

Sustainability Informatics

A new Subfield of Applied Informatics?

Stefan Naumann

- I. Introduction and Motivation
- II. What is "Sustainability Informatics"?
- III. Grass Roots of SI
- IV. Structuring the Research Field
- V. Summary and Conclusions

Information Technology and Sustainability:

- Bits instead of Atoms
- Worldwide communication across borders

But:

- IT consumes energy and resources in production, usage, and disposal
 - IT changes working environment and communication structures
- ➔ Effort and benefit have to be considered differentiated regarding environmental and social consequences!

- Sustainable Development (SD) plays an important part in several fields of Applied Informatics.
- No connected research field exists which links Environmental Informatics e. g. with fields like Information Systems and Social Informatics
- Within the field of Environmental Informatics developments in direction of to sustainability were early discussed [Page/Hilty 1995, Rolf 1995]
- In this talk we want to give a definition for Sustainable Informatics and outline a possible structure of this research field

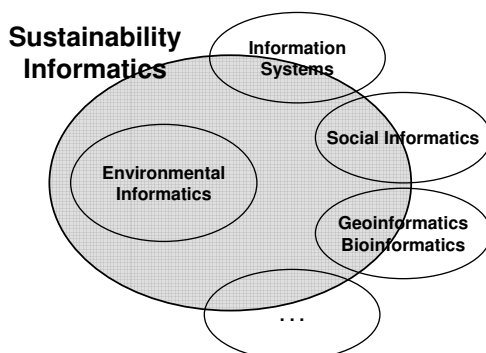
II. Defining “Sustainability Informatics”

Definition Sustainable Development

Sustainable Development (SD)

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. [World Commission 1991:43].”

Overview of Related Subfields



Working Definition

Sustainable Informatics

“Sustainable Informatics is a subfield of Applied Informatics.

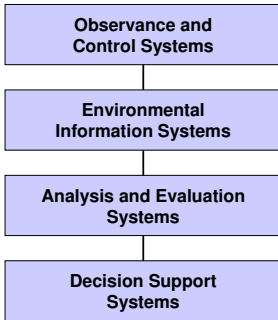
It contains research and development of those methods, models, hardware and software systems, which contribute to the goals of SD.

This includes the analysis and forecast of observed phenomena of the natural and social environment.

It includes also the design of hardware, software and information systems which supports SD.”

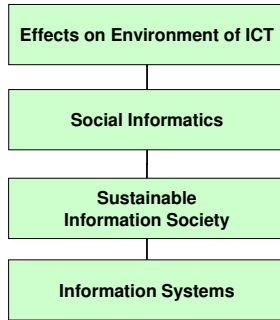
Comparison EI /SI

Environmental Informatics



(Page/Hilty 1995)

Sustainability Informatics



(Möller/Bornemann 2005, Naumann 2006&2007)

III. Grass Roots of SI

Grass Roots (1)

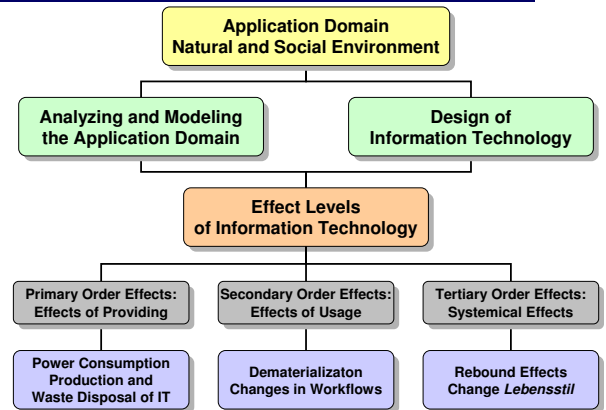
- Grass roots:
 - Rio conference 1992
 - Page&Hilty 1995 and Rolf 1995 discussed how Environmental Informatics could be developed into the direction of Sustainable Development.
- "Nachhaltigkeitsinformatik":
 - 2004: Discussion at the University of Hamburg
 - 2005: Möller/Bornemann: "Kyoto ist anderswo"
 - 2006: Naumann: „Referenzmodellierung für nicht-professionelle Kontexte“
 - Google 2008: "Sustainability Informatics" 88 results "Nachhaltigkeitsinformatik" 7 results.

