Process innovation as creative problem solving: An experimental study of textual descriptions and diagrams

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ABSTRACT

The use of process models to support business analysts' idea-generation tasks has been a long-standing topic of interest in process improvement. We examine how two types of representations of organizational processes – textual and diagrammatic – assist analysts in developing innovative solutions to process-redesign tasks. The results of our study clarify the types of process-redesign ideas generated by analysts who work with text versus those who work with models. We find that the volume and originality of process-redesign ideas do not differ significantly but that appropriateness of ideas varies. We discuss the implications of these findings for research and practice in process improvement.

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1. Introduction

When analyzing and/or designing information systems, analysts frequently use process models to document and analyze current organizational operations. These models help business personnel understand the work domain and identify opportunities in the improvement of business processes and related information systems [35]. This exercise typically involves developing process models that capture the current organizational reality and then giving them to analysts in the hope that the models will stimulate creative ideas about how the processes can be improved. However, whether process models actually assist analysts in their idea generation tasks, that is, in finding innovative solutions for future processes, or limit them to narrow ways of thinking remains in doubt. This question is far from trivial. For example, some claim that process modeling focuses on the shortcomings of an existing solution, so model-based process innovation aims on overcoming existing problems rather than achieving inspirational new goals [69]. Others suggest that good process models can be an important determinant in process-improvement success [41].

We study whether and how various ways of modeling organizational processes aid process innovation. We conceptualize process innovation as creative problem solving, where analysts generate appropriate and original ideas on how processes could be redesigned. We draw on problem-solving and visual representation theory (e.g., Refs. [26,43,88,91,92]) to hypothesize how textual and diagrammatic process models affect the creativity and type of redesign solutions. Subsequently, we report an experiment in which we tested our hypotheses.

Our study contributes to the extant literature in three primary ways. First, it adds to the body of knowledge on the use of process modeling in practice. The literature to date tends to explain how analysts *understand* visual models of organizational systems and processes (e.g., Refs. [53,67]) but not how the *use* of such models may influence the type and creative quality of ideas in process-redesign initiatives. However, input to process redesign remains the main outcome expected from process modeling [35]. Second, our study contributes to the literature on process redesign [66,81] by evaluating the types of creative solutions analysts generate by working with various types of process models. Third, we offer a new methodology for evaluating process-redesign ideas in terms of their originality, appropriateness, impact, and locus of change.

For industry, our study provides an answer to two deceptively simple questions: Do the outcomes of process redesigns vary with the process models analysts use? What type of representation

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format should analysts use based on the objective of process improvement?

2. Background

Our study relates to three streams in the literature: (i) how business process redesign is conducted and how creative problem solving is part of these efforts, (ii) how information about organizational processes can be represented, and (iii) how process representations can act as stimuli for creative redesign. We discuss each stream in turn.

2.1. Business process redesign and creative problem solving

Business processes are sets of logically related organizational tasks that are performed to achieve defined business outcomes [17]. Organizations often document their business processes in order to understand where weaknesses and performance deficiencies in processes manifest and to generate ideas about how new processes, supported by existing or future information systems, could be enacted.

Process innovation projects tend to unfold in a set pattern [40]: After a process innovation project is initiated, the diagnosis phase begins with evaluation of a current process and its attributes. Information representations, such as semi-structured texts, process flowcharts, and other types of diagrams, are used to capture information about the process [20]. In the subsequent redesign phase, analysts use these process models and creativity support techniques such as brainstorming to envision and choose among possible alternatives. In the reconstruction phase, changes to the process are introduced in the organization, and the new process is evaluated in the evaluation stage.

