

# Chapter 11

## From Systems and Tools to Networks and Infrastructures— from Design to Cultivation: Towards a Design Theory of Information Infrastructures<sup>1</sup>

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### ABSTRACT

*The author argues in this chapter that the kind of IT solutions we are developing today and in the years to come, which are integrating numbers of systems across organizational and geographical borders, in many respects are significantly different from and more complex than information systems of yesterday. To succeed with the establishment of such solutions new understandings and development approaches are needed. Such new understandings, and approaches should be based on a perspective seeing such solutions as information infrastructures—not information systems. Infrastructures evolve over long periods of time. New ones are designed as extensions and improvements of existing ones—not from scratch. Therefore the new elements have to fit into the old regime. In this process the existing infrastructure, the installed base, influences heavily how the new elements can be designed. As the installed base grows its development and further growth become self-reinforcing. Successful development of infrastructures requires, first, the creation of such a self-reinforcing process, second, managing its direction. Strategies for creating and managing such processes are here called cultivation. Gateways are important tools used in such cultivation processes.*

### INTRODUCTION

In a recent article Wanda Orlikowski and Suzanne Iacono (2001) survey ten volumes of ISR searching for theoretical conceptions of IT—without finding

it! What they argue should be the core of the IS discipline—a theoretical understanding of the key object (if not the constituting object) of our field is virtually nonexistent. Based on this finding they conclude that research aiming at developing such theories is “desperately” needed. Outlining a proposal for such a theory is the aim of this chapter. This

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will be a design theory as defined by Walls et al. (1992). The main components of such a theory is a “kernel theory,” upon which our understanding of the phenomena we are going to design is based, and a set of design guidelines (derived from, or at least in harmony with) the kernel theory.

Walls et al. (1992) propose that design theories for different kinds of IS field, like Executive Information Systems, should be developed. The theory presented in this chapter is addressing a kind of IS, or ICT solutions, called Information Infrastructures. The Internet is here seen as the paradigm example of such an infrastructure. But at the same time I see the Internet as an example of one more narrow category of information infrastructures which I call “universal service infrastructures.” The term information infrastructure, and the design theory presented, also includes two more categories which I call business sector infrastructures, of which EDI networks are prototypical examples, and corporate infrastructures. The latter category denotes the growing portfolio of information systems and ICT equipment within an organization which are increasingly integrated with each others as well as systems and equipment in other organizations across the globe.

I see information infrastructures as partly a new kind of technology which is under development and deployment. But I also see traditional informations systems as fundamentally being changed through their growth in reach and range and their integration. Accordingly I see informations systems as changing from individual applications and into huge and complex infrastructures. This is clearly the case in the process industry also (Rönnbäck et al. 2007, Jonsson et al. 2008, Jonsson et al. 2009, Westergren and Holmström 2009).

The structure of the chapter is as follows: In the next section the kernel theory of ICT solutions as infrastructure will be worked out. In section 3 I will present and discuss the design guidelines derived from this. In section 4 three examples of infrastructures will be presented in order to give richer illustrations of their characteristics,

and to give empirical support for the argument in the chapter. In section 5 some ideas for future research will be presented.

## **TOWARDS A THEORY OF ICT AS INFRASTRUCTURE/ INSTALLED BASE**

### **Existing “Design Theories:” IT Solutions as Tools and Systems**

There are very few explicitly described design theories within the IS or SE fields. Walls et al. presents a theory for what they call Vigilant EIS. Markus et al. (2002) have similarly developed a design theory for what they call “systems that support emergent knowledge processes.” Walls et al. (1992) claim, however, that the IS life cycle is a widely accepted IS design theory although it is not specified according to Wallis et al.s definition of a design theory. In the same way we can say that all IS design methodologies also, implicitly at least, define design theories. The same can also be said about most IS research.

In their survey of how IT was conceptualized or theorized in the ten volumes of ISR (vol. 1 to 10, i.e. covering the years 1990 to 1999) Orlikowski and Iacono (2001) found that 24.8% of the articles had a nominal view on IT which means that IT was absent—only mentioned by its name. 24.3% of the articles were based on a computational view (i.e. they were focusing on aspects of specific algorithms or models, or on modelling as a part of a design process or as a part of a simulation task). 20.3% of the articles were based on a tool view. This included several kinds of tools, among these tools for labour substitution, productivity improvements, information processing, social relations. Further, 18.1% of the articles had a proxy view (i.e. seeing IT as a substitution for something else like perception or diffusion processes, or capital), and 12.5% an ensemble view seeing IT as a socio-technical development project (4%), as

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