Automated Process (Re-)Design

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1 Introduction

Business process management (BPM) continuously attracts academia and practice, as it is known to drive organizational performance [7]. Especially process (re-)design entails significant economic value by introducing innovation, reducing costs, as well as improving quality, productivity, and customer experience [22]. Thus, it is considered an essential phase in the BPM lifecycle [15].

Today, organizations must overthink their business processes at an increasingly fast pace, consider continuously rising customer needs, create novel process-based value propositions, and engage in innovation to stay successful [7, 13, 15]. Technological developments are rapidly gaining momentum, processes are at drift, and ever more players enter the global market, resulting in the organizational environment becoming more volatile, uncertain, complex, and ambiguous (VUCA) [5]. Even though this poses pressure on organizations, it also offers a wide range of opportunities.

While automation is prevalent in other BPM lifecycle phases (e.g., in process execution) [1], process (re-)design commonly requires manual activities such as traditional creativity techniques [15, 22], making it time-consuming and labor-intensive. Thus, *automated process (re-)design* holds high yet unexploited potential for long-term corporate success since it could accelerate process (re-) design and make it more efficient as well as less dependent on human creativity.

2 Research Problem

2.1 Problem Description

Along the BPM lifecycle, many data-driven methods have recently emerged. Enabled by the increasing volume of data, process mining techniques have been developed to identify and discover process models based on process logs [2]. Predictive and prescriptive process monitoring techniques nowadays allow for

Automated process (re-)design	**Automated Improvement** Incrementally improve an existing process automatically	**Automated Innovation** Radically create a new process automatically
Manual process (re-)design	**Manual Improvement** Incrementally improve an existing process manually	**Manual Innovation** Radically create a new process manually
	Incremental process improvement	**Radical process innovation**

Table 1. Process (re-)design matrix

acquiring real-time insights into future behavior and results of running process instances and provide recommendations for optimizing process control [21].

Driven by the recent "hyperautomation" trend [19] and the widespread adoption of process-aware information systems, organizations increasingly aspire to leverage automation potential in the context of process operations [7]. Whereas process mining and monitoring primarily focus on (partially) automated process control, robotic process automation (RPA) has become the new "technological star" for the lightweight automation of process execution [20]. Although some research obstacles still need to be overcome, ever more organizations adopt RPA to reduce manual efforts when performing specific tasks in processes [20].

Despite all these automation efforts, it is remarkable that the BPM lifecycle phase process (re-)design remains a manual task with a high level of cognitive effort. To illustrate the level of automation in the context of process (re-)design, we propose a 2x2 matrix along two continua (Table 1). The first continuum concerns the degree of automation (manual to automated process (re-)design), the second concerns the scope of process (re-)design (incremental process improvement to radical process innovation). In the following, we describe the state-of-art of process (re-)design within the introduced quadrants.

With a lens on *incremental process improvement*, various collections of process redesign patterns and methods have been developed [8,12]. These collections reduce the cognitive effort and guide process stakeholders in process improvement. However, they neither replace manual effort nor do they leverage the potential of tools in the redesign process. Initial approaches for semi-automated process improvement have been developed (see [3]). Yet, these methods are at the lower end of automation, as they generally guide improving processes in a user-interactive way. Thus, there is still great potential to increase the level of automation. Research is already striving to further automate process improvement, enabling automatic exploration of beneficial process changes [9].

Focusing on *radical process innovation*, efforts also have been made to develop guidance for creating new processes with new value propositions [13]. For instance, Grisold et al. [14] created the "Five Diamond" method, which aims to guide organizations in identifying opportunities from business and technol-

ogy trends and integrating them into processes with novel value propositions. Nonetheless, equivalent to manual improvement, the introduced method does not support replacing manual efforts with automation. While automating process improvement seems easier to realize, the automation of process innovation proves to be an unsolvable problem to date. There is certainly still huge potential in the area of automated innovation that has barely been exploited.

