International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Robotic Process Automation: a review of organizational grey literature

Ritesh Chugh
School of Engineering and Technology, Central Queensland University
120 Spencer Street, Melbourne VIC 3000 Australia
r.chugh@cqu.edu.au

Stephanie Macht
School of Business and Law, Central Queensland University
400 Kent Street, Sydney NSW 2000 Australia
s.macht@cqu.edu.au

Rahat Hossain
School of Engineering and Technology, Central Queensland University
554-700 Yaamba Rd, Norman Gardens QLD 4701 Australia
m.hossain@cqu.edu.au

Abstract:
Research on Robotic Process Automation (RPA) in the last decade has increased but lags behind developments in practice. This study explores the definition, evolution and categories of RPA, its benefits and challenges, identifies guidelines for implementation and provides a future outlook. Since there is an evident scarcity of comprehensive grey literature reviews in the area, this study presents an extensive narrative review of organizational grey literature on RPA by analyzing sixty-one organizational reports and white papers published between 2015 and 2020. This study provides a unified definition of RPA and groups the many categories of RPA into three types: basic automation, cognitive automation, and artificial intelligence. The study identifies the benefits of RPA and categorizes them into monetary; simplicity; efficiency and productivity; flexibility and scalability; reliability and consistency; compliance and governance; customer satisfaction; employee efficiency; and other long-term organizational benefits. The main challenges of RPA are awareness and perception of RPA; uncertainty about how to prepare for RPA; change management challenges while implementing RPA; and challenges associated with RPA vendors. Three main steps of RPA implementation are highlighted. This study provides practitioners and researchers with an extensive bird's eye insight into RPA from an industry perspective.

Keywords:
bots; business services automation; process automation; robotic automation; Robotic Process Automation; literature review.

DOI: 10.12821/ijispm100101

Manuscript received: 5 February 2021
Manuscript accepted: 22 October 2021

1. Introduction

The integration of information systems in workplaces is not new, but the integration of software tools to automatically carry out business processes is an emerging and growing trend. Most previous automation was limited to the manufacturing sector that used physical robots for labor-intensive tasks (blue-collar robotization). However, now robots, also known as software robots, are proliferating knowledge-intensive tasks (white-collar robotization). Robotic Process Automation (RPA) is the use of software tools to automate or digitize business processes in order to eliminate mundane, tedious, repetitive, and predictable tasks that were previously carried out by humans [1]. The benefits of automating processes are manifold, such as lowering process costs, improved efficiency, error reduction, and employee and customer satisfaction [2]. It is predicted that the RPA market will grow to $2.9 billion by 2021 from a mere $250 million in 2016 [3]. The estimated potential economic impact of technologies that will automate knowledge work is forecast between $5-7 trillion by 2025 [4]. RPA plays a critical role in structuring information systems [5]. In fact, RPA is used to interact with different information systems without replacing existing systems [6]. It can also be argued that RPA provides agility to information systems. Furthermore, RPA can be used to automate many processes, including those in the project management journey [7].

Digital transformation describes the shift from traditional processes to automated ones using digital technologies with the aim of improving operational processes [8], and the importance of information systems in achieving these aims cannot be overstated [9]. RPA is the next step to traditional business process automation as it encompasses elements of rule-driven artificial intelligence and robotics to perform repeatable business processes with speed, quality, and reliability. It is vital for organizations and their business functions to constantly navigate the changing digital landscape in the current digital environment. All organizations and their inherent business functions must continuously innovate, change, and adapt to changing trends to achieve benefits. RPA is one such trend that allows organizations to reap multiple benefits as it enables rule-driven, mundane processes to be automated so that staff can concentrate on other knowledge-intensive tasks. RPA is not just about technology enablement that assists humans but about software automation that replaces the work previously carried out by humans [10, 11]. Moreover, business process management initiatives need to consider the changing boundaries between work done by people and software robots [12].

