Impact of Robotic Process Automation on Enterprise Architectures

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Abstract: The initial idea of Robotic Process Automation (RPA) is the automation of business processes through the presentation layer of existing application systems. For this simple emulation of user input and output by software robots, no changes of the systems and architecture is required. However, considering strategic aspects of aligning business and technology on an enterprise level as well as the growing capabilities of RPA driven by artificial intelligence, interrelations between RPA and Enterprise Architecture (EA) become visible and pose new questions. In this paper we discuss the relationship between RPA and EA in terms of perspectives and implications. As work-in-progress we focus on identifying new questions and research opportunities related to RPA and EA.

Keywords: Robotic Process Automation, Enterprise Architecture, Software Robots.

1   Introduction

At present, high expectations are related to the use of so-called software robots in the automation of software-supported business processes. With regard to implementation approaches, the discussion is dominated in particular by Robotic Process Automation (RPA), e.g., [ABH18], [SDC19]. This approach pursues a 1:1 automation of human actions, and thus a direct replacement of employees by machines. The starting point for the development of RPA was the observation that – despite the use of process-oriented enterprise systems (such as ERP, CRM and BPM systems) – additional manual activities are still indispensable today. In the RPA approach, these manual activities are learned and automated by software robots. Data entries formerly made by human users are emulated on the application's presentation layer. Hence, the implementation of RPA is possible without any changes to existing application systems.

The latter is an essential characteristic for the overall value proposition of the RPA approach. Since no changes to existing application systems are necessary, RPA can be implemented quickly and without the considerable effort for coding, testing, and rolling-out new software releases. From an architectural point of view, this could be a short

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story. In the initial approach, enterprise architecture (EA) is not affected by RPA implementations. However, this is only the case for rather simple RPA processes. The emergence of cognitive RPA approaches, and the growing potential of automating more complex tasks and decisions rise new implications for the role of RPA as part of EA. Fettke and Loos [FL18] have pointed out that both, the questions of how to structure RPA, and how to structure by instrumental use of RPA become even more important.

In this short paper we discuss the relationship between RPA and EA in terms of perspectives and implications. As work-in-progress we focus on identifying new questions and research opportunities related to the field of EA that emerge when looking at implementing RPA as a strategic initiative for process automation and innovation. Our research is based on our own RPA case studies and observations in practice [CA18], [SDC19].

2 Enterprise Architectures

The development, optimization, or implementation of information systems is a complex task that influences various parts of an enterprise. The modeling of those parts is supported by EA concepts [WS07]. They provide structures, templates, and methods for the overall design and description of an enterprise. Typically, those concepts are generic and independent from concrete industries. From a methodological perspective, EA can be seen as a structural element that supports the overall solution design. The scope of EA is normally broad, and often covers the whole or major parts of the enterprise [WF07]. Therefore, there is not one single representation of a concrete architecture, but various different views according to purpose and target audience.

An EA includes both, the content of the described architecture as well as procedures for their design and management. From the content perspective, an EA is a fundamental and complete illustration of an enterprise [Sc04]. Its purpose is the alignment between strategic and operational as well as business and technical perspectives [AGW11]. Accordingly, it combines various different artifacts, such as organizational structure, business process, or data structure. An ongoing challenge of an EA is the coordination of all relevant perspectives and interrelations in a holistic way, in order to continuously allow an understanding of the essential elements and their functioning [Sc04]. As in other areas of IT management, the automation of modeling and improving processes has been considered as a viable means to establish more accurate and adaptive EA models (e.g., [Fa+11], [Ko+16]).

A recent challenge is the impact of digital technologies – often referred to as digitalization – on EA. For example, new solutions for EA in combination with the Internet of Things [SWC17] and for the digitalization in the pharmaceutical industry are discussed [CSS17]. In this context, a higher flexibility and quick response to changes are requested [Sz+17]. However, the complexity of EA combined with different design projects [HL18] rise new challenges for an aligned development of an overall EA.

3   RPA and Application Systems

Just as tangible robots can perform human actions (e.g., in manufacturing), by use of RPA manual activities are substituted by software robots [SDC19]. The software robot acts exactly like the human user whose activity it automates. In the initial idea of RPA, an interaction with application systems is implemented solely via user interfaces. Existing operational application systems remain unchanged. RPA distinguishes itself from traditional approaches to process automation, which usually require technical and/or organizational changes.

The basic principle is the automation of user input and output, which is technically based on existing approaches such as screen scraping, macros, and scripting. RPA offers a wide range of functions for automating complete processes from a business perspective. An important aspect is that the implementation of RPA requires no technical knowledge (e.g., script programming) [WLC15]. Therefore, implementation can mainly be carried out by the business side without strong support from the IT department. The RPA system learns either by discovering rules or by observing manual activities. Since the software robot communicates with underlying systems via the presentation layer, each interaction requires a login to the respective application system. Thus, from the business logic, there are several software robots – as instances of the RPA system –, which are each registered in the system with their own user IDs.

