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# Sustainability in Information Systems: Assortment of Current Practices in IS Organizations

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## ABSTRACT

The increasing dissemination of information systems into all areas of business and personal life has drawn attention to its environmental effects. IS organizations are becoming aware that they have to take up their responsibility by thinking seriously about sustainability management for information systems. While measures for using computing resources efficiently have received considerable attention, the topic of sustainability in IS management is still lacking theoretical foundation. The purpose of this paper is to explore current environmental efforts in sustainable IS management. Based on fifteen expert interviews with CIOs, IS and environmental managers from IS organizations, the paper provides researchers and practitioners alike with an explorative study on the situation of sustainability in IS operations and, thus, makes a contribution to this emerging IS research topic.

### Keywords

Green IT, sustainability, IS management, sustainable computing.

## INTRODUCTION

Sustainable management is a concept of long-term simultaneous optimization of economical, ecological and social objectives to generate a lasting superior financial performance for the business (Elkington, 1997; Epstein, 2008). Due to the growing global impact of IS on economy, ecology and society, firms are increasingly extending the scope of sustainable management on the domain of information systems. This is done in order to achieve benefits such as cost reduction, risk avoidance and improved reputation for IS management. Measures that aim to reduce the ecological impact of the IS have been discussed under the headline of "Green IT". Even though Green IT has been used extensively by marketing departments to label their IT products and services as environmentally friendly, the term and its underlying measures have stayed rather vague and have not been well described.

The necessity for sustainable IS management derives from ever-growing power demands, waste streams, data amounts and future performance expectations towards IT. Google, for instance, operates about 450,000 servers consuming nearly 800 million kWh a year (Chou, 2008). Now, Google uses customized evaporative cooling to significantly reduce its data centers' energy consumption (Kurp, 2008). However, the impact of IT on the environment is broader than just energy consumption and deduced $CO_2$ emissions. High technological intensity, rapid technological progress and short life time cycles of IT products contribute significantly to the waste stream of electronic products (e-waste). Information and communication equipment as well as monitors make up 25 percent of the approximately 20 to 50 million tons of e-waste generated each year (UNEP, 2008). This development brings legislation and other stakeholders on to the scene for IS management. Regulative and reputational risks pose an additional threat to IS management besides the problem of volatile and in the long-run rising prices for natural resources. CIOs, IT managers and environmental experts are forced to rethink the way they manage their IS. The issue is no longer about whether an IS organization needs to care for environmental concerns but more about how to tackle them more efficiently, while connecting them with the general sustainability strategy of the firm. The research questions arising from this are:

- How can the scope of Green IT and its underlying measures be defined?
- Why are companies really doing Green IT?
- What is state of the art in the scope of Green IT?

For this purpose, interviews with subject matter experts (SMEs), such as CIOs, IS and environmental managers, from fifteen different, cross-sectoral IS organizations, thereof three US and twelve European companies, have been carried out as an explorative study. The state of the art analysis will provide researchers and practitioners alike with a better understanding and a roadmap for this emerging field of research. This aims to provide theoretical foundation to the topic for further research. The first step of the paper is to create a clear view on the concept of sustainability and IS management. Derived from expert interviews the most important measures for implementing sustainability along the value chain of IS management are displayed. Based on these results an evaluation is done regarding the current situation of sustainable IS management, research gaps and recommendations for scientists and practitioners.