RPA also delivers a more than 40% increase in full-time-equivalent workload, a 40% reduction in average handling cycle time, and a 30-80% reduction in processing costs [13]. In a similar vein, the National Association of Software and Services Companies highlighted that the use of RPA could yield cost reduction of 35-65% for onshore process operations and 10-30% for offshore delivery, with a short recovery period of investment ranging from 6-9 months from the implementation [14]. A variety of RPA vendors are vying for customer attention in the market, offering varying functionality. There is a surge in demand for RPA tools offered by commercial vendors [6]. Some strong performers and leaders in the RPA market are EdgeVerve Systems, Nice, Kofax, Redwood Software, Pegasystems, WorkFusion, UiPath, Blue Prism, and Automation Anywhere [15].

Business process environments benefit from RPA as it delivers intelligence, flexibility, and adaptability [16]. According to the Institute for Robotic Process Automation [17], an RPA software robot costs one-third the price of a full-time offshore employee and one-fifth the price of an onshore employee. Software robots, an integral part of RPA, can mimic humans and interact with applications on their behalf to perform a range of high-volume, transactional business processes such as collecting data from an online source, triggering activities, processing orders, responding to email queries, processing payroll records, processing insurance claims and registering patients. The examples also demonstrate that RPA has the potential to effectively carry out hundreds of tasks in a variety of different industries, including insurance, healthcare, banking, mortgage, education, and mining. An RPA software robot is capable of carrying out 600 actions in some situations, directly interacting with business applications and process transactions [18]. Process automation technologies could impact nearly 50% of the activities carried out by the global workforce [19].

The term RPA was coined in the early 2000s [20], and industry has displayed significant interest in and uptake of RPA since then. However, academic research on the matter lags, and there is still a dearth of peer-reviewed studies in this domain [1]. Nonetheless, at the time of writing, five RPA literature reviews were found: first, a conference paper that systematically reviewed only the scientific literature until March 2019 [21]; this review identified 36 scholarly papers about RPA and specifically explored the state of scholarly research in this field, the difference between RPA and Business Process Management, and the uses of RPA as discussed in the scholarly literature. While this initial review provides an excellent starting point to explore the current knowledge about this new automation solution, it highlights the lack of scholarly publications in this emerging field. The second available review by Syed and colleagues (2020) expands its literature base by analysing 125 peer-reviewed and white papers on RPA, focusing on the definition of the term, its benefits, organizations' RPA readiness, RPA's potential, methodologies to apply RPA, and RPA technologies. They included only those white papers that were referenced in published academic literature and unfortunately did not specify which white papers this referred to, or which findings emerged from which type of literature. They also failed to outline the timeframe of their literature search, but an investigation of their reference list shows only two sources from 2019, suggesting that their literature search also ended no later than early 2019. The third review by Enríquez et al. [22] presented an in-depth analysis of 54 primary studies from scientific and industrial literature to describe RPA and reviewed 14 commercial tools. However, the focus on industrial literature was inconspicuous. The fourth review by Beetz and Riedl [23] concentrated on developing a process evaluation model to identify RPA-suitable business processes and did not utilize industry-based literature. Finally, the literature review by Santos, et al. [24] also did not look at grey literature; neither did it explore literature beyond 2018.

Given the rapid development in this field and the fact that industry-based knowledge seems to be significantly ahead of academic knowledge, it is essential to explore the concept from an industry literature perspective specifically. Such a perspective can add useful knowledge currently missing in the RPA space. Therefore, to address the gap, it is the purpose of this study to present a narrative review of only the non-academic RPA literature to provide a conceptual, bird's eye overview of RPA from an industry perspective. More specifically, this study focuses on exploring the definition, evolution and categories of RPA, its benefits, and challenges, as well as guidelines for implementation and future outlook for RPA. Given the emerging interest in this field, such a review is timely and warranted to guide future research and inform researchers and industry practitioners. To achieve its aims, this study explores only grey literature in the form of organizational reports and white papers produced by companies that analyze, develop, sell, and recommend RPA and RPA products. In most instances, the companies focus on outlining the trends, impact, vendors, benefits, and challenges of RPA.

