Dissertation abstract

The aim of the dissertation *Ambient Intelligence Ecologies – Toward Biomimetic IT* is to investigate possible designs for future distributed IT systems. In specific the dissertation offers a conceptual analysis of biomimetic Ambient Intelligence (AmbI) technology. Biomimetics is characterized as an IT design methodology systematically applying models of complex adaptive systems borrowed from contemporary biology, physics, economy and sociology. The dissertation promotes biomimetics as a promising candidate methodology for creating autonomous, adaptive and self-maintenant IT as a response to increased technological challenges. The challenges relates to the growing scope and complexity of distributed IT systems that are likely to exceed our traditional means of control soon and calls for new ways of organizing complex technology. At the same time IT is gaining increasing significance for everyday life rendering the robustness and reliability but also the functional pliancy of technology crucial.

The dissertation begins by characterizing biomimetics through historical and theoretical investigations of similar approaches and a theoretical analysis of foundational theories of complex adaptive systems. It is argued that there is both historical, scientific and technological reasons to pursue biologically inspired approaches to IT design to meet future challenges.

Subsequently, the biomimetic methodology is applied to a parallel emerging IT trend, AmbI, a design approach for pervasive IT accentuating the urgent need for calmness and responsive flexibility of IT. Whereas AmbI is mostly discussed in terms of user-interface design, it is argued that the 'deep structural' characteristics of self-organizing technologies such as biomimetics might be necessary to obtain the goal of AmbI. We need, in other words, to embrace a complex systems view to obtain a more qualified approach to the design of next generation IT bridging

traditional theoretical and professional gaps such as interface-logical architecture and software-hardware.

As a concrete example of biomimetic AmbI design, the presents the ongoing DELCA Ghost project at the IT University of Copenhagen. The DELCA Ghost project has been launched to investigate, among other things, novel dynamic ways of providing pervasive assistance. The DELCA Ghost project is an example of the 'Copernican turn' of biomimetic IT: to obtain better IT we should not merely stay dependent on IT but make IT become dependent on us. In essence DELCA Ghosts are semi-autonomous virtual assistants 'feeding' on the positive feedback from users by being designed to 'associate' improvement of their performances to increased 'viability' through evolutionary processes.

The dissertation further argues that our deeply culturally embedded understanding of technology and design might be the greatest challenge to biomimetics. In short, 'technology' has historically denoted static, linear and analytically neatly decomposable systems governed by Newtonian laws of clean push-pull interaction among isolated entities. However, new sciences of complexity and emerging technologies is rendering this "Cartesian engineering" inadequate and infertile. The march of technological complexity represented by IT, bio- and nanotechnology and different cultural markers clearly suggest that millennia-old technological commons sense is soon giving way to dynamic and 'organismic' ways of designing technology. Generally, technology will come to integrate control with structure in complex organizational webs to create *dynamic* artifacts. This new technology will need new design methodologies deploying continuous reiterative processes of interactive design instead of top-down and linearly controlled creation of fait accompli artifacts.

Finally, the dissertation provides perspectives for dynamic technology by discussing technological, scientific and cultural prospects for dynamic technology and specific goals and challenges for biomimetic AmbI. Many hurdles seem to stand in the way for radical changes in IT design practice but the likely gains from realizing biomimetic principles are equally rewarding and perhaps even necessary.