Book 1 : Computing Research for Sustainability
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Overall, this book discussed any potential of "green" applications for improving energy conservation, enhancing energy management, reducing carbon emissions in many sectors, improving environmental protection (including mitigation and adaptation to climate change), and increasing awareness of environmental challenges and responses. Furthermore, green ICT might be also to be used in any any problem solutions by applicable computational techniques and emphasis of user-driven research. There are some sustainability challenges which can be identified by ICT tools such as computational modelling, data management, sensor technology, machine learning and any advanced approaches, tools, techniques and strategies toward understanding, addressing and communicating sustainability challenges. In order to promote sustainability broadly, this report focusing more on the "greening through IT" rather than "greening of IT".

In Chapter 1, this book presents examples of domains of potential impact by the roles and opportunities of ICT in achieving sustainability challenges. According to the *SMART 2020:Enabling the Low Carbon Economy in the Information* report, applying sustainability of ICT can be divided into three broad areas. They are consists of:

1. Built Infrastructure And Systems
2. Ecosystems Services And The Environment
3. Sociotechnical Systems

Built infrastructure and systems

This area includes buildings, transportation systems (personal, public, and commercial), and consumed goods (commodities, utilities, and foodstuffs). The ICT contributes to sustainable in numerous ways:

1. Improved sensor technologies (e.g., in embedded sensors in smart buildings)
2. Improved system models
3. Improved control and optimization (e.g., of logistics and smart electric grids)
4. Improved communications and Human-Computer Interfaces (e.g.,enabling people to make more effective decisions).

Ecosystems and the environment

This area encompasses assessing, understanding, and positively affecting (or not affecting) the environment and particular ecosystems. These efforts represent crosscutting challenges for many sustainability efforts. The scale and scope of efforts in this area range from local and regional efforts examining species habitats, to watershed management, to understanding the impacts of global climate change. The range of challenges itself poses a problem:

1. How best to assess the relative importance of various sustainability activities with an eye toward significant impact. Additionally
2. How computational techniques will be valuable for developing scientific knowledge and engineering technologies
3. How improved methods for a data-driven science, modelling for environment

4. How simulation to improve the degree of scientific understanding in ecology

Sociotechnical systems

Sociotechnical systems encompass society, organizations, and individuals, and their behavior as well as their technological infrastructure. Large and long-lived impacts on sustainability will require enabling, encouraging, and sustaining changes in behavior—on the part of individuals, organizations, and nation-states over the long term.

ICT, and in particular real-time information and tools, can better equip individuals and organizations to make daily, on-going, and significant changes in response to a constantly evolving set of circumstances.

The *Smart Grid* is an example has been discussed to describe the built infrastructure component. However, this example also can be related to ecosystems from new sources of renewable energy and sociotechnical systems on the supply and consumption management. Different methods and approaches will be needed for sustainable energy systems in small developing countries, for the micro-grid in developed countries, and for a continental-scale energy system.

The *Food Systems* is the second example for the first broad area, built infrastructure such as transportation system. However still this example related to the environment and ecosystems and to be more effective, it requires sophisticated tools and data management. There are three critical areas are described briefly below: information integration; education and reform; and systems modeling, prediction, and optimization.

The third example is *The development of sustainable and resilient infrastructures.* This example shows the crosscutting sustainability challenges encompass economic and social issues. The challenges in developing more sustainable and resilient infrastructures and the role of ICT in developing them have been described.

In Chapter 2, this book presents methods and approaches in order to help the challenges have been addressed in Chapter 1 by using sustainable ICT. “Decision Making” is the keyword in order to achieve the sustainable ICT objectives. There are four broad research areas as below:

1. Measurement and instrumentation
2. Information-intensive systems
3. Analysis, modeling, simulation, and optimization
4. Human-centered systems.

These broad research areas comprising from measurement, data mining, modelling, control and human-computer interaction has positive implications to the communities. However, there are also some hard problems such as mitigation climate change and pressing nature of the challenges by the rapid innovation. In addition, the overlapping may has clear positive implications.

In Chapter 3, this book presents how the interplay between addressing sustainability challenges and computer science research merits attention. It describes some ways of conducting and managing research so the SC/IT research have an even greater impact on sustainability challenges by programmatic and institutional opportunities.

This chapter has argued for a bottom-up approach to research that values application-driven results while also supporting the iterative process that eventually leads to more universally useful contributions. The advances in IT have become critical enablers of change in the systems such as financial systems, manufacturing systems, energy systems and so on.