The 1997 Luxembourg Convention on Grey Literature defines it as literature "produced on all levels of governmental, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers" [25]. Based on this definition, grey literature examples can include research reports, conference proceedings, white papers, unpublished data, evidence from websites, dissertations, government reports, and fact sheets [26]. Grey literature, which is published outside of the traditional format and does not undergo the typical academic peer-review processes, has increased in the current digital environment [27, 28]. It comprises a diverse body of material and is recognized as a shift from evidence-based to evidence-informed decision making [29]. Moreover, grey literature provides important contextual contemporary information and can reinforce the wisdom of organizational practice not supported by scientific proof [30]. Grey literature can overcome the shortcomings of reliance purely on peer-reviewed literature (e.g., bias towards publishing significant results only) and can make positive contributions to inquiry and practice, especially in fields where a lag of scholarship is evident [28].

The remainder of the paper is organized as follows. The next section sketches the research method. This is followed by a reflection on the evolution of RPA, its various definitions, and categories. In section four, the benefits and challenges of RPA are outlined. Steps for RPA implementation are highlighted in section five, along with a future outlook. Finally, the key premises of the paper have been summarised along with the limitations of this study and avenues for further research in the conclusion section.

2. Research method

In this study, a narrative literature review was conducted. Narrative literature reviews gather, critique, synthesize and summarise literature with an aim to address a subject area and draw conclusions [31]. To ensure the literature search was rigorous and achieved objectivity, inclusion and exclusion criteria were used. To define the literature search limits, only the phrase "robotic process automation" was used. This was to ensure that process automation is not mixed with robotic process automation, as there is a vast difference between the two. As previously mentioned, the scholarly, peer-reviewed literature in this field is scarce, but nonetheless, a few reviews of RPA literature already exist. However, what is missing is the knowledge to be gleaned from industry publications, particularly given that the industry appears to be ahead of academic researchers in the context of RPA. Thus, to address this gap and provide a holistic overview of RPA, this study's literature review is restricted to grey literature only.

Despite the significant benefits that grey literature can provide to the academic community, it is essential to acknowledge that it is not free from its own shortcomings, which include the diversity of document types that constitute grey literature, the likely bias in some of those documents, the difficulties of evaluating inclusion in studies (as grey literature may not have an abstract), and the fact that search for grey literature may not be entirely replicable [32]. In order to address these main shortcomings, grey literature experts (e.g. [28]) suggest that authors who use grey literature be particular in their explanation of the inclusion criteria and literature search and evaluation processes.

To evaluate which literature to include, the AACODS framework was used [33]: *Authority*, *Accuracy*, *Coverage*, *Objectivity*, *Date*, *and Significance*. Following the need to ensure grey literature is accurate and written by an authoritative source (*Authority* criterion), this review focused only on reports and white papers produced by organizations that verifiably work closely with RPA (*Significance* criterion) – these are companies that analyze, develop, sell, and recommend RPA and RPA products. This focus on the otherwise unmanageably large diversity of grey literature ensured the systematic collection of relevant literature and supported the evaluation according to the remaining criteria.

Google's web search engine was used to search for the organizational reports and white papers as it indexes them and provides relevant search mechanisms [34]. Using the advanced search functionality, the search was constrained to English documents published between 01/01/2015 to 31/12/2020 using the exact phrase "robotic process automation" (*Coverage* criterion). The year limitation was determined through Google Trends for the term "robotic process automation". Globally, interest over time for RPA was lower than 10 in January 2015 and reached a high of 100 in January 2020, although it dwindled to 67 in December 2020 (see figure 1). A value of 100 demonstrates peak popularity for RPA. Furthermore, the limitation in publication years was also restricted to the last six years because by 2015, RPA was considered to be at the early majority stage of adoption [10], and a lot has been accomplished in this area after 2015 (*Date* criterion). Finally, to make the search manageable and due to a lack of other search fields in Google's search engine, the search was limited to Adobe Acrobat PDF file types only.