## RELATED RESEARCH

### The principle of corporate sustainability

Sustainability has been extensively discussed within corporate management[1] under the synonyms of corporate social responsibility (CSR), greening the business, eco-efficiency or eco-advantage. Although many studies concerning sustainable management have been introduced, sustainability in IS has not been evaluated until now. Global development and challenges (see section 1) as well as the general need to align IS strategy to corporate strategy, form the need for an integrated concept of sustainability in IS. In its primary sense sustainability can be described as a survival assurance meaning that an economical, ecological or social system should be preserved for future generations and, thus, necessary resources should only be exploited to a degree where it is possible to restore them within a regeneration cycle. The most common definition from the Brundtland Commission defines sustainability as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). All definitions of sustainability have the preservation of the economical, ecological and social system for the benefit of future generations in common. These dimensions represent the three main pillars of sustainability and are known as the "triple-bottom-line" concept (Elkington, 1997). The "triple-bottom-line" concept provides a framework to companies to measure and report their performance and organizational success in relation to these pillars. Thus, the primary objective of a corporate sustainability program is to account for the triple bottom line. Corporate sustainability is about minimizing a business' negative impacts on people, societies and the environment while maintaining or enhancing value for customers, business partners and shareholders. Especially at the business level, sustainability is mainly equated with the economical or financial sustainability (Dyllick and Hockerts, 2002). However, integrated corporate sustainability is achieved by recognizing the interdependence of the three dimensions over time and keeping an optimal balance between them.

### The value chain of IS management

In order to define the field of research it is necessary to identify the relevant scope of IS management and to outline the key activities of IS service provisioning. The IS business consists of internal (in-house) and external organizations that provide products and services, such as hardware, software and services that can be assigned to IS organizations. These types of organizations generally follow the processes source, make, deliver, and return through which the value creation takes place. The management of these processes defines the scope of IS management. The foundation for this process oriented concept originated from the Supply Chain Operations Reference (SCOR) model (Supply Chain Council, 2006), a well-known value chain concept in industrial management, which makes it applicable for IS hardware providers. The transfer of the SCOR model to IS software and IS service providers has been done by Zarnekow et. al. by developing the integrated information management (IIM) model (Zarnekow, Brenner and Pilgram, 2006). The IIM model focuses on the whole IS value chain including customer and supplier relationship, while traditional IS management concepts are focusing on the management of applications (Hochstein, Brenner and Uebernickel, 2006). Figure 1 illustrates the value chain of IS business, including a return process and the stakeholders' interests:

[1] For some works on the topic see (Esty and Winston, 2006; Epstein, 2008)

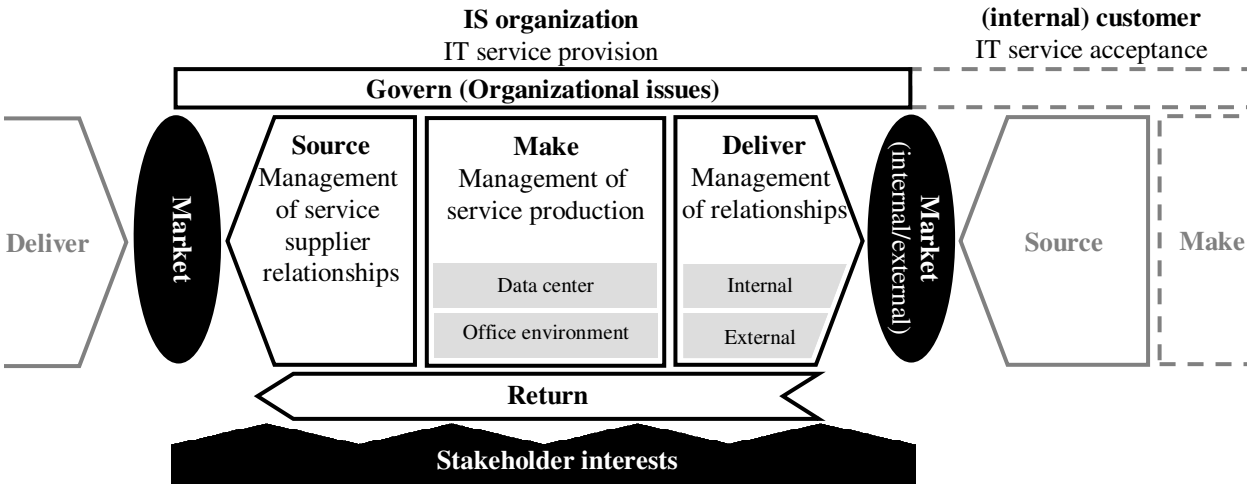


**Figure 1. Value chain of IS management (Source: Following Zarnekow et. al., 2006)**

The **govern** function encompasses strategic procedures, and measures, which ensure that allocated IS products and services contribute to the business objectives. In particular, IS governance determines the supervisory functions, organizational structures, and processes.

