Developing multiagent systems for design activity analysis

Denis Choulier[1], Alain-Jérôme Fougères[1,2] and Egon Ostrosi[1,*]

[1]Laboratory IRTES-M3M
UTBM - University of Technology of Belfort-Montbéliard
[2]ESTA – School of Business & Engineering
9010 Belfort Cedex – France
E-mail: {denis.choulier,alain-jerome.fougeres,egon.ostrosi}@utbm.fr
[*]The author for correspondence

Abstract

Engineering design is a complex socio-technical activity characterized by co-evolution of problem and solution. However, the actual design theories are not well-suited to represent and model the complexity of design activity, the co-evolution and its dynamics. Therefore, there is a need to develop design activity reasoning theories and tools, which can theorize and simulate the model of co-evolution and its dynamics. Multiagent systems have the capacity to play an important role in developing and analyzing models and theories of interactivity in socio-technical societies, particularly in design. This paper first addresses a theory for design activity reasoning. Then, it will present a multiagent system, called ADEA (*Agents-based DEsign activity Analysis*), in order to model, simulate and analyze this theory. The agents of the ADEA platform formalize the necessary design roles, characterising the design activity as well as the relationship between design parameters in the design space. ADEA's platform shows that cognitive limitation of role agents has been overcome, considering their relationship with the design space modeled as a network of design parameter agents.

Key Words: Design activity theory, socio-technical processes, smart agent technologies, multiagent systems.

1 Introduction

Engineering design is a complex socio-technical activity. The importance of understanding design activity justifies the efforts of the scientific community to develop design theories such as Design Science [1], Reflection-in-Action [2, 3], Situated Function-Behaviour-Structure [4], General Design Theory [5, 6], Axiomatic Design [7], Axiomatic Theory [8], Theory of Inventive Problem Solving [9, 10, 11], Infused Design [12, 13], and C-K Design Theory [14].

Some aspects of design activity such as situativity [4], the role of the context [15], the role of capturing of data resulting from design activities and supporting the creation of these data [16], the constructivist framework [17], visual reasoning [18], creative conceptual thinking [19], designing as a representation transformation process [20], the cognitive synchronization [21] and the socio-technical aspects [22, 23] such as "specific role" and "action plan" [24] have been studied. The role of the 'insight' through identification of the emerging relationships between requirements and the design solutions is also explored for controlling and acting on the design process [25, 26]. Generic set of design activities has been also classified into *design definition activities*, *design evaluation activities* and *design management activities* [27].

Based on observations of in-practice design activity, the concept of co-evolution was introduced [28]. The Function-Behavior-Structure [4] is an example of a co-evolution model.