Greening organizations: the Contribution of Enterprise Architecture

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ABSTRACT

The importance of sustainability is rapidly increasing and by now has an increasing impact on the operations of organizations. In modern organizations many of the business processes are supported by IT, which makes the relation between sustainability and IT an important subject. However, how to integrate business strategy with IT operations in relation to sustainability is unclear.

In this paper we focus on the role of Enterprise Architecture in this process and try to answer "How Enterprise Architecture may contribute in the traceable transformation from sustainability principles towards requirements on Green IT in the field of higher education."

Based on a literature study and qualitative research at different organizations we adapted the Sustainable Information Systems Management (SISM) model of Erek et al (2012). The SISM Revisited model not only guides organizations in identifying areas of interest for aligning the sustainability strategy of an organization with its IS/IT activities, but we expect it will be useful to implement sustainability in organizations as well.

Keywords: sustainability, green IT, enterprise architecture, alignment

INTRODUCTION

Sustainability has become a major issue in the operations of organizations. For many organizations, sustainability has become part of their value system and is accounted for in their annual reports.

In the IT-world, sustainability usually goes by the name of Green IT. Two 'flavours' may be discerned concerning Green IT:
- *Greening of IT*: where the IT itself is made more sustainable. Main topics here are energy consumption, the use and processing of (rare) materials (including child labour) and eWaste. In the words of San Murugesan (2008): "The greening of IT is all about the design, manufacturing, use and disposal of IT systems".
- *Greening through IT:* here, IT is used to increase sustainability by supporting, assisting or replacing more traditional and less sustainable processes. A well-known example is the use of IT for communication, which diminishes the need for physical contact and hence transport.

However, Greening through IT appears to impose a paradox: where replacement by IT may increase the overall sustainability of the organization, at the same time it increases the use of IT, which makes the IT use more energy, materials, etcetera and consequently less sustainable. From our research we learned that this paradox restrains IT departments where sustainability is concerned: they foresee that the use of IT will increase in the near future, limiting the greening of IT itself.

So we feel that an intermediate party is necessary to choose and prioritize on projects regarding Green IT. However, in most organizations such an intermediary already exists: the (Enterprise) Architectural function. "In fact, Enterprise Architecture is the art/science of "architecting" the enterprise. It is the process of modelling and documenting all aspects of the organization (i.e. the enterprise) to ensure that services, processes, applications, information, data, technology, locations, people, events and timelines are all aligned with the enterprise goals and objectives" (Campbell, 2012). In our research, we aim at clarifying the contribution of Enterprise Architecture for Green IT. As our research is commissioned by SURFnet, the organization responsible for the (Dutch) IT-infrastructure in universities, we restrict ourselves to the field of higher education as well, making our research question "*How may Enterprise Architecture*

contribute in the traceable transformation from sustainability principles towards requirements on Green IT in higher education?"

Our research will be conducted along two lines:
- A study of relevant literature (desk research).
- Interviews in five organizations of higher education and, for comparison purposes, five other organizations.

From what we learn, we will try to develop directives for other organizations in higher education on how to use Enterprise Architecture for Green IT. As our research is still in progress, in this paper we will give preliminary results.

The remainder of this paper is organized as follows. Section 2 describes the literature research on sustainability and IT. In section 3 the process of interviewing respondents is described. Section 4 presents a model that links business strategy and IT architecture and in section 5 a discussion is presented together with suggestions for further research.

LITERATURE STUDY

In the field of sustainability the amount of research is gradually increasing. Research on how to implement a sustainable business strategy and align IT activities in accordance, is however still limited. Today in organizations many of the business processes are supported by IT (Zarnekow et al. 2005), which makes it an important subject.

While there are not many methods that integrate a management and IT perspective there are a lot of management approaches within the field of sustainability. According to Elkington (1997) most of these approaches are based on the political-societal driven "triple bottom line" model. This means that economical, ecological and social aspects should be integrated in order to execute sustainable economic activities.

Since many Green IT initiatives start as a project an interesting research area is that on sustainability and project(management). Silvius and Schipper (2010) describe a Sustainable Project Management Maturity Model that supports in identifying the aspects concerning sustainability that should be taken into account during a project. This model is constructed along the lines of two views on sustainability. First of all the triple P-criteria (People, Planet, Profit)

is incorporated into the model and second, an organizational perspective is included: in which way are resources, business processes, the business model, and products/services influenced by the sustainability goals of the organization?