The **source** process covers all tasks within the supplier relationship management. Usually, IS organizations purchase hardware components, software solutions, personnel or other technological resources. These resources are used in the production phase and are transformed to marketable IS services.

The **make** process comprises all tasks for the management of IS service production. In this paper focus is put on the two main places of IS service production: the data center and the office environment. Attention is therefore drawn to the efficient planning, development and production of IS services in these two areas.

The **delivery** process is responsible for the management of internal and external relationships. The main objective is to meet all types of internal and external demands in an adequate manner. This does not only comprise IS services but also demands for compliance or transparency. The delivery process can be seen as a mediator function between the internal make and the following source process.

Based on the original SCOR model we included a **return** process into the IS value chain. The return phase depicts the processes of recycling, preserving and reusing tangible and/or intangible resources. It ensures a lifecycle oriented view on IS services, including a waste management and reutilization of products in the value chain.

To frame the value chain of IS management **stakeholders'** interests are taken into account. The reason for doing so is that the diversity of stakeholders like shareholders, policy makers, suppliers, labor unions, customers or others, can have a major impact on corporate - in this case IS management - performance. Summing up, the model cuts the value chain into four core processes which have to be considered simultaneously for implementing sustainability in IS management.

## EXPECTED OUTCOMES AND DATA COLLECTION

### Expected connections between sustainability objectives, green measures and their benefits

For each phase of the value chain of IS management a continuum of "green" measures is applicable. Building up on the work from Schmidt et. al. this section provides an overview of proposed connections between the main objectives of sustainable IS management, possible measures to achieve those and expected benefits (Schmidt, Erek, Kolbe and Zarnekow, 2009). The objectives and measures make no claim to be complete, but show that sustainable IS management should look beyond data centers to broader issues, such as resource consumption, transparency and marketing. Table 1 gives an exploratory overview of the expected connections. These causal relationships were tested through the collected interviews.

| | **Source** | **Make** | **Deliver** | **Return** |
|---|---|---|---|---|
| **Objectives of sustainable IS management** | Achieve transparency of suppliers, its products and services | Minimize the consumption of resources while maximizing the output | Meeting internal and external demands | Recycle and reuse of resources |
| **Green IT Measures** | • Audits of suppliers<br>• Demanding certifications<br>• Life cycle considerations for products and services | • New technologies and concepts for increased efficiency in data centers and the office environment | • Communication of all applied efforts<br>• Dialogs with stakeholders<br>• Benchmarking of performance | • Environmentally sensitive disposal<br>• Disassembly of parts and products<br>• Reusing of parts |
| **Associated Benefits** | • Risk avoidance<br>• Better quality of products and services | • Cost reduction<br>• Higher flexibility | • Risk reduction<br>• Reputational improvement | • Risk reduction<br>• Cost reduction |

