Workflow Development for Agent-based Simulation of Engineering Design Teams

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Index Terms—Design Activity, Engineering Design Process, Workflow, Teamwork

1 Introduction

ORGANISATIONS have been turning into team-based structures for decades. Solving of complex problems requires multi-disciplinary knowledge and divergent perspectives of individuals. Still, forming a team does not imply that desirable teamwork will emerge. For this reason, the research focus started shifting from benefits of teams and teamwork, to team functionality, effectiveness and interaction [1]. Effectiveness does not only help designers to perform better, but also to be more innovative and gain satisfaction and trust. Hence a lot of research and managerial effort is spent on understanding the effects of team composition and task distribution activities.

The advances in information technologies provided space for simulating individuals working and interacting in teams and performing individual and teamwork activities. The aim of this literature review is to explore the directions for building an activity model of teams developing technical systems, as an integrative part of a wider teamwork model. The model should provide specific workflows and procedures that reflect the nature of different types of engineering design projects and activities.

2 Describing Engineering Design

Describing and modelling of teamwork requires understanding the engineering design process that teams follow since it is the tasks that form all of the interaction. Engineering design process can be described as a sequence of steps undertaken to progress from initial idea, need or requirements to a complete description of a technical system. There exists no descriptive or prescriptive model of design that would cover all design disciplines, all types of products, or even all possible steps within the design process. Research outputs vary in scope (disciplines, stakeholders and knowledge areas, lifecycle stage), the level of detail (abstraction, granularity), and terminology [2, 3].

2.1 The Big Picture: Stages of Design Process

A stage is a subdivision of the design process that relates to the state of the product under development. The low granularity of process representation is what makes stage-based models applicable in different environments and different types of design projects.

New product development literature gives less attention to the design process, and is more focused on research, strategy and marketing activities along the product development, providing guidelines based on the successful stories from the industry. Best practices show that certain stages, especially the early development, require more interdisciplinary, either by temporarily integrating experts within the project team or via communication outside team boundaries.

Design textbooks, on the other side, provide the higher granularity of the development stage, as they specify multiple states that developed product goes through and describe them from a more technical perspective. These textbooks are mostly written prescriptively but are based on the industrial practice observed by the authors. Design process stages usually include problem formulation, conceptual design, embodiment design, detailed design, and testing and production.

2.2 Under the Lens: Design Activities

As an engineering project advances, stages are related to different types of activities, such as ideation and decision-making in early stages and technical, engineering work in later development stages. Moreover, the entire product development process can be viewed through the lens of problem-solving and decision-making activity cycles. In these cycles, the elementary operations such as goal formulation, information exchange, generation, analysis, elaboration, evaluation, decision, and documentation are carried out.

Currently, the focus of the PhD project is to model activity cycles based on the literature review and empirical studies, and provide basic simulation workflows.

Acknowledgment

This summary reports on work funded by Croatian Science Foundation MInMED project (www.minmed.org).

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