinformatics.”

At the same time, DNA and RNA computing present an entirely novel paradigm for computation. Nanoinformatics and DNA-based computing are likely to change completely how information is modelled and processed in biomedicine and to impact the emerging field of nanomedicine significantly (Maojo et al. 2010). While bioinformatics is usually applied in the context of analysing DNA sequence data, nanoinformatics is applied in the context of characterizing particles and materials with applications in nanotechnology and biotechnology. A key issue in nanoinformatics is the link between information, data, results, and findings using nano-related processes and the standard clinical procedures. This task will be fundamental for the future evolution in the medical arena (De La Iglesia et al. 2009) (Fig. 9.1).

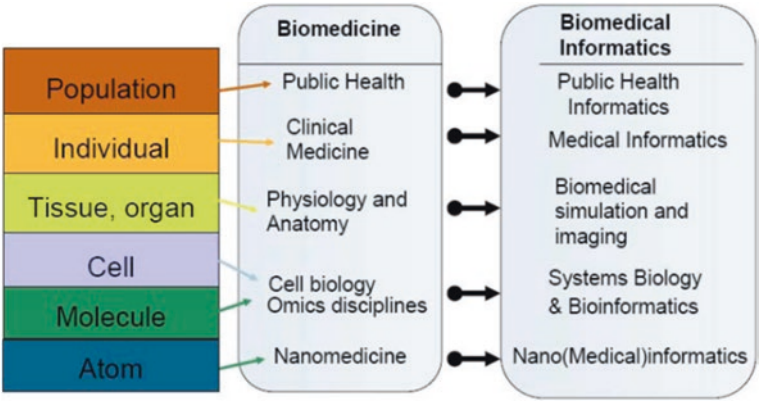

Fig. 9.1 Biomedical informatics going down to the atom level, towards nanoinformatics (De La Iglesia et al. 2009, p. 990)

The next-generation nanoinformatics tools will focus on computational cooperation and systems integration, at which time the overflow of data will be translated into knowledge. These advances will have to move beyond data-sharing to task-sharing when a nanotechnology lab experiment touches on the computing power of a set of equipment behind a common user interface. Future progress in this field will move toward intelligent automation, complex data mining, and intuitive visualization of results (Ruping and Sherman 2004).

The brain-machine interface (BMI) is an example of the convergence of ICT and cognitive science. Recent progress in fundamental neurophysiological research suggests that the vision displayed science fiction movies, such as implanted electrodes, may become possible as the human brain is directly interfaced with computers or embedded in external devices. Information-gathering and information-processing devices could also be incorporated in the human body, but there is still a long way to go before these applications are used in real life. All current prototypes are one-directional—usually from the brain to the external environment—with no feedback loops, but bi-directional interfacing will be necessary for real-life applications like the control of paralyzed limbs or complex prosthetic devices so the brain can use its sophisticated feedback control strategies. In addition, a number of technological challenges, such as better sensory input or better understanding of neural coding of primary motor regions, must be solved before this highly invasive technique can be applied to humans. Bi-directional brain-computer interfacing (BBCI) holds great promise in the treatment of neurological and trauma patients, but before this kind of treatment can be implemented, it is necessary to identify the exact brain regions that are used for specific tasks. Real-time encoding and decoding software for brain input and output signals is also required (Malanowski and Compañó 2007).

Robotics is another convergence of ICT and cognitive science. The increased use of personal-assistance robots in the health care sector could save resources and

be an effective and affordable option for the care of older citizens (Malanowski and Compañó 2007).

IS can also help to facilitate the use of emerging technologies in practice. Many decision-makers have difficulties using the technology, and IS can help to overcome this obstacle. It can also help to prove the value of the new technology and can improve control and monitoring of the implementation and accuracy of the technology (Kendall 1997).

9.3 Discussion

Science and technology and business policies play important roles in converging technologies. Science is reaching closer to technological applications in the emerging fields and is increasing its impact on society (Roco 2008). The convergence of nanotechnology, modern biology, the digital revolution, and cognitive sciences will bring about tremendous improvements in transformative tools, generate new products and services, enable opportunities to meet and enhance human potential and social achievements, and eventually reshape societal relationships (Hamelink 2006). Therefore, intelligent IS are required that can facilitate communication between the fields of science and the development of more complex, interrelated technologies.

Developments in systems approaches, mathematics, and computation in conjunction with emerging technologies help to clarify the natural world and scientific research as closely coupled, complex, hierarchical entities. At this unique moment of scientific and technical achievement, improvement of human performance at the individual and group levels and the development of suitable revolutionary products, primary goals for converging new technologies, become possible. Fundamentally new tools, technologies, and products will be integrated into individual and social human architecture (Roco 2004).