**Table 1. Expected connections in the scope of sustainable IS management**

The procuring IS organization is connected to the risks associated with the suppliers' reputation, its products and services. Therefore transparency of these aspects is the main objective within the *source process*. An unethically or environmentally unfriendly behavior of a supplier can easily rub off on the downstream supply chain leading to uncontrollable and hard to manage issues. Besides that, the performance of products and services within their life cycle predetermines the capabilities of all following processes, influencing costs, flexibility and reputation. Hence, sustainable IS management requires measures to achieve transparency. Supplier audits, certain certifications, such as IS0 14001, or special labels for products and services (e.g. Energy Star for desktop computers) can reduce asymmetric information and behavioral uncertainty. Organizations might also install a more sophisticated, centralized sourcing management by committing themselves to general sustainable sourcing principles to purchase products and services in a way that takes into account the long-term impact on people (social perspective), profits (economic view) and the environment (ecological view). Two well-known examples for eco-labels are TCO and Energy Star. The TCO certification program ensures that CRT-based computer displays have a low electro-magnetic discharge and include criteria on energy consumption, ergonomics, and the use of hazardous materials in construction (Proto, Malandrino and Supino, 2007). The Energy Star label is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies (EPA, 2009).

In the *make process*, IS service provision should be achieved by minimize the consumption of resources while maximizing the service output. This objective is directly connected to the benefits of cost reduction. But consuming and using less resources, especially physical ones, also increases the flexibility of the IS organization to deal with change and transition processes. Sustainable IS management is therefore looking for new technologies and concepts to increased efficiency in data centers and the office environment. Despite some already existing concepts, such as server virtualization, new possible measure like "grid computing" evolve. Grid computing is a collaboration concept to perform very large computing tasks together by connected IT infrastructure. Another example is "cloud computing". It is an internet-based architecture through which real-time scalable resources are provided as a service over the internet. An often-quoted example is Google Apps, which provides common business applications online that are accessed from a web browser, while the software and data are stored on Google servers (Thomas, 2008). A well managed power management can reduce the electricity consumption significantly in the data center and the office environment. Whether by installing software in the data center that automatically shuts down unused systems or by simply instructing users to turn off idle machines. An effective power management strategy can save a significant sum of money as well as lower environmental pollution through reduced energy consumption.

In the *deliver process* the objective of the IS organizations is to meet the internal and external demands of all stakeholders. By integrating the deliver process with all other processes of the IS value chain additional benefits, such as the reduction of external risks and reputational improvement, can be achieved. Employees like to work for a responsible sustainable organization and are highly motivated to contribute to this objective. Other stakeholders differ greatly in their information

interests. Therefore sustainable IS management has to identify measures to complement their services with appropriate communication strategies. One tool is a standardized reporting guideline. The reporting guideline published by the Global Reporting Initiative (GRI) is a widely used sustainability reporting framework and provides principles and indicators that can be used by organizations to measure and report on their economic, environmental, and social performance. These standardized guidelines make it possible to benchmark organizational performance with respect to regulators such as lawmakers or industry oversight committees. Moreover, it forms the basis to communicate organizational commitment to sustainable development and to satisfy the information needs of internal and external stakeholders. Special consortiums, such as the "green grid" or "uptime institute", are working on specific topics of IS and are putting up new standards that could potentially become mandatory for the industry.

The *return process* aims to recycle and reuse as many resources as possible. It comprises all measures and methods for recycling, preserving and reusing tangible and/or intangible resources. Thus, concepts for waste treatment and securing natural resources have to be defined and applied.

#### Data collection and assessment of current measures

Between October 2008 and January 2009 interviews with SMEs from fifteen different IS organizations of large-scale international enterprises have been carried out, using a structured interview guideline. The sample selection was based on company size and industry ensuring a cross-sectoral analysis. The questions of the interview guideline were structured following the underlying concept of the value chain of IS management (see previous section):

1. Introduction: Position, responsibilities and experiences of the SME
2. Green IT: Personal opinion on the relevance and future development
3. Sustainability: Perspective on sustainability by the company and the IS organization
4. Stakeholders: Important stakeholders and their demands from the IS organization
5. Source: Measures implemented and achieved benefits
6. Make: Measures implemented and achieved benefits
7. Deliver: Measures implemented and achieved benefits
8. Return: Measures implemented and achieved benefits
9. Closing: Open questions, further suggestions

The structure and questions were developed from literature research. To ensure that no important issues are neglected open interview questions were asked. Interview partners were CIOs, IS and environmental managers. The fifteen companies dived themselves into the following industries: 5 IT service providers, 3 hardware and software, 2 telecommunication, 2 financial services, 1 internet, 1 semiconductors, 1 pharmaceuticals and chemicals.