There are different perspectives where the discussion on Green IT is concerned (Elliot 2011; Erek 2012; Loos 2011; Molla 2009). The first of these is the view on IT as a domain that uses a lot of energy and thereby causes a large environmental impact due to the CO_2 emissions: the Greening of IT. For example Harmon et al. (2010) find that "the practice of maximizing the efficient use of computing resources to minimize environmental impact" is the focus of Green IT. Another stream of research looks at the role IT and Information Systems (IT/IS) can play in contributing to the sustainability strategy of an organization. Using IT/IS a company can organize its processes and activities more effectively and efficiently, thereby reducing waste and optimally using resources (Loos 2011): Greening through IT. Watson et al. (2010) and Nedbal et al. (2011) also support this view in favor of the "purely technology-oriented view of Green IT". They state that IT/IS have an important function as enabler for sustainable business processes and label this "IT-for-Green". Finally, Elliot (2011) integrates both perspectives on sustainability in IT as follows: "…activities to minimize the negative impacts and maximize the positive impacts of human behavior on the environment through the design, production, application, operation, and disposal of IT and IT-enabled products and services throughout their life cycle" (Elliot et al. 2011).

Erek et al. (2012) find that "most current sustainable activities performed by IT organizations concentrate on isolated and, for the most part, uncoordinated technical (energy-) efficiency parameters with a narrow view on decreasing costs (bottom-up approach)." Such isolated activities are seldom aligned to each other and to the strategy of the organization. Therefore Erek et al. (2012) state that an approach is needed that integrates the different perspectives on sustainability with strategic target settings for sustainable management and they introduce the sustainable information systems management (SISM) model (figure 1) that incorporates three degrees of IT-induced environmental impact. The first degree effect considers the value chain of the IT organization itself and consists of three parts: Sourcing, Production and Delivery. Governance throughout the value chain is important in order to align the sustainability strategy with the organizational strategy. The second and third degree effects consider the business organization and its products/services.

The model takes the different levels in an organization according to Zarnekow et al. (2005) and Österle and Winter (2003) into account as well. Together these aspects create a matrix structure that provides organizations (or researchers) with 13 so called 'fields of action' (the cells within the matrix). According to Erek et al. (2012) "The SISM model addresses the adequate integration of economical, ecological and social interests into the management of IT organizations with the goal of designing and implementing a sustainable management within the organization."
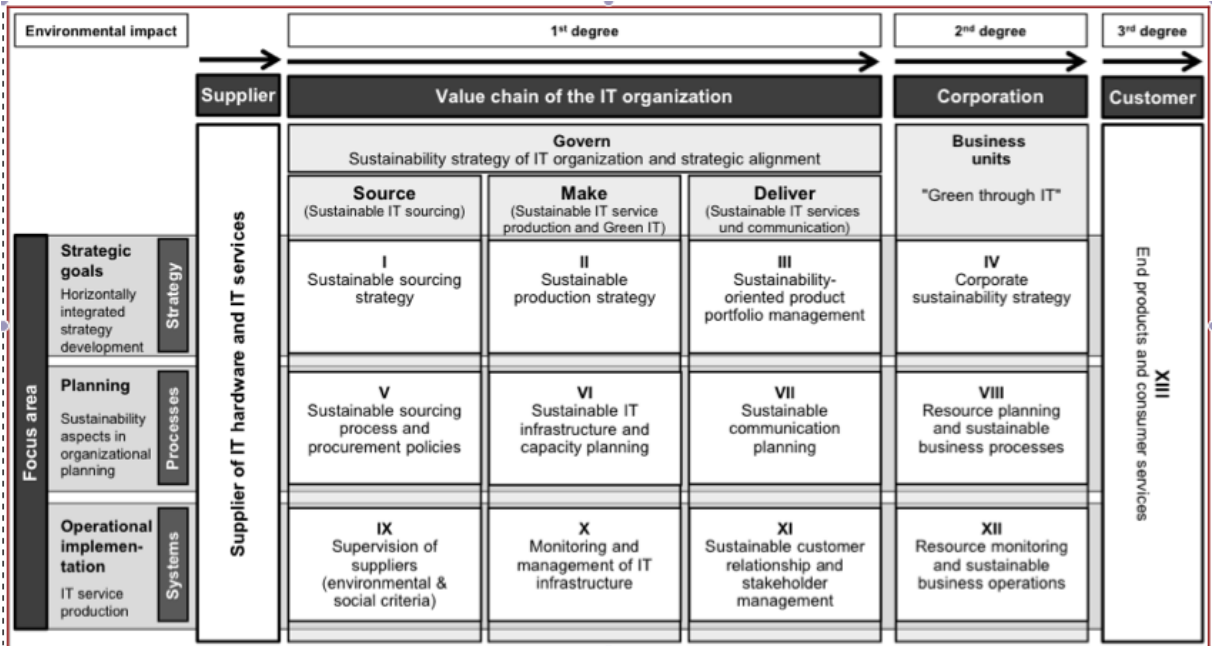