Our study addresses the redesign stage of process innovation projects [40], particularly the generation of ideas about a current process in the form of a "future" process model. This task can address several components of a business process:

1. *Changing the control-flow components* of a process by, for example, cutting unnecessary, non-value-adding tasks or inserting additional tasks for quality assurance.
2. *Changing the technology component* on which processes operate by changing the systems, applications, tools, or infrastructure required to execute a process [7]. Examples include changes to manufacturing machines in a production process, the use of new tools and techniques in a decision process, and the use of different digital platforms for communication processes.
3. *Changing the organizational component* of a process by allocating process tasks to organizational actors (e.g., Ref. [94]) or outside organizations (e.g., Ref. [47]).
4. *Changing an information system component* of a process by changing how a process is enacted within it or supported by it (e.g., Ref. [86]). An example is implementing a workflow solution for supply chain processes [45].
5. *Changing the data component* of business processes by modifying how information is produced or consumed in the course of the process tasks [83] (e.g., through electronic patient records).

The literature on the process of redesign in process innovation, rather than the outcome of redesign, is sparse [66,85]. Sharp and McDermott stated [75, p. 323]: "How to get from the as-is to the to-be [in a process-redesign project] isn't explained, so we conclude that during the break, the famous ATAMO procedure is invoked – And Then, A Miracle Occurs."

As there is no widely accepted theoretical frame for the redesign phase, we conceptualize process redesign as the conjuring of creative changes to a business process, and process

innovation as the actual implementation of these changes. Our distinction follows West and Farr [90, p. 10], who distinguish between creativity as "the ideation component of innovation" and innovation as "the proposal and applications of the new ideas."

Following this distinction, we can view process redesign as a creative problem-solving activity – that is, an activity that creates solutions that are both original/novel and worthwhile/valuable [80]. Process redesign as a creative problem-solving task involves three steps: idea generation, composition, and evaluation [1]. Typically, a process problem is presented to analysts in the form of information about the current way of working and an objective to introduce changes or overcome issues such as bottlenecks or quality concerns. Then, analysts develop one or more redesign solutions to the problem, identify one preferred solution, and develop and implement the corresponding future process. Finally, the implemented solution is evaluated for its ability to meet the original objective.

2.2. Representing information about organizational processes

To redesign processes to resolve issues, analysts require information about how the processes are currently executed. Current processes are documented using approaches that range from textual documentation, such as policy documents or even e-mails, to structured texts (e.g., in Excel spreadsheets) and visual approaches such as flowcharts and formal diagrams. A global study of process-modeling initiatives in 130 companies [60] showed that 55.9% of the organizations documented their processes as text and 31.5% as tables. The most popular diagrammatic formats were Business Process Model and Notation (BPMN, 21.3%) and Unified Modeling Language (UML, 15.0%). Table 1 provides real-world examples of textual and diagrammatic representations of business processes used in education, research, and industry. In these examples, the text format typically uses sentences and subsentences to describe the flow of work, whereas diagrammatic forms use markers such as boxes, circles, and diamonds to illustrate the flow of work.

Our study addresses whether and how the representation format – purely text and purely diagram – influences process redesign as a creative problem-solving activity. Because we are primarily interested in the existence and magnitude of the contrasts between representation formats, we consider these two opposing types of

Table 1
Real-world examples of text and diagrammatic representations.

Sector	Examples
Education	Processes in textbooks about business process management usually provide both textual description and corresponding diagrammatic models (e.g., Ref. [21]; Example 1.1 and Fig. 1.6) Other textbooks provide both diagrams and structured text models of business processes (e.g., Ref. [33]; Figs. 6.1 and 6.2)
Research	Many experimental studies involving models of business processes provide textual and diagrammatic models. For instance, textual and graphic models are used for the processes of: - Creating a software solution [59] - Providing financial services [65, p. 97 and p. 100] - Providing room service in hotels [44, pp. 66, p.75]
Industry	Business process management information and material provided by industry associations typically include process models (e.g., reference models or best practice models) both as textual descriptions and as diagrams (e.g., system or flowchart diagrams). Examples include - The American Productivity and Quality Center: http://www.apqc.org/pcf - The American Production and Inventory Control Society: http://www.apics.org/sites/apics-supply-chain-council/frameworks/scor - The Massachusetts Institute of Technology process handbook: http://process.mit.edu/Default.asp