All interviews were recorded and transcribed. The transcription was sent back to the interview partner for final confirmation. Due to the open response options and the cross sectional character of the interviews not all questions could be answered completely. Because of the small sample conclusions are limited to the interviewed IS organizations. Nevertheless the results indicate possible relations and results for other IS organizations. From the interviews all mentioned measures, which from a SMEs perspective are connected to Green IT were collected and rated concerning their implementation status (see table 2).

| Status | Value | Description |
|---|---|---|
| Implemented | + | Measure has been generally implemented. |
| Partially implemented | 0 | Measure has been partially implemented. Ongoing considerations and planning. |
| Not implemented | - | Measure has not been implemented into daily operations. |
| No known actions | | No information concerning the current status of the measure available. |

**Table 2. Implementation scale of Green IT measures**

The results are shown in table 3. For each measure the minimum of total implementations is being calculated to highlight its significance and dissemination within the interviewed IS organizations.

| Domain and measure<br>Organizational issues | Industry | SME1<br>Semiconductors | SME2<br>Hardware, Software | SME3<br>Hardware, Software | SME4<br>Hardware, Software, IT services | SME5<br>IT services | SME6<br>IT services | SME7<br>IT services | SME8<br>IT services | SME9<br>IT services | SME10<br>Telecommunications | SME11<br>Telecommunications | SME12<br>Internet | SME13<br>Financial services | SME14<br>Financial services | SME15<br>Pharmaceuticals, chemicals | Total implementations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elaborated environmental management system | | + | + | + | + | + | + | + | | - | + | + | + | + | + | + | 13 |
| Environmental officer responsible for IT | | + | + | + | + | + | + | + | - | - | + | + | + | - | + | + | 12 |
| CO2 targets as business objectives | | | + | 0 | + | + | + | - | | - | + | + | + | + | + | + | 10 |
| Internal environmental auditing of IT | | + | + | - | + | + | + | + | - | - | | + | + | - | + | - | 9 |
| Environmental target agreements for IT | | | + | + | + | | + | + | | - | | + | + | + | + | | 9 |
| CO2 targets and measuring for IT operations | | | + | - | + | + | + | - | | - | | + | + | 0 | + | | 7 |
| Certified after ISO 14001 | | + | 0 | 0 | + | + | + | - | - | - | - | | - | - | + | + | 6 |
| External environmental auditing of IT | | - | - | - | + | + | - | + | - | - | | - | - | - | + | - | 4 |
| Cost allocation of electricity | | | 0 | 0 | | 0 | 0 | | 0 | - | | | 0 | | 0 | 0 | 0 |
| **Source** | | | | | | | | | | | | | | | | | |
| Consider energy consumption in the RFPs | | + | + | + | + | + | + | + | + | + | + | 0 | + | | + | | 12 |
| Audits of suppliers (e.g. compliance to RoHS, WEEE) | | + | + | | + | + | + | + | | - | + | + | - | + | + | + | 11 |
| Life cycle considerations for IT | | + | + | + | + | + | + | + | - | - | + | - | + | | + | | 10 |
| Checking for eco labels (e.g. Energy Star) | | + | + | | + | + | + | + | | - | | | | + | + | + | 9 |
| Centralized sourcing | | + | + | | | + | + | | | - | | | | + | + | + | 7 |
| Own certification program for products | | | + | | + | + | | - | - | - | | + | | + | + | - | 6 |
| Checking for subsidies | | | | + | | | | + | - | - | + | | + | | | | 4 |