Fig 1. Interest over time for RPA

One of the researchers carried out the above-mentioned search, which another researcher subsequently retested. As a result, Google turned up with 336 items, of which 40 were immediately excluded (7 pages not found; 6 suspicious websites were blocked; and 27 personal reports not related to organizations). To ensure objectivity, only one researcher was initially involved in screening the remaining 296 records so that the inclusion criteria (summarised in table 1) were not interpreted differently by the research team, and no bias was introduced [35]. Subsequently, however, a second researcher verified all records.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Literature from 2015 to 2020	Before 2015
Written in the English language	Other languages
Grey literature in the form of organizational reports and white papers by companies that analyze, develop, sell, and recommend RPA and RPA products	Non-organizational reports, news releases, specific product brochures, and case studies
Literature with a sole focus on RPA	Literature focusing on Intelligent Process Automation (IPA) and Process Automation
Adobe Acrobat PDF file types only	Other file formats

The remaining records were assessed for their fitness and relevance by reading the titles, abstracts (where available), and complete documents where necessary. To comply with the AACODS *Accuracy* and *Objectivity* criteria, only organizational reports and white papers with clear non-promotional aims were considered, and records that could be classified otherwise (e.g., news releases, specific product brochures, and case studies) were eliminated at this stage. This finally led to a shortlist of sixty-one organizational reports and white papers. Table 2 provides a brief description of the shortlisted records (arranged in chronological order) that have been used in this literature review, along with the authoring organization's name and the document's title.

The specific research questions (RQ) that guided the analysis of the shortlisted items are:

RQ1: What is RPA, its evolution, and its categories?

RQ2: What are the benefits and challenges of RPA?

RQ3: What are the implementation guidelines for RPA and its future outlook?

Often Internet-based sources can be challenging to locate because the original documents may have been altered, deleted or the uniform resource locators (URLs) changed, thus making the cited URLs obsolete [36]. To allay these URL decay concerns, the Adobe Acrobat PDF files of the sixty-one shortlisted documents are deposited in the Figshare research digital repository [37].

The shortlisted documents were grouped according to their similarities, and critical analysis was conducted [38] to address the aims and answer the research questions. In the following sections, a discussion of the findings of the documents ensues, along with the summary and commentary.

Table 2. Shortlisted organizational reports and white papers

Name of the authoring organization and year published	Title of the document	Description of the content
Deloitte, 2015 [81]	The Robots are Coming	Examines robotic process automation and its role in shared services and Global Business Services.
Everest Group & NASSCOM, 2015 [47]	Seizing the Robotic Process Automation (RPA) Market Opportunity	Examines the state of the RPA market, lessons learned from early adopters, and its potential in the years ahead.
EY, 2015 [42]	Robotic Process Automation	Focuses on RPA and the benefits and opportunities it can provide to organizations.
Forrester Research, 2015 [75]	The State of Robotic Process Automation: A Poor Man's Business Process Management, Or Possibly Something More	Provides an assessment of the state of the RPA market, reasons for its usage, and outlines a framework for enterprise architects.
Kofax, 2015 [68]	Complete the Productivity Picture: A Guide to Robotic Process Automation	Outlines the drawbacks of 'swivel chair automation' and custom development and makes a case for RPA.
Atos, 2016 [43]	Robotic Process Automation for Smarter and Better Working	Explores practical experience on how organizations can create the conditions for successfully using RPA.
Capgemini Consulting, 2016 [45]	Robotic Process Automation - Robots Conquer Business Processes in Back Offices	Investigates the understanding of RPA, its advantages, sourcing and automation strategies, future outlook and implementation plans for RPA within back-office processes.
Fujitsu, 2016 [40]	If You Can Teach It, You Can Automate It: Robotic Process Automation	Describes software robotics and RPA, provides RPA use cases and reasons to automate.
The Hackett Group, 2016 [69]	Understanding Robotic Process Automation: Value Proposition, Deployment Model and Use Cases	Analyzes RPA's value proposition and how RPA is used.
IBM, 2016 [72]	Robotic Process Automation: Leading with Robotics and Automation in a Fast-Paced, Digitally Disruptive Environment	Outlines the benefits that RPA can deliver.
Infosys, 2016 [50]	Robotic Process Automation (RPA): Now is the Time to be Future Ready	Expands on the scope of RPA with cases and provides the RPA lifecycle.
KPMG, 2016 [77]	Rise of the Robots	Explores the benefits of robots and AI/cognitive automation technology and outlines nine steps for RPA innovation.
Protiviti, 2016 [44]	Looking Deeper into Robotic Automation	Outlines considerations and case studies for robotic process automation and robotic desktop automation.
PwC, 2016 [66]	Robotic Process Automation: Creating a Digital Workforce	Makes a case for creating a digital workforce and identifies suitable processes for RPA.
PwC, 2016 [61]	People, Change… and Robots	Explores how businesses can embrace RPA by engaging with employees to create organizational and cultural change for the successful adoption of RPA.
PwC, 2016 [73]	Organize Your Future with Robotic Process Automation	Outlines the benefits of RPA, along with the steps in end-to-end proof of concept.
Avanade & BluePrism, 2017 [70]	Robotic Process Automation: Your Catalyst for Intelligent Automation	Explains the benefits and challenges of RPA adoption.
Brickendon Consulting, 2017 [78]	Robotic Process Automation (RPA)	Provides the challenges, opportunities, and implementation considerations for RPA.
Capgemini Consulting, 2017 [46]	The Automation Revolution – A Plethora of Opportunities for Organizations and Individuals	Shares expert insights on various aspects of automation.