In the face of an ageing population, the health care system can benefit from using converging applications and products. New diagnostic and therapy procedures offer opportunities for patients and for the health care systems in general. The use of the potentials in medicine could be stimulated by an analysis of the broad spectrum of medical applicability and preventive medicine (Malanowski and Compañó 2007).

9.4 Research Agenda

Developments in the field of information and communication technologies may soon lose sight of the human scale, so an assessment of emerging technologies and their application in terms of the human condition is urgently needed. A useful field for such an assessment is the digitalization of health care (Hamelink 2006).

First examples of sociable technologies were toys like Tamagotchies and Sony's AIBO. Certain positive effects of the use of such robots in hospitals and homes for the elderly, such as mood improvement through interaction with a seal robot, have already been demonstrated (Wada et al. 2004). Nonetheless, a deeper theoretical understanding of emotions is necessary for the advancement of emotional robotics. The ubiquitous computing concept includes wearable computers, such as fabrics that incorporate electrical circuits that can be used for health monitoring (Beckert et al. 2007).

The first nanotechnology-based drug-delivery systems that release drugs in particular locations of the body are already commercially available (Wagner and Zweck 2005), but since research on the interaction of nanomaterials and living organisms has just begun, only limited information concerning long-term effects and the potential toxicity of nanoparticles inside the human body is available (Beckert et al. 2007).

The awareness among scientists of the concept of convergence must be improved in the future, given the uneven picture of real science and technology developments. The convergence concept works first as a political concept or a concept of research managers, but the term is so new that most researchers are not aware of convergence, even if they work in the middle of a converging discipline, busy with technology developments in the conceptual overlapping of nano, bio, info and cognitive science. Therefore, the concept of technological convergence still has a long way to go from vision to the guiding actions of scientists and finally to concrete technology development (Beckert et al. 2007).

A long-term problem regarding the introduction of enhancement technologies in a market environment is the risk that individuals must assume as new enhancement technologies are made available. The concern with protecting human subjects during clinical trials and in other experimental settings is a precursor to the difficult question of the conditions under which a proposed enhancement is considered sufficiently safe to be made available for the whole population. States and interstate bodies will need to provide some sort of welfare safety-net or insurance against the risks that individuals will undertake (and be encouraged to undertake) by subjecting themselves to enhancement regimes (Fuller 2009).

9.5 Conclusion

The main function of IS in the development of technologies and the interconnection between science and technology is to provide the means for disseminating information among the fields of science. IS also facilitates communication among experts by creating the common notation of information that is required to make a highly technical topic and the complex language of the specialists understandable for scientists in other fields.

References

Bainbridge, W. S. (2007). Converging technologies and human destiny. *The Journal of medicine and philosophy, 32*(3), 197–216.

Barbian, J. (2003). High-tech times. *Training, 40*(10), 52–55.

Beckert, B., Blümel, C., & Friedewald, M. (2007). Visions and realities in converging technologies. *Innovation: The European Journal of Social Science Research, 20*(4), 375–394.

Buechner, M. M., & Balog, J. (1998). Techno sapiens. *Time International (Canada Edition), 151*(20), 8–13.

Cummings, M. P., & Temple, G. G. (2010). Broader incorporation of bioinformatics in education: opportunities and challenges. *Briefings in bioinformatics, 11*(6), 537–543.

De La Iglesia, D., Chiesa, S., Kern, J., Maojo, V., Martin-Sanchez, F., Potamias, G., et al. (2009). Nanoinformatics: new challenges for biomedical informatics at the nano level. *Studies in health technology and informatics, 150*, 987–991.

Fuller, S. (2009). Knowledge politics and new converging technologies: A social epistemological perspective. *Innovation: The European Journal of Social Science Research, 22*(1), 7–34.

Glenn, J. C., Gordon, T. J., & Florescu, E. (2011). 2011 State of the future (Challenge 14). *Security,* 2025, 1–203.

Gonzalez-Ibanez, Alvaro M., Gonzalez-Nilo, F., & Cachau, R. (2009). The collaboratory for structural nanobiology. *Biophysical Journal, 96*(3), 491.

Hamelink, C. J. (2006). Rethinking ICTs. *European Journal of Communication, 21*(3), 389–396.

Ho, D., Garcia, D., & Ho, C.-M. (2006). Nanomanufacturing and characterization modalities for bio-nano-informatics systems. *Journal of Nanoscience and Nanotechnology, 6*(4), 875–891.

Invernizzi, N., & Foladori, G. (2005). Nanotechnology and the developing world: Will nanotechnology overcome poverty or widen disparities? *Nanotechnology Law & Business, 2*(3), 294–304.

Karmiloff-Smith, A. (1994). Beyond modularity: A developmental perspective on cognitive science. *International Journal of Language & Communication Disorders, 29*(1), 95–105.