| Sourcing of standardized systems | | | | | | | + | | + | - | | | | | + | | 3 |
| Use of regenerative energies | | | 0 | 0 | + | 0 | + | - | - | - | | - | - | | | | 2 |
| **Make** | | | | | | | | | | | | | | | | | |
| ***Data center*** | | | | | | | | | | | | | | | | | |
| Server virtualization | | + | + | + | + | + | + | + | + | + | + | | + | + | + | + | 14 |
| Cooling optimization | | + | + | + | + | + | + | + | + | + | + | - | + | + | + | 0 | 13 |
| Storage virtualization | | + | + | + | + | + | + | | + | + | + | - | + | + | + | 0 | 12 |
| Network and auxiliary optimization | | | + | + | + | + | + | + | + | + | + | - | + | | + | - | 11 |
| Monitoring of electricity consumption | | + | + | | + | + | + | | + | 0 | + | 0 | + | | + | + | 10 |
| Power down of systems | | | + | | + | + | + | | + | | | 0 | + | | | | 6 |
| Use of external consulting | | | - | - | - | + | + | + | - | 0 | | - | + | | + | - | 5 |
| Grid computing | | | | | | | | - | + | + | | - | | | | | 2 |
| Utilization of fuel cell | | - | - | | | + | - | | - | - | | - | - | - | - | - | 1 |
| Cloud computing | | | 0 | - | | | | - | - | - | | - | | | | - | 0 |
| ***Office environment*** | | | | | | | | | | | | | | | | | |
| Video conferencing | | + | | + | + | + | | + | - | - | + | - | + | + | + | - | 9 |
| Training and informing of employees | | 0 | | 0 | + | 0 | 0 | + | - | - | + | + | + | + | + | 0 | 7 |
| Printing optimization | | | | | | | | + | | - | | | + | + | + | | 4 |
| Desktop virtualization | | + | | - | + | + | 0 | 0 | 0 | 0 | | - | | | 0 | 0 | 3 |
| Wake on LAN (Remote shut down of desktops) | | | | | | | | | | | | | | + | + | | 2 |
| Primarily utilization of notebooks | | - | | + | | | | - | - | - | | - | | | | - | 1 |
| Shared desk | | | - | | + | | | - | - | - | | | | | | | 1 |
| **Deliver** | | | | | | | | | | | | | | | | | |
| ***Internal Communication*** | | | | | | | | | | | | | | | | | |
| Internal marketing of Green IT activities | | - | + | + | + | 0 | 0 | + | 0 | + | - | - | + | + | + | - | 8 |
| Surveys with internal stakeholders | | - | + | | + | | | + | - | - | | - | + | + | | | 5 |
| ***External Communication*** | | | | | | | | | | | | | | | | | |
| Dialog with stakeholders (e.g. WWF, green grid) | | + | + | + | + | + | + | + | 0 | - | + | + | + | + | + | + | 13 |
| External environmental reporting | | + | + | + | + | + | + | + | - | - | + | + | - | + | + | + | 12 |
| Compliance to reporting guidelines (e.g. GRI) | | + | + | - | + | + | + | - | + | - | - | + | | + | + | + | 10 |
| Listed in indices for sustainability | | | | + | | + | + | - | - | - | - | + | | + | + | + | 7 |
| Surveys with external stakeholders | | | + | | + | - | | + | - | - | + | + | | + | + | | 7 |
| Using Green IT activities for marketing | | + | + | - | + | + | 0 | - | - | - | + | + | 0 | - | - | - | 6 |
| Sharing best practices | | | + | + | + | + | | - | - | - | - | | - | | | | 4 |
| **Return** | | | | | | | | | | | | | | | | | |
| Elaborated recycling concept existent | | + | + | | + | + | + | + | - | - | | + | - | | | | 7 |
| Recycling infrastructure | | + | + | | + | + | + | - | - | - | | | - | | | | 5 |

**Table 3. Scope of Green IT measures and their implementation**

## ANALYSIS: INSIGHTS FROM IS ORGANIZATIONS

The insights from the interviews will be summarized emphasizing on the status and associated benefits of each measure. Special focus is put on the most important findings from the processes of the IS value chain.