Grass Roots (2)

- "Environmental Informatics 2001" in Zurich discussed energy consumption of ICT, implications for the society and other topics beyond "pure" Environmental Informatics
- Several books and articles were published within this spirit: [Schneidewind et al. 2000, Hertin/Berkhout 2002, Angrick 2003, Dompke et al. 2004].
- Broader approaches for the field of informatics and society:
 - These models sometimes contain questions of sustainability, but do not focus on them.
 - Example for a model that analyses mutual reactions between human beings, organisations, environment, and society is the "Mikropolis-Modell" from the University of Hamburg

IV. Structuring the Research Field

Overview „Sustainability Informatics“



Analyzing the Application Domain

Analysis of natural and social phenomena by means of IT

- This covers methods to model and simulate observations and measurements within environment, business, and society.
- Methods of the Environmental Informatics field are suitable to analyze natural processes (modeling and simulating climate change, pollutant dispersals, dynamic systems)
- Phenomena and effects in the fields of economy and society have to be investigated.
 - Online Communities have an increasing influence on consumer decisions and business processes.
 - They enable new forms of social movements -> SD!

Analyzing and Classifying the Impacts of ICT

- Every artificial and technical system influences human behaviour, society, and environment.
- ICT has a double role as a measuring and as a design instrument
- A popular categorization differs between
 - direct effects (e. g. energy consumption)
 - indirect effects (e. g. changes in working environments)
 - structural and behavioral effects of ICT (e.g. changes in culture)
- The categorization investigates intended and unintended effects of ICT on human beings, society, economy, and environment

Design of Software Systems (1)

How can ICT be designed to foster SD?

- Energy and resource consumption of hardware AND software in development, usage, and disposal
- Hardware: Green IT, Energy Efficiency
- Sustainable Software
 - Negative Example: Vista®
 - Positive examples: Software systems and algorithms which reduce directly or indirectly power consumption and environmental pollution.

Design of Software Systems (2)

- System-bounded sustainability
 - Sustainability of the software itself: Maintenance, Documentation, Usability, Production, Resource Consumption in Usage etc.
- System-unbounded sustainability
 - Comprises mutual reactions between software and ecological, economical, and social systems (e. g. a shop system gives information about eco certificates etc.)

V. Summary and Conclusions

Conclusions

- Brundtland commission: protection of the environment cannot be divided from questions of social justice and economical developments.
- Sustainability Informatics can be understood as an advancement of Environmental Informatics.
 - Environmental Informatics is the core of Sustainability Informatics.
 - It is necessary to continuously extend it in order to address other questions regarding Sustainable Development.

Outlook: Research Agenda (1)

1. Developing Theoretical Foundations
 - All “applied” research fields are involved in two or more research fields
 - Both subfields - “Sustainable Development” and “Core Informatics” discuss actually their scientific basis
 - Often progress in applied informatics means progress in the application field – IT is just a assistive mean
 - To sharpen the theoretical foundations a deeper look is useful:
 - For Sustainable Development e.g. Tremmel 2004, Grunwald/Kopfmüller 2006
 - For Informatics e.g. Floyd / Klaeren 1999

Outlook: Research Agenda (2)

2. Developing of analytical, empirical, and design methods
 - Empirical studies and surveys
 - Action research & case study research
 - Modeling and simulation
 - Models for software architectures, process models, reference models for SD
 - Life Cycle Assessment for software systems
 - Checklists and guidelines in order to design software systems for sustainability

End.

Thank you for your attention.

- **Stefan Naumann**
Institute for Software Systems in Business, Environment,
and Administration
Umwelt-Campus Birkenfeld
- **Any comments are welcome:**
s.naumann@umwelt-campus.de

