Cognitive BPM: Business Process Automation and Innovation with Artificial Intelligence

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Abstract. Business Process Management (BPM) offers a structured and organized way of managing business operations. However, it is based on routines and rigid definitions that offer limited flexibility and automation options. Advances in Artificial Intelligence (AI) technology are creating new possibilities by making business processes cognitive. IT Business Value research suggests that the adoption of Cognitive Computing (CC) in BPM will improve performance. In addition, I argue this effect is mediated by automation and innovation of business processes. Research in this field is scarce. I will empirically address this research problem by firstly developing measurement scales for the adoption of CC in the BPM context (CBPM) and Business Process Automation (BPA). Secondly, I will conduct an overarching survey that explores the connection between CBPM and corporate performance (CP). My work will contribute to the academic discourse on IT Business Value research and provide insights into what outcomes managers can expect from CC and AI technology adoption in day-to-day business operations and what management strategies to employ.

Keywords: Cognitive BPM, Cognitive Computing, Artificial Intelligence, Machine Learning, Process Automation, Process Innovation, Process Performance, Corporate Performance, Intelligent Enterprises.

1 Introduction

Cognitive computing [1] is an umbrella term for new problem-solving models that mimic the cognitive capabilities of the human mind via autonomous reasoning and learning. The main goal of CBPM is automation [2]. The basic idea is to mine the data of business operations, monitor execution, gather information, and use this data to train the Cognitive System to automatically respond to business situations. With every new situation, the system learns and adapts. Ultimately, the system itself determines the next best action. This profoundly changes the existing process models [3], making them highly event-driven, adaptive, and strictly goal-oriented by autonomous planning and decision making [4]. The resulting improvements are reflected in business process innovation. With this approach, we move towards truly Intelligent Enterprises [5-7] in which data feeds intelligence, which in turn feeds process automation and innovation.

My research addresses the question of to what extent CBPM improves performance and whether this effect is mediated by the automation [8-16] and innovation [17-27] of business processes. To this end, I build on a theoretical argument of IT Business Value research, examining the impact of information technology on performance. My theory is based on the Resource Based View (RBV) of the firm [28, 29] as a theoretical framework for the identification of IT resources impacting CP [30-32]. During the initial examination of the domain, it was discovered that very little literature exists on the topic. Based on a Systematic Literature Review (SLR), a lack of empirical research addressing the connection between CBPM (IT resource) and improved CP (performance) was identified.

To empirically examine the research problem, I will utilize a survey design. For the constructs of BPI, Business Process Performance (BPerf), and CP, I will use the existing measurement instruments developed in previous studies [33-45]. I am defining a new measurement scale for the constructs of CBPM and BPA because a comprehensive model or measurement instrument does not yet exist.

The results of the research will contribute to extant IT Business Value research literature that relies on RBV as a basis for further managerial research. It will provide empirical evidence if CBPM is noted to be an important strategic determinant of increased process and corporate performance, mediated by the automation and innovation of business processes. From a managerial standpoint, the results will provide insights into what outcomes managers can expect from the adoption of CC and AI technology in day-to-day business operations and what management strategies to employ to achieve performance gains.

2 Theoretical background and hypotheses

Wang [46] presented the idea of a cognitive approach, using AI to manage dynamic and complex processes. The concept of CBPM was introduced by Motahari-Nezhad and Akkiraju [47] as a new BPM paradigm encompassing all aspects of BPM that are impacted and enabled by CC. Roeglinger et al. [1] defined the key characteristics of CC in the BPM context. The advantages are derived from cognitive computing and AI technologies. The key ones are automation and improvement through innovation. Various IT Business Value research [31, 48-51] suggests a strong relation between IT resources and CP. Thus, I argue that CC is becoming an invaluable business resource for future engineering systems and has a positive effect on CP.

Marrella and Mecella [52, 53] identified automation as the key enabler of the reactivity and flexibility necessary for BPM. Various authors explored AI techniques [4, 54-56] as key automation drivers. I conclude that the key improvements presented by the adoption of CC in BPM come from automating business activities.

Hull and Motahari-Nezhad [3] define Cognitive Process Enablement as the enhancement of business processes at the underlying process modeling, incorporating the Plan-Act-Learn cycle. I argue this will result in business process innovations, as the concept refers to performing the business activity in a new, innovative way [57]. Thus, I posit that BPA and BPI serve as mediators between CBPM and CP.

Prior research on BPM offers a more detailed perspective on the role of BPM in relation to CP [39, 43, 58, 59], suggesting that BPerf has the role of a mediator between BPM and CP. As a result, we obtain a more detailed view of CBPM influence on performance. I conclude that the same applies to the proposed model, and I formulate that BPerf has a mediating role and positively influences CP.