### $CO_2$ targets are gaining ground but electricity consumption of IT is hard to measure

Many large-scale enterprises have set up defined targets to reduce their overall emissions of greenhouse gases including $CO_2$. These targets primarily aim to reduce costs of resource consumption, build up a positive image of the enterprise, set incentives to optimize processes and prevent further regulation by legislation. Especially in the United States, experts consider the possibility of an upcoming carbon tax that could be applied first to utility companies and later on to all types of industries. To measure their emissions the enterprises are mainly following the guidelines of the greenhouse gas protocol from the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The guidelines distinguish between direct emissions, for example from business travel and indirect emissions, for example from purchased electricity. As a large consumer of electricity the IT infrastructure in data centers and the office environment contributes to the indirect greenhouse gas emissions of the company. Therefore $CO_2$ reduction targets in the form of electricity savings are partially passed down to IT operations. A challenge lies in the exact measurement of electricity consumption of IT. Many times data centers are located in the same buildings with other offices making it hard to separate individual consumptions. Even harder is the case within the office environment. Until now the exact energy consumption of desktops, monitors, notebooks, networks, printers and communication equipment can only be estimated. That is why cost allocation of electricity consumption in some cases is done only for servers in the data center but never for all IT equipment. Reportedly, some companies have switched their accounting from floor space utilization in the data center (e.g. rack space), to energy spent by utilized devices. This new cost accounting approach forces business units to think seriously about the energy-efficiency in their IT supported processes. Nevertheless new technical solutions to measure the exact consumption of electricity by IT, as well as an accounting by the costs-by-cause principle are needed. This would create stronger incentives to manage IS in a sustainable manner.

### The main area of interest: the data center

The data center is getting the most attention by all interviewed SMEs. This is indicated by the overall number of mentioned measures as well as their high implementation rate. Especially popular are server and storage virtualization and optimizations regarding the cooling of the data center, the network and additionally auxiliary equipment. Server virtualization for instance can be used to consolidate the operations of many disposed servers onto fewer physical machines. Storage virtualization helps to perform the tasks of backup and archiving more easily by abstracting logical storage from physical storage, thus, disguising the actual complexity of the storage area network. The focus on the data center has several reasons:

1. The data center consumes high amounts of electricity leading to high expenditures.
2. Servers and equipment in the data center are expensive, space is rare. Optimizing their utilization can result in longer life cycles, performance gains or less equipment binding financial capital.
3. Building new data centers is very expensive. To handle future performance demands they need to be overbuilt. New technological concepts such as cloud computing or grid computing pose a threat to the future importance of data centers.
4. The data center with its applications is the heart of all business operations making it an indispensable resource from the business perspective.
5. The data center is in under the sole responsibility of the CIO. This makes it easer to apply measures and concepts aimed at resource reduction.

It can be stated that most IS organizations poses a high level of maturity in the scope of data centers. This finding is supported by the low implementation level of external consulting. Still, the future relevance of data centers is not determined yet. Further optimization potentials lie in the inter-corporate trading of computing capacities as it is already applied for electricity at utility companies. This could eventually lead to an external sourcing of data center services and the disappearance of company owned and operated data centers.

