

## Chapter 13

# Antecedents of Improvisation in IT-Enabled Engineering Work

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### ABSTRACT

*The success of engineering work depends on the ability of individuals to improvise in response to emerging challenges and opportunities (Kappel & Rubenstein, 1999). Building on experiential learning theory (Eisenhardt & Tabrizi 1995; Kolb, 1984) and improvisation theory (Miner, Bassoff, & Moorman, 2001), this authors argue that information systems facilitate the generation of new product and process design ideas by providing richer feedback, creating shorter learning cycles, and enabling engineers to try a variety of new ideas more easily. An empirical research model of the antecedents of improvisation in IT-enabled engineering work is proposed. This model is examined using a sample of 208 individuals engaged in computer-intensive engineering design work. The multiple regression results suggest that software capability, autonomy, problem solving/decision support usage, system use for work planning, and length of use explain the extent of new product and process ideas that are generated. The practical and theoretical implications of these findings are discussed.*

### INTRODUCTION

Eisenhardt and Tabrizi (1995) describe two strategies for engineering design work. If all requirements are known in advance and stable, the design engineer can pre-plan all work to save time. Where design requirements are not fully known or subject

to change, design engineers may have to engage in experiential learning (Kolb, 1984). Using this experiential strategy, engineers approach problems with some general, often vague, idea of what they want to accomplish and some learned routines for interacting with the computer. They repetitively interact with the computer, assess the substantive

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results using analysis and intuition, and then, sometimes, they extemporaneously generate new ideas (i.e., improvisations) that they incorporate in their intellectual work product or process. As the design process unfolds, design engineers must improvise to adapt to emerging task requirements (Brown & Duguid, 1991; Orr, 1990b).

Kappel and Rubenstein (1999) describe how the introduction of information technology into the engineering design process can enhance creativity in design. Improvisation in design work is the interactive use of an information system application by an engineer to extemporaneously design, execute, and assess novel ideas. The novel ideas may pertain to the design of the individual's product (end result) or the design of the individual's work processes (activities). Thus, improvisation is the impromptu generation and trying out of new ideas. It is planning spontaneously based upon substantive feedback and the temporal convergence of planning and execution (Miner, Bassoff, & Moorman, 2001). This generation and trying out of novel ideas helps engineers respond to emerging challenges and opportunities in their work. Novel ideas enhance learning and productivity in engineering work.

The organizational literature on improvisation emphasizes its importance for organizational learning and renewal (Miner et al., 2001). This literature has clarified the concept of improvisation, suggesting novelty, substantive convergence, temporal convergence, and intentionality as the defining characteristics of improvisation. It distinguishes between planned ideas (innovations) and emergent ideas (improvisations).

Little is known about the antecedents of on-the-spot new idea generation in engineering design work. Improvisations have referents (e.g., antecedents) that may stimulate or constrain novel productions (Miner et al., 2001). Improvisation theory uses jazz as a metaphor and assumes that the real time interactions among musicians or between individual musicians and their audience stimulate

improvisations (e.g., new melodies). Or, product development team members interact and, thus, trigger the creation of new ideas. In IT-enabled engineering design work, there is an interaction among an active human agent, an emergent work process, and an interpretively flexible technology that may stimulate the on-line creation of impromptu new ideas (Orlikowski, 1992, 2000).

While the information systems literature has devoted considerable attention to the design of information systems that support knowledge work (Alavi & Leidner, 2001; Majchrzak, Rice, Malhotra, King, & Ba, 2000), emergent knowledge processes (Markus, Majchrzak, & Gasser, 2002), and the situated and emergent nature of information technology usage (Orlikowski, 1992, 2000), it has not specifically focused on the antecedents that stimulate improvisation in engineering design work. There has been an increased interest in application design to support experimentation (Terry & Mynatt, 2002) and creativity (Greene, 2002) in knowledge work. More recently, the information systems literature has focused on related phenomena such as personal innovativeness in the use of the internet (Larsen & Sørensen, 2005), the need for flexible systems where users themselves will be able (and increasingly enabled by technology) to satisfy their changing needs (Kanellis & Paul, 2005), and the need for users to take personal initiative with respect to experimenting in their use of information technology (Spitler, 2005). However, the information systems literature has not specifically focused on the role of improvisation in engineering work, and the subtle and often unrecognized ways in which information technology may transform the nature of engineering work by facilitating the experiential approach.

In the next section, this paper first describes how computers make engineering design work more improvisable. Then, in Section 2.1, we review the literature on improvisation. We contrast improvisation in the context of emergencies with improvisation in an engineering work context.

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