Kendall, K. E. (1997). The significance of information systems research on emerging technologies: Seven information technologies that promise to improve managerial effectiveness. *Decision Sciences, 28*(4), 775–792.

Malanowski, N., & Compañó, R. (2007). Combining ICT and cognitive science: Opportunities and risks. *Foresight, 9*(3), 18–29.

Maojo, V., Martin-Sanchez, F., Kulikowski, C., Rodriguez-Paton, A., & Fritts, M. (2010). Nanoinformatics and DNA-based computing: Catalyzing nanomedicine. *Pediatric Research, 67*(5), 481–489.

McGrady, E., Conger, S., Blanke, S., & Landry, B. J. L. (2010). Emerging technologies in healthcare: navigating risks, evaluating rewards. *Journal of Healthcare Management, 55*(5), 353–364.

Merkle, R. C. (2001). Nanotechnology: What will it mean? *Spectrum, IEEE, 38*(1), 19–21.

Roco, M. C. (2004). Science and technology integration for increased human potential and societal outcomes. Annals of the New York Academy of Sciences, The Coevolution of Human Potential and Converging Technologies, 1013, 1–16.

Roco, M. C. (2008). Possibilities for global governance of converging technologies. Journal of Nanoparticle Research, 10, 11–29.

Roco, M. C., & Bainbridge, W. S. (2003). *Converging technologies for improving human performance: Nanotechnology, biotechnology, information technology and cognitive science*. Dordrecht: Kluwer.

Ruping, K., & Sherman, B. W. (2004). Nanoinformatics : Emerging computational tools in nanoscale research. *Physics, 3*, 525–528.

Scheufele, D. A., & Lewenstein, B. V. (2005). The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research, 7*(6), 659–667.

Varela, F. J., Thompson, E., & Rosch, E. (1991). The embodied mind: Cognitive science and human experience. In (F. J. Varela, E. Thompson, & E. Rosch (Eds.)) *An International Journal of Complexity and (pp. xx, 308)*. Cambridge: MIT Press.

Wada, K., Shibata, T., Saito, T., & Tanie, K. (2004). Effects of robot-assisted activity for elderly people and nurses at a day service center. In *Proceedings of the IEEE, 92*(11), 1780–1788.

Wagner, V., & Zweck, A. (2005). *Nanobiotechnology in the medical sector—drivers for development and possible impacts*. Düsseldorf: VDI Future Technologies Consulting.

Chapter 10
Global Challenges for Humanity: How Can Ethical Considerations Become More Routinely Incorporated into Global Decisions?

Nebojsa Milic and Krzysztof Oleszkiewicz

10.1 Introduction

Incorporating ethical principles into global decision-making and implementation is not an easy or monolithic task. Different cultures perceive ethics from different perspectives, making it challenging for international bodies and organizations make ethics-related decisions and set ethics-related goals.

The Oxford Dictionary defines ethics as "a set of moral principles, especially ones relating to or affirming a specified group, field, or form of conduct". Roots of the term are based on Latin word *ethice*, which was derived from Greek word ē*thik*ē (the science of morals). As civilization progressed, the understanding of ethics has evolved. In the modern era ethics is often related to duty (Waller 2005) and to scientific progress (Liszka 2011).

Today, ethics is globally and tacitly negotiated among cultures, religions, and generations of the human society on social networks (SN). SNs have become an irreplaceable part of everyday life for a large percentage of the world's population, so it is rational to expect that the age structure of SNs corresponds closely with the age structure of the analysed society. However, not all parts of society participate equally in SN, as research shows that "digital production inequality suggests that elite voices still dominate in the new digital commons" (Schradie 2011).

This research paper seeks to denote the state of the art and the future of incorporating ethical principles into worldwide decisions. In so doing the literature review provides a detailed overview of published work in IS on this topic, and explores the potential role of information systems (IS) in this area.

The paper is structured as follows: first, we review the academics' and practitioners' literature and analyse existing SN and IS-mediated platforms that have emerged. Then a summary of this review is used to derive future fields

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of research that might contribute to solving the challenge by leveraging IS. Finally, the paper discusses the literature review and concludes with questions aimed toward further augmentation and promotion of this only lightly investigated topic.

10.2 Research Method

The paper follows a systematic literature review process (vom Brocke et al. 2009) with the aim of creating a valid foundation for future research. The criteria applied in the initial literature search required that the papers' publication dates be after 2005, and keywords were searched in the titles, abstracts, and (where applicable) investigated areas of the papers based in the disciplines of IS, economics, sociology, and politics. The literature review was conducted from the end of October to the beginning of December 2011. The journals searched were those in the Senior Scholars Consortium (2011) "Basket of 8".