4   Impact of RPA on EA

The possible application of RPA for business process automation and its impact on an overall EA depends on the complexity of the processes to be automated (cf. Fig. 1). Three different degrees of complexity should be distinguished [Cz18]: (1) routine tasks in which data is copied or combined from different application systems; (2) structured tasks with rule-based decisions, in which data from different application systems is used and evaluated on the basis of a set of rules; (3) unstructured tasks and decisions that require experience knowledge in addition to existing data and rules.
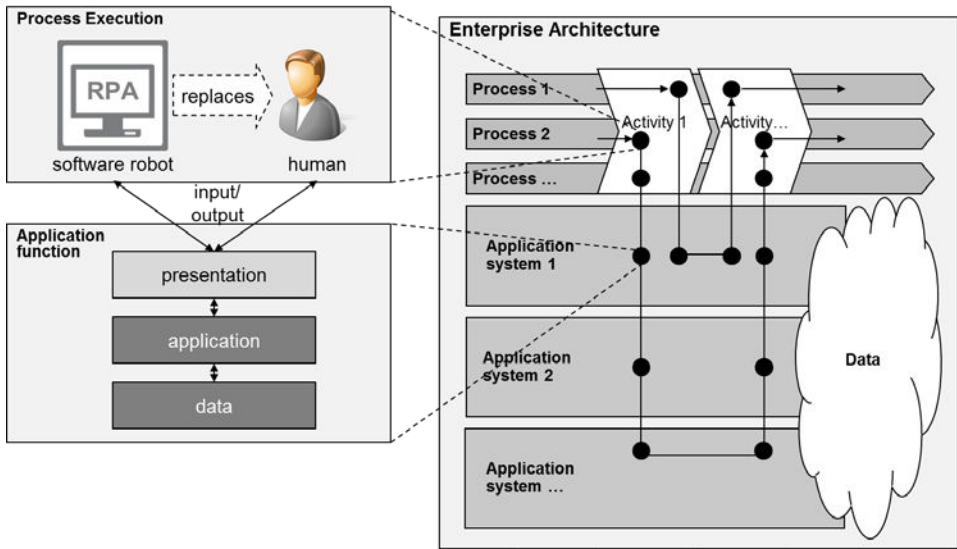
Fig. 1: Basic RPA architecture with connections to Enterprise Architecture

For the first two degrees of complexity the successful adoption of RPA systems is documented based on project examples in different industries (e.g, [WLC15], [CA18], [SDC19]). However, unstructured tasks and decisions require the combination of RPA with artificial intelligence approaches [Sc17], [HHF19]. It seems likely that a comprehensive RPA solution requires a conceptual design that might impact certain parts of EA. In this context, [Ji+19] propose a method for RPA that includes a process design as well as a continuous process improvement. Furthermore, [FL18] discuss the combination of RPA with a continuous process management lifecycle. From a practical perspective, [SDC19] describe a comprehensive RPA project that includes various conceptual design activities as well as the design and implementation of innovative processes based on RPA.

As a first step for structuring the impact of RPA on EA, we suggest the following perspectives:

1. *Support of existing tasks*: The RPA system handles 1:1 minor routine tasks. As a result, employees are relieved and can use their working time for more productive tasks. Changes to existing processes or application systems are typically not expected.

2. *Substitution of complete organizational functions*: The RPA system takes over complete tasks that were previously performed by employees. These are replaced 1:1 by the software robot. It has to be examined to what extent existing processes and systems have to be changed.

3. *Innovation*: The RPA system enables completely new workflows, that can be, for example, part of new business models. New architectural elements (e.g., processes) have to be developed.

Tab. 1 shows the general potentials of RPA and its possible impact on EA based on observations and analysis of case studies by the authors. Furthermore, an example for each potential/impact combination is given:

Potential	Functional Scope	Impact on EA	Example
Support	Minor routine tasks	Low	Creation of new user accounts in different application systems
Substitution	Complete functions	Middle	End-to-End-Processing of credit enquiries
Innovation	New workflow	High	Proactive incident management during thunder storms

Tab. 1: RPA potentials and assumed impact on EA

In this context, the following questions arise and require further research:

1. *How are new processes defined for RPA systems?* The initial idea of RPA is the learning of existing as-is processes by observation and rule building. An important characteristic is the simplified implementation compared to traditional approaches. However, the implementation of new processes would require an integration of process modelling functionalities compared to workflow management systems, which somehow contradicts the initial idea of RPA.

2. *How are RPA systems integrated in the overall application architecture?* For minor routine tasks the RPA system communicates with the application system via the user interface, without any change of the existing architecture. However, it is questionable if this approach also is sufficient for the substitution of complete functions or process innovations. In addition, RPA solutions may also stimulate the substitution of traditional middleware components (e.g., message oriented middleware or object request broker), such that long-term effects on the technology architecture are inevitable.

3. *How are RPA systems linked with each other?* Typically, in business processes humans interact with each other. If complete functions are automated by RPA systems interactions between those systems are required. This requires explicit standards in order to guarantee a high degree of interoperability.

4. How are real-time adaptations by RPA systems documented? An advantage of EA is the documentation of the major elements of an enterprise, which is essen-

tial for future developments. Combining RPA with artificial intelligence would allow a continuous and automated adaptation of processes. However, it is unclear how those changes are documented, for example, in an EA.

5. *How could RPA systems contribute to an adaptive EA?* EA management (EAM) comprises tasks and processes to design and maintain EA instances for individual companies. What is the potential of RPA for automating EAM processes to make EA more adaptive?

The goal of this work-in-progress paper is starting a discussion about the impact of RPA on EA. The questions above are a first starting point for further research.

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