Chapter 17

How IT-Enabled Services Can Help to Change our World: Building Networks for the Energy-Efficient City of Tomorrow

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ABSTRACT

How natural resources are used in modern society is considered a high-priority topic within national and international political and social debate. Increases in energy efficiency, the use of renewable energy sources and emission control are important aspects of this subject that must be considered. A deeper understanding of existing infrastructure and the willingness to change on an individual and social level are needed, while determining factors like demographic change are taken into account. This paper introduces the energy-efficient city of tomorrow as a city of socio-technical networks that interact and are a basis for energy-related optimizations. Furthermore, the authors discuss the special role that IT-enabled services can play in understanding and changing those networks. To illustrate, the authors present a service as a case study that illustrates how services can provide relevant information and help to induce change.

1. INTRODUCTION

On the background of the finite nature of conventional fossil-biogenous energy sources like oil, gas or coal and with the challenges posed in respect to climate protection, a global debate has started during the last years to discuss matters around reliable, cost-effective and environmental-friendly energy production and usage. Major challenges have been identified on an international level in the finiteness of fossil fuels (Pelte, 2010), global increase in energy demand and climate changes as a result of global warming. More national concerns like the dependency on fuel-imports,
questions on how to define an optimal national energy mix or building energy infrastructures and energy market regulation (Dratwa & Ebers, 2010) show the variety of questions and tasks in the respective field.

In this area of conflict, energy efficiency within existing structures gains in importance. Here, the focus is on reducing the demand for further energy while configuring raises in energy consumption without impact on climate change. Furthermore, potentials to save energy and to lower environmental impact need to be identified and used, to reach a higher energy productivity (Krassuski, Jochum, Rufin, Ortmann, & Graichen, 2009).

Existing structure elements are buildings, roads, tracks and supply lines within areas that are populated by people – they form cities and communities. Within them, the different actors operate within a definable system. They generate and use energy through the usage or configuration of the structure elements while being strongly heterogeneous in respect to their individual knowledge, perception, goals and conduct. At the same time, the infrastructure elements themselves show large variations in different dimensions (e.g., building density, alternatives in energy supply, level of reconstruction). Also, the city seen as a system must be defined as highly volatile and my will change constantly due to different factor such as demographic change. To raise energy efficiency within such a system it is necessary to define a multi-dimensional system understanding. This understanding has to reflect the individual and its actions as well as living conditions and existing infrastructure. Ultimately, raises in energy efficiency will have to be conducted on the basis of these dimensions harmonized with the economic efficiency of the changes desired.

In this area of conflict more attention has to be given to (IT-Enabled) services. Services can act as enabler to define a new form of “energy truth” that brings together information and bundles different aspects to provide new solutions or help to form decisions. The term “energy truth” embraces the acknowledgement and disclosure of the current energy situation and resulting effects in the area of energy availability, energy consumption and energy costs. It realizes the limited possibilities of politics, economy and citizens and aims to find alternatives to existing ways of thinking and doing (Fähnrich, Meyer, & Kühne, 2011).

Through services, that ideally are developed systematically with the help of procedures models and tools of a service engineering (Bullinger, Fähnrich, & Meiren, 2003) or as result of a service science thinking (Maglio, Kieliszewski, & Spohrer, 2010), new action patterns can be formed that search for solutions to the benefit of all actors involved.

In this paper, we try to illustrate the potential for the energy-efficient city of tomorrow that can be exploited through the introduction of well-designed IT-enabled services. We will try to discuss the city as a system and how services can help to redefine and optimize those structures on the basis of a current sustainability understanding (Tukker & Butter, 2007). We will demonstrate our findings through a case study conducted within the city of Leipzig/Germany.

2. UNDERSTANDING THE CITY AS AN ENERGY NETWORK

To better understand the role services can play in an energy efficient-city, one has to develop a better understanding of the challenges, requirements and interrelationships within such a given system. System theory (Bertalanffy, 1950) can help to form an exemplary description of the elements and phenomena of a real world object (Favre, 2005) like a city to form a limited model that can describe relationships between objects within a given context (e.g., energy). Such a model can be visualized using graphs: relevant objects/elements are the vertices and the relationships between those objects can be represented using edges between the vertices. To model a city as a
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