Figure 1: Sustainable Information Systems Management model (Erek et al. 2012)

The various effects as described in this model each have a different impact on the environment. Effects of the first degree have a negative impact in the production, deployment and disposal stages. The effects of the second degree are related to the Greening through IT as described above and thus are focused on the business processes within an organization. Finally, the effects of the third degree cover the environmental impact that is caused by the use of a product/service. According to Buchta et al. (2009) these effects are only relevant in those cases where IT is part of the end product/service of an organization (e.g. for a web retailer or in e-government services).

Although the SISM model provides guidance in determining areas that are important in aligning the sustainability strategy of an organization with its IT/IS activities, it does not provide answers on how to implement such an alignment. In this research we try to find an answer by looking at the role of Enterprise Architecture in an organization. Where architecture is defined in

ISO/IEC/IEEE 42010 (2011) as the "fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution", it is clear that principles play a central role in architecture. Principles guide the implementation of an architecture (TOGAF 9.1, 2011) and as such are one of the cornerstones of Enterprise Architecture (Greefhorst, D., Proper, E., 2011). Architectural principles are derived from the goals and strategy of the organization and drive the implementation through requirements (Schultz, 2007) as depicted in figure 2.
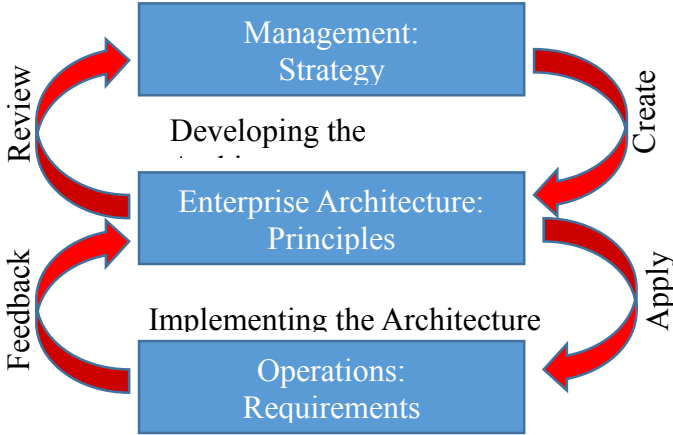

Figure 2: Principles in Enterprise Architecture

Greefhorst (2011) argues that the principles – and hence the inferred requirements – are non-functional and as such describe constraints and quality restrictions for the implementation, which is coherent with the role of sustainability in implementation. Hence, in our research we focus on the role of principles regarding sustainability: how are they derived and how is their implementation governed?

RESEARCH IN ORGANIZATIONS

As stated in the introduction of this paper, our practical research is based on (semi-structured) interviews in various organizations: commercial enterprises, governmental organizations and universities. At the time of writing this paper, five organizations have been visited and five more are to follow, three of which are planned. The distribution of these organizations over the various categories is shown in figure 3.
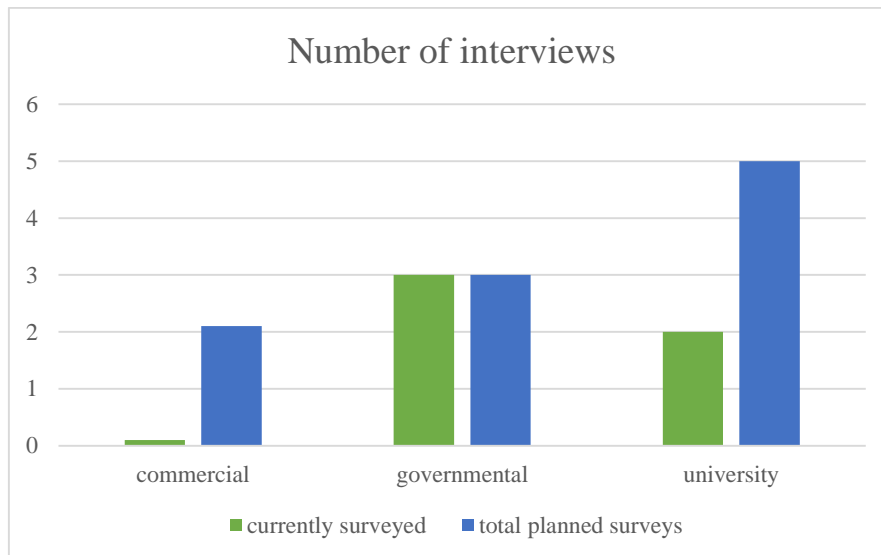
Figure 3: Distribution of interviews over categories

The interviews have been conducted in three stages:

- *Preparation.*
- *Interview(s).*
- *Study of supplementary material.*

In the preparation stage, public statements, strategies etc. were gathered (mainly from the websites of the organizations). In this way, we obtained an understanding of the importance of sustainability for the organization and for the main sustainability goals to be reached. This knowledge has been used to fine-tune the interview questions.