### Behavioral challenges in the office environment

In contrast to the data center the office environment shows no clear picture of preferred measures implemented by IS organizations. Besides video conferencing it seems that initiatives are rare and scattered. Nevertheless noticeable resource savings can be achieved. Experts stated for example that printers requesting a personal pin to start the print job can reduce the

paper consumption by up to 40%. Similar results can be expected from a reorganization of printers by abandoning personal printers and putting them in the hallway or a printing room. In many companies a considerable amount of electricity gets wasted by employees not switching of their desktop computers after work to have a faster start the next day. This could be reduced or avoided by using "Wake on Lan" functions to shut off computers remotely at a special hour or by intensified environmental training and education of the employees. Both measures are applied rather seldom. Another measure is desktop virtualization which decouples the users' physical machine from the desktop by emulating the desktop hardware environment of the client and running a virtual machine alongside the existing operating system. The operating system can be located on the local machine or can be delivered to a thin client from a data center server (Gibbs, 2008). By simplifying the load on a much smaller, cheaper, and less power consuming thin client, additional cost savings can be achieved. As the cost of hardware plunges and the cost of energy and disposing of waste are rising, advantages of thin clients grow. Despite reachable cost savings at the desktop level, evaluations from the interviewed companies indicate that tremendous amounts of servers have to be added to run thin clients, making it tough to calculate business cases. Overall the office environment shows an inconsistent and underdeveloped situation. The reasons for this can be found in the challenge to change end users behavior. Expected inconveniences in an environment with overlapping responsibilities from IT and business are demanding proactive communication to overcome resistances for resource saving projects.

### Stakeholder dialogs and Green IT

The interviews indicate that almost all IS organizations are in some kind of dialog with stakeholders about Green IT. Missing standards, little scientific research and the fear of missing out on something important might explain this high engagement. Although Green IT is frequently prejudiced as a hype theme, it stays a hot topic for IS organizations. More and more environmental reports feature Green IT related aspects to communicate the organizations' activities to stakeholders. In addition, some companies are using their Green IT activities for marketing purposes. Most interviews with SMEs verified that the telecommunication industry is very active in the scope of Green IT. This high level of Green IT activities forces other companies to follow. But the results also show that only few companies are convinced about the potential benefits from Green IT related marketing focusing on environmental aspects.

## CONCLUSION AND FURTHER RESEARCH

Green IT comprises a very large area with many measures and perspectives. In practice, no common definition has been found for Green IT, thus, hampering a clear view on the topic. Misleadingly, many organizations are focused on energy consumption, neglecting the significance of materials and behavioral aspects in IT. From this research Green IT covers the environmental aspect of sustainable IS management. It comprises all kinds of strategic, process oriented and technical measures applied in the governing, sourcing, making , delivering and returning processes of an IS organization to increase resource efficiency and decrease environment related risks.

This research is a first initial approach to describe the current environmental aspects of sustainability in IS. Through fifteen interviews with subject matter experts the scope of Green IT and its underlying measures is outlined. Based on these results scientists should be encouraged to do further research regarding single aspects of this study. CIOs, IT and environmental managers can compare their own achievements with the results from this study to evaluate their capabilities. Furthermore, the elaborated structure of Green IT provides a common base for communication and future projects in this field.

Given the rising prices for energy and other resources the relevance of sustainability in IS is destined to gain even more importance in the future. IS organizations have to be aware that sustainable measures are no longer a question of choice, it is a necessity in order to remain competitive in the future. The potential business benefits of sustainable IS management can be seen in terms of reduced costs, streamlined processes, and more efficient collaboration with suppliers and customers. In addition to the enhanced efficiency through operations, sustainability in IS management can improve the corporate reputation, the competitive advantage, and the attractiveness to investors and customers through demonstrating a corporate commitment to environmental awareness.

Building up on this research the next research step will be a large-scale survey with a representative sample of CIOs and IT managers to proof or disprove gained hypotheses. In particular, the expected causal relationships in the scope of sustainable IS management (table 1) which primarily have been derived theoretically will be validated using a representative sample. Further rounds of case studies and expert interviews will follow. The objective is to add sustainability into approved management systems such as IT-Balanced Scorecard. Also, the development of a sustainability maturity model for IS organizations is intended. This would enable a benchmarking of different IS organizations. Therefore existing standards for sustainable IS management need to be evaluated and new ones need to be developed.

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