Overall, we conclude that process (re-)design is still predominantly a manual task. The automation of process (re-)design, especially with a focus on process innovation, undoubtedly remains a major hurdle to overcome.

2.2 Challenges to Overcome

Several characteristics of business processes and the complexity of the process (re-)design task itself make the BPM lifecycle phase of process (re-)design stand out and, therefore, prevent or at least complicate its automation. Such characteristics are described here in broad strokes:

Process (re-)design requires creativity. Process (re-)design often requires breaking with existing structures and routines within the process to create something new. Falling back on existing concepts might be a good idea for evolutionary process improvements. Still, radical (re-)design relies on going beyond what has already been there and exploring the whole solution space of (possibly unknown) process (re-)design opportunities. In contrast to data-based improvement, such explorative and innovative efforts mostly rely on "creativity", i.e., the use of imagination or original ideas to create something new. Creativity is often described as an inherently human capability. Therefore, automating (re-)design efforts requires advances in computational creativity.

Processes are multi-dimensional. (Re-)designing processes is not as straightforward as simply rearranging the sequence of activities within the investigated process. Business processes are commonly conceptualized using five fundamental perspectives [23]. Besides the above-mentioned control-flow or behavioral perspective, these perspectives relate to the functional elements of a process (functional perspective), the assignment of tasks to human participants (organizational view), the implementation of atomic activities (operational perspective), and the information entities handled during individual tasks (informational perspective). All perspectives have to be considered in automated (re-)design efforts.

Processes are executed in context. Business processes are often part of an organization's process landscape and, therefore, situated within a complex network of dependencies such as restricted resources, logical relationships [17], and domain-specific characteristics [4]. This makes it very hard to consider process (re-)design as a clearly delimited activity and, thus, complicates automation.

Processes are socio-technical. Processes are sets of activities in which humans and technology co-create value [10]. Automated approaches in every phase of the BPM lifecycle are constricted by what data is available on these activities. Process mining can, e.g., only discover processes when their activities have left traces in the involved information systems or have otherwise been recorded [16] and when these traces are of high quality [4]. In return, this data represents only the

technical perspective on the process. Process and domain knowledge of human agents participating in or being responsible for the process is essential in guiding any (re-)design effort, making full automation impractical, if not unfeasible.

Processes are at drift. All organizational concepts are subject to unintentional change, i.e., the deviation from their planned purpose over time. In a VUCA world, processes are no exception, constantly suffering from gradual and incremental changes over time called process or concept drift [6] or being radically changed by disruptive shocks [18]. This impacts automated process (re-)design activities twofold: First, due to such drift, processes are dynamic, constantly changing, and event-driven artifacts that are difficult to fully capture, define, and reinvent using high-level process models. Second, in a dynamic and changing environment, attempting to (re-)design business processes is "subject to resistance, deals, side effects, and the properties of the IT landscape" [6, p. 193].

3 Directions Towards a Solution

Initial ideas towards a solution may involve approaches that leverage advances in computational creativity, e.g., evolutionary computation [3] or generative machine learning [11]. Further, to accelerate process (re-)design, organizations could automatically incorporate feedback into design suggestions to shorten reaction cycles, e.g., via artificial intelligence-enabled process improvement tools and complex predictive models that capture trends from data.

These initial ideas are beset with challenges themselves. For example, relying on historical data could lead to new processes already being outdated at the time of implementation. This demonstrates the need to address ancillary issues such as real-time data deployment [7]. A fully automated workflow environment would also be necessary to implement new process designs without delay. Additionally, artificial intelligence often works as a black box and lacks explainability.

In conclusion, *automated process (re-)design* remains a relevant research gap that should be explored further. However, even if fully automated process (re-)design became feasible, new challenges would arise since organizations could then easily develop new processes. The focus of competition could move from talent to access to data or to the best forecasting models estimating the impact of changes on the future or identifying the next relevant time for re-evaluation.

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