The literature research focused on four fields of interest that correlate with IS:

(1) **Global ethical considerations**: What are the current issues that are discussed globally and have a global effect? What is the consensus for how the ethical dimension is regarded? How are global decisions being made and implemented?
(2) **Beneficial movements supported by IS**: How are ISs contributing to increasing the transparency efforts of non-governmental organizations? What effect is observable?
(3) **Effect of public opinion on global decisions**: Do ISs help to inject public opinion into decision processes that have global effects? What is necessary to influence those processes?
(4) **Ideal place for ethical discussions**: What is the ideal environment in which ethical issues can be considered and archived in the most effective way? How such an environment be achieved?

As a consequence of the low number of results, an additional search was conducted using loosened criteria. First, we conducted a full text search, with most of the queries based on the combinations of the words *decision*, *ethic**, *global*, *information system**, and *routine*. Furthermore, year constraints were completely removed, as well as the discipline exclusions. The articles from these search results were selected by analysing their introductions, abstracts, and conclusions. The relevant research papers are grouped into four categories (Table 10.1), which are used as the basis for the upcoming discussion of the results.

Table 10.1 Qualitative classification of relevant research papers

Category	Literature
IS augmenting global decisions	Brey, P. (2007). Is Information Ethics Culture-Relative? International Journal of Technology and Human Interaction, 2–24
	Davis, T., & Forester-Miller, H. (1996). A Practitioner' s Guide to Ethical Decision Making
	Miscione, G., Staring, K., Ostmo, L., & Fossum, C. (2008). The Shifting Legitimation of an Information System: Local, Global and Large Scale. GlobDev 2008, Paper 7. AIS
IS aligned with ethical principles	Altman, C. (2004). Converging Technologies: The Future of the Global Information Society. San Francisco
	Ess, C. (2006). Cybernetic pluralism in an emerging global information. Ethics and Information Technology, Volume: 8, Issue: 4, 215–226
	Maner, W. (1996). Unique Ethical Problems in Information technology. Science and Engineering Ethics, 137–154
	YanFang, C. (2005). Ethical Factors in Decision Making for Information System Management. Department of SCIS, Baruch College and Graduate Center CUNY
IS as a broker for social interaction	Floridi, L. (2008). Network Ethics: Information and Business Ethics in a Networked Society. Journal of Business Ethics, Volume 90, Supplement 4, 649–659
	Nye, J. S. (2004). Power in a global information age. New York: Taylor & Francis
	Pippa, N. (2001). Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide. New York: Taylor & Francis
IS as supporter of global activism	Floridi, L. (2007). Global Information Ethics: The Importance of Being Environmentally Earnest. International Journal of Technology and Human Interaction, 1–11
	Nye, J. S. (2004). Power in a global information age. New York: Taylor & Francis
	Sorj, B. (2006). Internet, Public Sphere and Political Marketing: Between the Promotion of Communication and Moralist Solipsism. Rio de Janeiro: The Edelstein Center for Social Research

10.3 Research Results

(1) Information systems augmenting global decisions

Scholars have gained insight into the mechanisms of global decision-making that are related to the field of IS. There is no universal IS that has been defined and developed solely for the purposes of global decision-making, although many existing ISs can improve the environment for global decisions. Miscione et al. (2008) note that "social development in the context of globalization is related to the use of ICT and determined by the ability to establish synergistic interactions between technological innovations and human values." However, existing mechanisms of decision-making on the global level should incorporate tools that take into account that "cross-cultural normative ethics cannot be practiced without a

thorough understanding of the prevailing moral system in the culture that is being addressed" (Brey 2007). Scholars suggest that all ethically relevant decisions can be enhanced through a framework for ethical decision-making as "a useful method for exploring ethical dilemmas and identifying ethical courses of action" (Davis and Forester-Miller 1996).

(2) Information systems aligned with ethical principles

Although early insight into current research states that "there is no general consensus with respect to the complete framework of ethical decision making in IS" (YanFang 2005), it possible to find beneficial works that relate, although not directly, to this paper's topic of interest. As a foundation, ethical pluralism must be recognized (Ess 2006). However, since Western and Asian traditions define the majority of the stakeholders, and since those two moral centres have shaped and influenced the overall understanding and implementation of ethics around the globe, if IS is to be enabled to cooperate and somewhat improve global ethics and decision-making processes (by making them more ethical in a routine sense), analogies based on these two traditions must be used for upcoming ethical decisions and considerations.

However, scholars raise the question concerning whether the use of IS is beneficial or malignant in its ethical effects, as they "have the power to transform civilization into potential utopia—or dystopia—depending on society's ability to confront the questions with maturity and tolerance" (Altman 2004).