Name of the authoring organization and year published	Title of the document	Description of the content
Chazey Partners, 2017 [92]	Robotic Process Automation: Enablement through Digital Transformation	Describes RPA, its levels, phases and provides a roadmap along with best practice lessons.
Contextor, 2017 [65]	Robotic Process Automation: A Pragmatic Approach to Digital Transformation	Provides comprehensive information on RPA with success stories, guidance, and impact.
Deloitte, 2017 [62]	The Digital Workforce is Here: Understanding and Exploring Robotic Process Automation (RPA)	Describes the automation spectrum, RPA adoption challenges and critical decision points in the RPA journey.
DXC Technology, 2017 [67]	Robotic Process Automation Brings the Future to Your Workplace	Examines the state of RPA in the Australian and New Zealand market.
EY, 2017 [49]	Insights on Robotic Process Automation	Discusses characteristics for RPA candidacy, its levels, the business functions that can derive benefits, and critical success factors in RPA implementation.
Forrester Research, 2017 [15]	The Forrester Wave™: Robotic Process Automation, Q1 2017, The 12 Providers That Matter Most and How They Stack Up	Provides criteria-based evaluation of RPA providers, grouped into current offering, strategy, and market presence.
Gartner, 2017 [90]	Market Guide for Robotic Process Automation Software	Outlines the differences in technical functionality of RPA tools along with an overview of providers and their offerings.
Initio, 2017 [51]	RPA: The Automation of Automation	Provides an understanding of RPA, what it can do, its benefits, and the application of RPA in the banking, financial services, and insurance industry.
Knowledge Capital Partners (KCP), 2017 [52]	Robotic Process Automation: Benchmarking the Client Experience	Summarises the experience of Blue Prism (a leader in RPA) clients by looking into the attributes and capabilities of RPA software and the value achieved.
Kofax, 2017 [41]	Creating a Digital Workplace	Justifies the importance of eliminating manual tasks with RPA along with the outcomes for different industries.
KPMG, 2017 [79]	Accelerating Automation: Plan Your Faster, Smoother Journey	Outlines principles to accelerate automation, an action plan for the first 100 days of RPA, and operating model considerations.
Now We Comply, 2017 [71]	Robotic Process Automation: The New Engine of Business Innovation	Looks at the types of RPA tools, operational impacts, enabling effects, and use cases across key business domains.
Optimal Corporation, 2017 [48]	The Case for Robotic Process Automation (RPA)	Identifies RPA benefits and strategic and tactical actions for successful implementation of RPA.
PwC, 2017 [88]	Who Minds the Bots?	Identifies risks of RPA along with controls to aid in effective implementation.
The Hackett Group, 2017 [83]	A Blueprint for Getting Started with Robotic Process Automation	Outlines steps for integrating RPA into business services operations.
The Robotic Workforce, 2017 [97]	A Guide to Robotic Process Automation	Describes RPA and what it can do for organizations.
Wipro, 2017 [96]	Robotic Process Automation: Driving Efficiency the Smarter Way	Outlines benefits of RPA along with an approach for deploying RPA.
A.T. Kearney, 2018 [85]	Robotic Process Automation: The Impact of RPA on Finance Back-Office Processes	Assesses the impact of RPA on finance back-office processes, identifies key trends and application areas.
Canon, 2018 [84]	Key Strategies for Implementing. Robotic Process Automation	Examines challenges and strategies in RPA implementation.