Literature

- Angrick, Michael (Hrsg.) (2003): Auf dem Weg zur nachhaltigen Informationsgesellschaft. Metropolis, Marburg 2003
- Dompke, Mario von Gebler, Justus; Göhring, Wolf; Hergel, Melanie; Hilty, Lorenz M.; Isenmann, Ralf; Kuhnnd, Michael; Naumann, Stefan; Quack, Dietlind; Seifert, Eberhard K. (2004): Memorandum Nachhaltige Informationsgesellschaft. Fraunhofer IRB Verlag, Stuttgart 2004
- Floyd, Christiane; Klaeren, Herbert (1999): Informatik als Praxis und Wissenschaft. In: Busse, Johannes (Hrsg.): Tübinger Studentente Informatik und Gesellschaft, Tübingen 1999
- Frank, Ulrich (1997): Erfahrung, Erkenntnis und Wirklichkeitsgestaltung. Anmerkungen zur Rolle der Empirie in der Wirtschaftsinformatik. In: Gün, Oskar; Heinrich, Lutz J.: Wirtschaftsinformatik – Ergebnisse empirischer Forschung. Berlin, Heidelberg et al.: Springer 1997
- Greenpeace (2007): Windows Vista - Müll für die (dritte) Welt http://www.greenpeace.de/themen/chemie/nach-richten/artikel/windows_vista_muell_fuer_die_dritte_welt/, published 2007-05-05, last visit 2008-09-15
- Grunwald, Armin; Kopfmüller, Jürgen (2006): Nachhaltigkeit. Campus Verlag, Frankfurt / New York 2006
- Herfin, Julia; Berkhout, Frans (2002): Digital Technologies and the Environment. Drawing out the Links. Ökologisches Wirtschaften Ausgabe 3-4, Schwerpunkt „Digital – Nachhaltig“; pp.11-13, 2002
- Hilty, Lorenz; Glögen, Paul W. (ed.) (2001): Sustainability in the Information Society. Proceedings of the 15th International Symposium Informatics for Environment Protection, Zurich 2001. Metropolis Verlag, Marburg 2001
- King, Rob (1999): What is Social Informatics and Why does it Matter? D-Lib Magazine, Volume 5 Number 1, January 1999
- Klischewski, Ralf (1992): „Wirkungs-“ oder „Gestaltungsforschung“? Technikfolgenabschätzung in der Informatik. InfoTech, Volume 4, 4 / 1992, pp. 38-44
- Krause, Detlev; Rolf, Arno; Christ, Marcel; Simon, Edouard (2006): Wissen, wie alles zusammenhängt. Das Mikropolis-Modell als Orientierungswerkzeug für die Gestaltung von Informationstechnik in Organisationen und Gesellschaft. Informatik Spektrum, Band 29 (2006), Heft 4, pp. 265-273
- Müller, Andreas; Bornemann, Basil (2005): Kyoto ist anderswo. Zwischen Interdisziplinärität und Nachhaltigkeit. Informatik Spektrum, Volume 28 (2005) Issue 1, pp. 15-23
- Naumann, Stefan (2006): Referenzmodellierung für nicht-professionelle Kontexte. Akteursorientierung, Kooperation und Nachhaltigkeit. Dissertation, Universität Hamburg, 2006. <http://www.sub.uni-hamburg.de/opus/volltext-2007/3164>
- Naumann, Stefan; Rolf, Arno; Gumm, Dörina; Martens, Marcel (2005): Bewertung und Gestaltung virtueller Organisationen anhand des Orientierungsmodells Mikropolis. In: Meißner, Klaus; Engelen, Martin (Hrsg.): Virtuelle Organisation und Neue Medien 2005. Josef GuV Verlag, Lohmar 2005, pp. 281-292
- Page, Bernd; Hilty, Lorenz (Hrsg.) (1995): Umweltinformatik. Informatikmethoden für Umweltschutz und Umweltforschung. München/Wien 1995, 2. Auflage
- Rolf, Arno (1995): Orientierungen für die Umweltinformatik. In: [Page/Hilty 1995]
- Schneidewind, Uwe; Fleisch, Edgar (1998): Ökologische Chancen und Risiken der Reorganisation von verteilten Geschäftsprozessen durch Telekooperation. In: Krcmar, Helmut; Leve, Henrik; Schwabe, Gerhard: Herausforderung Telekooperation. Springer, Berlin et al. 1998, pp. 139-153
- Schneidewind, Uwe; Steingraber, Cornelia; Truschel, Arno (Hrsg.) (2000): Nachhaltige Informationsgesellschaft. Analyse und Gestaltungsempfehlungen aus Management- und institutioneller Sicht. Metropolis Verlag, Marburg 2000
- Tremmel, Jörg (2004): „Nachhaltigkeit“ - definiert nach einem kriteriengebundenen Verfahren. In: GAIA 13 (1) / 2004, S. 28-34
- Whitman, Michael E.; Wozzycynski, Amy B. (2004): The Handbook of Information Systems Research. Idea Group Publishing, Hershey et al. 2004
- World Commission on Environment and Development (ed.) (1981): Our common future. Oxford University Press, Oxford 1991, 13th edition