The interviews themselves were conducted with an enterprise architect or an information manager and – where possible - with a sustainability coordinator. The questions centered around three topics:

- *Developing the architecture*: is sustainability implemented in the architecture and if so, how.
- *Implementing the architecture*: are the sustainability goals monitored by architects during implementation and if so, how.
- *Sustainability*: what are the main concerns for the organization regarding sustainability now and in the near future?

During the interviews, additional materials have sometimes been submitted which in the third stage have been studied.

The main conclusions from our interviews are:

- All organizations visited have adopted sustainability goals. A common theme in these goals is diminishing CO_2 emissions by reducing energy usage. For the universities visited, it was important to incorporate sustainability in their bachelor and/or master programs.

- In all organizations visited except one, sustainability was not an issue in the Enterprise Architecture. Reasons given ranged from: "sustainability in our organization is a concern for facility management"; "making the information robust is our primary goal" to "yes, probably next year we will introduce a principle on sustainability".

- For the implementation of the architecture, we found that in all organizations visited a 'decision board' exists that prioritizes projects and provides budgets. Sustainability was not an issue in the proceedings of these boards; the focus seemed to be efficiency.

- In most organizations, energy consumption and production methods are an issue when purchasing new IT-systems. Energy-efficiency in the datacenter is a major concern as well for most organizations, but power management was used only in a couple of organizations.

SISM REVISITED

To categorize the contribution of EA to sustainability we combined three different approaches from literature:

- The SISM model, developed by Erek et al. (2012), as presented in figure 1.
- The maturity model for sustainability in projects from Silvius and Schipper (2010) as discussed in the literature study. With this model, maturity is measured and a route towards more maturity is offered.
- The principles in the development and implementation of Enterprise Architecture (see figure 2).

In figure 4, these models are combined in one overall model, which we – for now - have labeled SISM Revisited.

	Resources	Business Processes	Business Model	Products/ Services
Management: Strategy				
Architecture: Principles				
Operations: Implementation				
SISM Terminology	IT Organization: Source, Make & Deliver	Corporation		Customer

Figure 4: The SISM Revisited model

Where the SISM model guides us in identifying areas of interest for aligning the sustainability strategy of an organization with its IS/IT activities, with the SISM Revisited model we expect to be able to advise on how to implement such an alignment as well. This expectation is based on the route towards more maturity as described by Silvius and Schipper (2010) and on the way in which architectural principles can be used for implementation.

For now, the model can be used to qualify the role of Enterprise Architecture in sustainability issues. When, for example, the strategy has a high ambition and we find implementations of this ambition in the operations, but in the Enterprise Architecture there are no principles and/or goals regarding sustainability, this means that the Enterprise Architecture is not in control in making the organization more sustainable by the use of IT. If, on the other hand, in the strategy a high ambition is formulated and in the Enterprise Architecture this ambition has been translated in a coherent set of principles and/or goals, this gives a good starting point for an effective and efficient implementation of sustainability in the operations of the organization.

DISCUSSION AND FUTURE RESEARCH

In this paper we have described a research in progress in which we try to discover how enterprise architecture can contribute in implementing sustainability principles in such a way that IT operations support an organizations sustainability strategy. Based on a literature study

and interviews at different organizations we adapted the Sustainable Information Systems Management (SISM) model so that it can be used for this purpose. However the number of interviews conducted is not yet enough to finalize the adapted model.

In all organizations visited so far, the ambitions regarding sustainability were quite high, extending from Resources to Business Processes. In four of these organizations, sustainability was not incorporated in the Enterprise Architecture while in the operations all kind of initiatives were developed, mostly on the Resources-level. In the fifth organization, it was stated in the architecture that all projects should comply with the sustainability goals. In this way, the architects contributed to the goal that the sustainability of the organization should increase with time.

Finally, the model should be validated by using it in practice. As we focus on higher educational institutions we aim to test the model at the HU University of Applied Sciences to determine its applicability.

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