(3) Information systems as a broker for social interaction

As important as the use of IS in the area of decision-making and ethical support is the role of IS in mediating the discussion that reshapes existing ethical norms. Academia has already distinguished specific spheres that can be mediated by IS. Researchers have investigated various forms of newly emerging cultures and found numerous ways to derive overall trends and opinions from very different discussion places. Participants in those discussions are usually so dynamic and free that research has even coined a new term to describe those changes, "fragmegration", which expresses the idea that "both integration toward larger identities and fragmentation into smaller communities can occur at the same time" (Nye 2004). IS-mediated discussions and communications are widely recognized as intriguing and fruitful spheres for further research endeavours. The sphere of social communication has been defined as the *infosphere*, and research has recognized its importance of it by stating that the "infosphere is a common space [that] needs to be preserved and improved to the advantage of all" (Floridi 2008).

(4) Global activism supported by information systems

Global activism, which is supported by IS and technology, is not unlike other forms of protests against social, political, or economic deficits on the streets and in front of town halls, but researchers have found a need for "effort to foster all those informational conditions that facilitate participation, dialogue, negotiation and consensus-building practices among people, across cultures and through generations" (Floridi 2007). Although IS have fostered and supported global activism, there are fears that "political campaigns on the Internet may increase the active

participation of the people, the moralist-solipsist[1] trend, fostered by the new medium, could lead to viewing political institutions as being ever more illegitimate and to lowering the quality of the democratic debate" (Sorj 2006).

10.4 Practical Examples—Digest of the Real World

10.4.1 The Chunked Structure of Owners of the Global Network

Various organisations and stakeholders are responsible for organising the Internet technically and organizationally. The W3-Consortium is an institution that maintains standards, private companies, Internet service providers, and research facilities that provide technical infrastructure, routers, and backbones, without which the Internet would not be possible. On the other hand, country-based splitting of subnets allows countries like China to maintain information walls that filter information and the myriad contributors that provide endless amounts of information. This divided structure offers great potential for creativity and balance as well as for disorder and vandalism (Capurro 2000); in any case, it definitely hinders a standardised approach to contributions to global decisions that is owned by one stakeholder.

10.4.2 How Social Media Changes Minds

Social media has ignited vast amounts of political and ethical influence. For example, a significant beneficial change that was gained through the usage of SN is the expression of opinion. Specific networks[2] are used to influence others and even to create news (The Economist 2011). Furthermore, networks are now being used as a significant factor in freedom. Starting in the middle of 2010 Facebook became a dominant information source in almost all democratically developed countries (The Economist 2010), and the Arab Spring revolutionary wave was initially started through SN. The level of SN participation in this social movement was so great that the US State Department even asked Twitter to delay its scheduled network upgrade because it could limit Iranians' ability to express their concerns about elections results (Pleming 2009). As opposing arguments it could be stated that critics state the opinion expression and creativity is a myth in its basis when it comes to the freedom and opinion expression (Flanagan 2011).

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[1] Moralism–solipsism is a theory that holds that the self can know nothing but its own modifications and that it is all that exists (Merriam-Webster).

[2] http://Storify.com is an example of this specific SN resource.

The next section introduces several platforms that provide a step toward achieving the goal of routinely incorporating ethical issues in global decision-making.

10.4.3 Ushahidi—Platform for Instant Collaboration

An example of how individuals can participate in global decisions is the African crowdsourcing platform Ushahidi, which emerged after the 2007 presidential election and the following riots in Kenya. According to David Kobia, founder of the platform and open source software, Ushahidi is an interactive mapping tool that enables individuals to record events on a map. Ushahidi takes those elements of location and time and puts them into a functional and usable platform (Vericat 2010). Anyone can contribute information via SMS, MMS, e-mail, and other channels. This information is published in real time on the webpage and presented graphically in a map of the region for everyone to use and respond to. The resulting platform enables the "crowd" to collaborate instantly; it is an incubator for the creation of a "hive mind" among the participating crowd.

The benefit of a platform like Ushahidi rises with the number of participating individuals, so there must be a reason that mobilises lots of people, such as natural disasters or political turmoil, two major areas where Ushahidi is used. Such platforms add to the traditional information flow of singular contributors like the Red Cross or the parties that are involved in a conflict by creating a platform for everyone.

Various problems arise in applying this platform to ethical considerations. Ethical positions tend to be the result of a long-lasting process that involves continuous participation. Its uneven level of participation also impedes a process that incorporates ethical considerations in a routine way. However, when ethical questions arise whose effect must be managed instantly, Ushahidi might provide a place where individuals can raise their voices and participate in global decisions. Still, the direct link to the process of global decision-making is missing and difficult to establish.