2.1 Research hypotheses

Relevant constructs, relationships, and the research hypotheses considered in this research are shown in Figure 1.

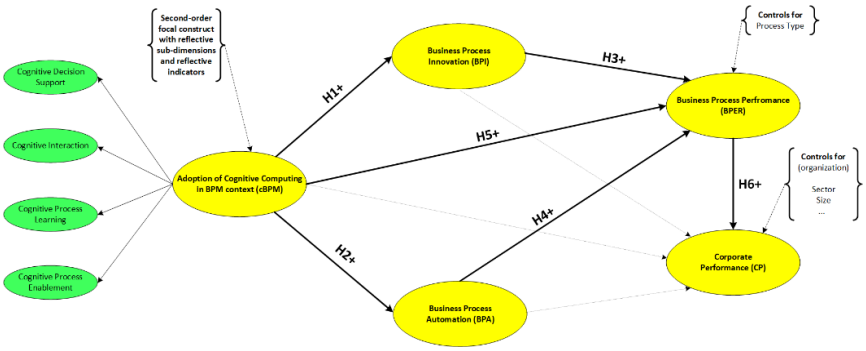

Fig. 1. Relevant constructs, relationships, and research hypothesis

3 Research design and methodology

The research will be carried out using a mixed-method approach, firstly by conducting exploratory research utilizing in-depth semi-structured interviews to discuss the topic with experts in the field.

Next, two new measures will be developed: CBPM adoption (second-order construct with reflective indicators) and BPA (first-order constructs with reflective indicators). Sub-dimensions of the CBPM adoption construct will be based on the four pillars of CBPM [3] (Decision Support, Interaction, Process Learning, and Cognitive Process Enablement) and merged with AI techniques classified by the CC characteristics proposed by Roeglinger et al. [1]. Items will be generated from the literature review and supplemented by insights and findings from the interviews, based on the procedure proposed by MacKenzie et al. [60] for construct development. An evaluation of content validity will follow the method suggested by Lawshe [61] with an expert panel, involving selected experts from industry and MIS academics. A pilot study will be conducted for the purifying and refining of the measurement. Reliability and factor analysis (EFA/CFA) will be used to assess the validity and internal consistency.

Developed measures for CBPM adoption and BPA will be merged with the existing measures for BPI, BPerf, and CP in a structured questionnaire. The developed

questionnaire will be used in the main survey to collect data. The sample for the main survey will consist of participants from the population of the EU companies using BPM/iBPM software with integrated AI technology in managing their processes. A sample size of at least 367 was defined. A control group of 25% will be included. Based on sample size and an optimistic 10% response rate, 3670 invites will be sent out. I will use random, probability sampling. If problems identifying respondents (hidden population) will arise, nonprobability snowball sampling will be used. A single primary data source, a single-source, self-report, and cross-sectional design will be used. The data will be collected through a questionnaire survey, and distributed by regular post and electronically. The questionnaire will be anonymous.

I will evaluate and control for non-response bias and common-method bias. To evaluate common-method bias, I will use Harman's single-factor test [62] and follow the recommendations for control by Podsakoff and MacKenzie [63]. Data analysis will be performed using SEM and mediation analysis by Hayes for testing a sequential multiple-mediator model [64].

4 State of the research

The research groundwork included SLR, developed research questions, derived hypothesis, and a theoretical conceptual model. SLR was based on the guidelines as proposed by Kitchenham [65, 66]. The search strategy was derived from an initial mapping study, identifying the topic scope and resources. I included literature from the fields of management, business, information system, and computer science. Resources included digital libraries, specific journals and conference proceedings focusing on BPM and AI.

A detailed action plan for construct development of CBPM and BPA with the initial set of scale items was prepared. An interview guide was developed, and three initial (of 15 planned) semi-structured interviews with academics and experts from the industry were conducted.

An analysis of AI techniques and algorithms with the potential of use in the context of BPM is currently in progress. An analysis of BPM software utilizing AI is in progress, focusing on Intelligent Business Process Management Suites (iBPM) implementations and Cognitive Services.

In the current stage of the research, some open points and issues have been identified, which I hope to resolve with the help of fellow academics and practitioners with experience in the field of BPM research.

Open points and issues:

a.) feedback on the validity of the proposed sequential multiple-mediator model;
b.) measurement/construct development: effectively capturing all the facets of AI usage in BPM, using second-order vs the first-order construct with linear composite (e.g., summated score) for CBPM, using formative model vs reflective for CBPM construct and removing CP construct from the model;
c.) defining and sourcing eligible participants: conditioned with access;
d.) conducting EU-wide research: translating of scales, scope, and accessibility.

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