10.4.4 Edge.org—Experts' Collaboration

The belief behind the idea of http://edge.org, stated by John Brockman, owner of the website http://edge.org is that "a finite number of people throughout history have invented, rather than discovered, the world. The words of the world are the life of the world, and a certain number of people have uttered those words" (Zaleski 2000). One question is published on the http://edge.org page each year, and experts from all over the world post their answers, thus contributing to human knowledge. The published questions touch specific areas that affect various fields of knowledge and are relevant and express a current trend. The question asked in

2010 was "How is the internet changing the way you think?" The results were responses—usually essays—from more than 170 experts and various articles in newspapers.

Edge.org shows a way for a complex, broadly defined question to be answered by experts from a variety of perspectives. Every expert tries to look "beyond the edge" and to contribute from his or her field's perspective. This approach might also be feasible in creating ethical viewpoints that can be incorporated into global decisions. As the result is the common conclusion of all participating experts, it may be more likely to be accepted in global decision-making than are ethical considerations from other, perhaps more biased sources. Edge.org also presents its results in various media, increasing its effect on public opinion and global decision-making. For groups with no relationship to global decision-makers, Edge.org offers a way to create publicity in the media in support of their ethical points of view.

Through the contributions of experts to solving current questions of interest and the resulting interest in the media, http://edge.org shows how ethical considerations can find their way into global decisions. Attention in the media raises the importance of an ethical issue that facilitates its incorporation into global decisions. Similar to Ushahidi, http://edge.com has no direct link to any global decision process because its intention is to accumulate viewpoints and contribute to knowledge.

10.4.5 Avaaz.org—Political Campaign Incubator

In the same way Ushahidi provides a crowd-sourcing platform for instant collaboration and information interchange among peers, the international non-governmental organization Avaaz brings people together to influence global problems. The website http://avaaz.org is a platform that provides each visitor the ability to participate online on campaigns for or petitions against various issues. The large number of participants at http://avaaz.org is increasing its effect, as it has increased media attention. With this approach http://avaaz.org influenced a new anti-corruption law in Brazil, a move by Britain to create a marine-conservation zone in the Indian Ocean, and a proposal to allow more hunting of whales (The Economist 2010). In short, Avaaz reduces the effort involved in activism from that of attending demonstrations to that of a simple click. [An often-mentioned criticism of such platforms, is "clicktivism" (A town crier in the global village 2010)]. However, Avaaz does not only provide the web-based platform but also organises demonstrations, such as when Ricken Patel, the co-founder of Avaaz, called on Avaaz' members to put pressure on Brazilian and Turkish politicians to intercede with Iran.

This reduction in the complexity of participation is one of Avaaz' strengths: its potential to collect peers from all over the world to participate collectively in a common goal. As for Ushahidi, an increase in participants also increases the awareness of public media and global decision-makers.

Avaaz' structure as a campaigning platform is not designed for consensus-finding in controversial ethical questions but, rather, allowing ethical viewpoints to be expressed as a campaign or petition. While the decision process concerning what campaigns are created is not fully transparent or influenceable by everyone, the platform uses campaigns and the related media support to influence global decision-making directly, an aspect of the site that is missing in Ushahidi and http://Edge.org.

10.5 Discussion

There is a reciprocity between global ethics and culture on the one side and IS in their current shape on the other. IS are grounded in ethical and cultural values but they also influence these values [see Brey (2007) and Capurro et al. (2007)]. However, a literature review that analysed papers primarily from information science, management, decision science, economics, sociology, philosophy, and political science revealed no firm stance on or definitions of such interrelation.

When this research occurred, the academic community had no clear interest in expanding the Millennium Project's Global Challenges with additional disciplines. The majority of academic endeavours within the sphere of the Global Challenges was being conducted from the stances of political science or sociology. Ethics and similar themes were tied with the philosophical corpus of the papers, while global decision mechanism and IS co-existed in the cross-sections of information systems, economics, management, and decision theory.

In that context IS is a dimension that both involves and is affected by parts of each of the existing dimensions. For example, the mass communication theory, "Spiral of Silence" (Noelle-Neumann 1991), describes how the majority affects individuals' expressions of opinion because they fear punishment if they express unpopular views. Mass communication in IS today heavily affects and is affected by this Spiral of Silence, as the Internet is the platform on which to express unpopular opinions but is also a place for radical agitation and heavy manipulation efforts.

10.6 Research Agenda

Several questions emerged from the literature review and discussion of IS and ethics:

10.6.1 How to Implement? Routines for Highly Volatile Issues Like Ethics

The introduction and the literature review showed that the term "ethics" has numerous attributes that prevent standardised processes from being implemented in order to incorporate ethics in global decision-making. The issue of ethics is

highly volatile and variable, especially in global decisions. As the example of the crowd-sourcing platform Ushahidi (see Sect. 10.4.3) shows, ethical issues can mobilise large numbers of people in a short time, and in the same way people lose interest at the same speed. Moreover, ethics are intangible, they differ regionally, and parties involved in decision-making are often unable to reach consensus about them.

One way to meet the challenge of incorporating ethical considerations routinely into global decisions is to provide a modelling notation that provides the flexibility to support ethics' intangibility and regional differences. No institution has implemented such a process, and the literature review revealed no literature that has dealt with this issue. Future research could explore this in subject an academic way in an attempt to establish a way to incorporate ethical considerations routinely in global decision-making.

While various modeling techniques exist, to represent uncertainty or creativity in processes (Seidel et al. 2010) it might be of interest to consider the volatility and instability of ethics.

What is the trigger that will start the process of incorporating ethical considerations into global decision-making? What are the relevant steps? How can participation be maintained during decision-making? These and other questions arise when traditional approaches to process modelling are applied. Similar to existing process management approaches, various roles must be defined, which have political implications. For instance, the roles of business leader, process owner, and operational manager must be defined when implementing this kind of process.

10.6.2 How to Measure? Effects of Routine Involvement

There are various ways to create and maintain systems that measure process outcomes, such as measuring qualitative indicators and aligning process goals with the overall strategy (Harmon 2010). Such measurement is a key component of continuous process improvement methods like Six Sigma and the Balanced Scorecard. Recent contributions have shown how to incorporate fuzzy criteria like "value" into business process management (e.g., vom Brocke et al. 2009). The term "ethics" has a fuzzy component that interferes with a functioning measurement system in several ways, but it is more difficult to measure the quality of the single contributions or the overall output because ethical considerations come into play and blur the measurement. It might be difficult to determine valid criteria with which to evaluate the quality of the result—a kind of "seal of ethical quality" that is recognised globally.

A second challenge is the effect of global decisions that affect third parties that are not involved in the decision process. For example the discussion concerning whether to outsource factories in other countries might consider the stakeholders in these countries and the deciding company, but effects of the outsourcing might also occur in neighbouring countries, among suppliers, or to logistics. It is often

difficult to foresee the whole bandwidth of external effects when making a decision, so it might be challenging to incorporate those externalities into the process evaluation.

The ambiguity of the term "ethics" impedes the design of a typical performance measurement system and the traditional approaches of business process implementation (e.g., as-is models and to-be models). The main challenge is to incorporate ethical considerations into a functioning measurement system in order to make them meaningful for global purposes.

10.6.3 How to Manage? Long-Term Management for Short-Term Problems

Finally, the question of using IS to manage processes within the domains of routine global decision-making remains a good starting point for future research. For example, it could be possible to implement concepts from workflow management to streamline and optimise processes that see significant deviations. Will flexible modelling techniques help the entire process to become more manageable and easier to model? Is it possible to make routine decisions by means of IS flexible and adherent to rapidly changing environments and optional unbalancing externalities? Will the diversified instrumentarium of flexibility techniques help to solve the particular problems of: handling exceptions and unpredictable circumstances—such as the Arab Spring phenomenon, which could significantly change the ethical background of the decision-making process—by means of exception handling, late modelling, or case handling techniques. These are patterns in modelling workflow management systems that provide the required flexibility. Whether these patterns are applicable to ethical activities could be an interesting research question. Applying existing business process management strategies like Six Sigma to these modelled processes could also enable continuous process improvement.

10.7 Conclusion

The polyvalent planes between which this research is conducted and the modestly researched interconnections make drawing conclusions a daunting task. It is difficult to conclude whether there is potential for routine decision-making through IS without the mediation of the Internet, yet that medium could prove completely adequate to the task. The literature review conducted here does not provide a complete study of research in this field, although it does provide an overview of currently discussed topics in the frame of ethics.

Approaches to incorporating uncertainty in the design of business processes, such as in modelling, already exist, yet considerable research remains to be done in this area that could lead to frameworks that make it possible for corporations

and institutions to include ethical considerations in local processes and at the same time align ethical issues on a global level using a globally accepted framework of ethical modelling of business processes. The literature has not discussed using the techniques of business process management to incorporate ethical considerations into decision-making, so the proposals stated in this paper have a somewhat fragile grounding.

Should the solutions or further research try to fit within the domains of already defined scientific disciplines, integrate existing disciplines through creation of common ground, or evolve into completely new scientific disciplines or approaches? One might think about overarching SN that could interact with all existing SN and provide global bodies (e.g., a UN organizational unit) with a tacit overview and understanding of how global ethics are developing, evolving, and being perceived.

As there is no such global body that might be used for ethical purposes, various platforms have emerged that people use for ethical considerations. Websites like Ushahidi.com and the campaigning platform Avaaz.org meet the rising demand to leverage the power of the Internet to collect the energy of the masses in pursuit of social, economic, ecological, and political goals. It is expected that the importance of these platforms will increase and that some of them will grow into globally relevant institutions that attend to ethical issues in global decision-making.

References

A town crier in the global village. (2010). *Economist*, p. 62.

Altman, C. (2004). *Converging technologies: The future of the global information Society*. San Francisco.

Brey, P. (2007). Is information ethics culture-relative? *International Journal of Technology and Human Interaction, 3*, 2–24.

Capurro, R. (2000). Ethical challenges of the information society in the 21st century. *International Information & Library Review, 32*, 257–276.

Capurro, R., Frühbauer, J., & Hausmanninger, T. (2007). Localizing the Internet. Ethical aspects in intercultural perspective. *ICIE Series, 4*, 21–38.

Davis, T., & Forester-Miller, H. (1996). *A Practitioner's guide to ethical decision making*. Dictionary.com. (n.d.). Retrieved 12 May 2011, from Dictionary.com: http://dictionary.reference.com/browse/society.

Ess, C. (2006). Cybernetic pluralism in an emerging global information. *Ethics and Information Technology, 8*(4), 215–226.

Flanagan, B. (2011, May 18). *Facebook Revolution 'a myth', Critics Say*. Retrieved May 20, 2011, from The National. http://www.thenational.ae/business/media/facebook-revolution-a-myth-critics-say.

Floridi, L. (2007). Global information ethics: The importance of being environmentally earnest. *International Journal of Technology and Human Interaction, 3*, 1–11.

Floridi, L. (2008). Network ethics: information and business ethics in a networked society. *Journal of Business Ethics, 90*(Suppl 4), 649–659.

Harmon, P. (2010). The scope and evolution of business process management. In J. vom Brocke, & M. Rosemann, (eds.) *Handbook on Business Process Management* (vol. 1). Berlin: Springer.

Liszka, J. (2011). *What is Pragmatic Ethics*. Retrieved October 29, 2011, from Department of Philosophy, College of Liberal Arts and Sciences. http://www.philosophy.uncc.edu/mleldrid/SAAP/USC/TP25.html.

Maner, W. (1996). Unique ethical problems in information technologoy. *Science and Engineering Ethics, 2*, 137–154.

Miscione, G., Staring, K., Ostmo, L., & Fossum, C. (2008). The shifting legitimation of an information system: Local, global and large scale. *GlobDev 2008*, Paper 7. AIS.

Noelle-Neumann, E. (1991). Communication Yearbook 14. In J. A. Anderson (Ed.), *The theory of public opinion: The concept of Spiral of SIlence* (pp. 256–287). Newburry Park: Sage.

Nye, J. S. (2004). *Power in a global information age*. New York: Taylor & Francis.

Pippa, N. (2001). *Digital divide: Civic engagement, information poverty, and the Internet Worldwide*. New York: Taylor & Francis.

Pleming, S. (2009, June 16). *U.S. State Department speaks to Twitter over Iran*. Retrieved June 1, 2011, from Reuters. http://www.reuters.com/article/2009/06/16/us-iran-election-twitter-usa-idUSWBT01137420090616.

Schradie, J. (2011). *The digital production gap: The digital divide and Web 2.0 collide*. Berkeley: Department of Sociology, University of California.

Seidel, S., Muller-Wienbergen, F., & Rosemann, M. (2010). Pockets of creativity in business processes. *Communications of the Association, Pockets of Creativity in Business Processes, 27*(1).

Senior Scholars Consortium. (2011). *Senior Scholars' Basket of Journals*. Retrieved 12 March, 2011, from http://home.aisnet.org/displaycommon.cfm?an=1&subarticlenbr=346.

Sorj, B. (2006). *Internet, public sphere and political marketing: Between the promotion of communication and moralist solipsism*. Rio de Janeiro: The Edelstein Center for Social Research.

The Economist. (2010, September 29). Facebook and freedom. Retrieved June 1, 2011, from The Economist. http://www.economist.com.

The Economist. (2011, May 12). *The Economist*. Retrieved June 8, 2011, from How to use Facebook friends and influence people. http://www.economist.com/blogs/democracyinamerica/2010/09/social_networks.

Vericat, J. (2010, Fall/Winter). Open source mapping as liberation technology. *Journal of International Affairs, 64*(1) 195–201.

vom Brocke, J. M., Simons, A. M., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: On the importance of rigour in documenting the literature search process. In *17th European Conference on Information Systems* (pp. 2206–2217).

Waller, B. N. (2005). *Consider ethics, theory, readings and contemporary issues*. New York: Pearson Longman.

YanFang, C. (2005). *Ethical factors in decision making for information system management*. New York: Department of SCIS, Baruch College and Graduate Center CUNY.

Zaleski, J. (2000, 01 24). *PW talks with John Brockman* (Vol. 247, Issue 4, p. 306.). Publishers Weekly.