Name of the authoring organization and year published	Title of the document	Description of the content
Deloitte, 2018 [89]	Understanding the Challenge of Implementing Your Virtual Workforce: Robotic Process Automation as Part of a New Social-Technological Paradigm	Discusses a change management approach that is focused on closely aligning people, processes, and structure in RPA implementations.
EY, 2018 [86]	Risk and Control Considerations Within Robotic Process Automation Implementations	Provides an insight into risk management in RPA implementations, particularly looking at risk considerations and controls.
Knowledge Capital Partners, 2018 [93]	Keys to RPA Success	Summarises key management practices in RPA deployment.
Kofax, 2018 [74]	The Ultimate Guide to Choosing the Right Robotic Process Automation Solution	Provides a list of key features and functionality that businesses should look for in an RPA solution.
KPMG, 2018 [39]	Robotic Process Automation (RPA): On Entering an Age of Automation of White-collar Work Through Advances in AI and Robotics	Discusses RPA implementation, its classes, and impact and provides a standardized approach to implementation.
KPMG, 2018 [91]	Robotic Process Automation: How to Move on from the Proof of Concept Phase? A RPA Governance Framework	Outlines a structured RPA governance framework to provide guidance and best practices for implementing and operating RPA.
KPMG, 2018 [63]	Delivering Value in Procurement with Robotic Process Automation	Proposes the deployment of RPA bots to enhance procurement processes and reduce costs.
PwC, 2018 [98]	Robotic Process Automation in a Virtual Environment	Outlines the benefits of RPA in a virtual environment, along with the challenges faced by RPA developers.
APQC, 2019 [80]	Leveraging Emerging Tools and Technologies in Finance: Robotic Process Automation	Provides an overview of RPA and its benefits for finance teams.
BPM-D, 2019 [64]	Value-Driven Robotic Process Automation: Enabling Effective Digital Transformation	Discusses the opportunities and challenges of applying RPA as a process improvement approach.
Deloitte, 2019 [87]	Robotic Process Automation (RPA) within Federal Identity Management	Discusses the design of secure digital identification solutions using RPA bots.
FIS, 2019 [94]	Robotic Process Automation Enabled Back Office Operations	Outlines the role of RPA for optimizing back-office processes, along with an approach to create efficiency.
Protiviti, 2019 [82]	Taking RPA to the Next Level	Highlights best practices and lessons learned in RPA adoption.
Skymind, 2019 [95]	Introduction to AI and Robotic Process Automation	Compares RPA and AI as distinct technologies and how they can be merged.
VNC, 2019 [76]	Robotic Process Automation	Provides an overview of RPA, its benefits, tools, and an outlook.
BDO, 2020 [53]	Robotic Process Automation During COVID-19	Highlights why businesses need robotic process automation during COVID-19.
Dell Technologies, 2020 [54]	Bridging Digital Transformations Through RPA	Discusses the adoption strategy of RPA, along with transformation use cases and keys to successful implementation.
Gartner, 2020 [55]	Magic Quadrant for Robotic Process Automation	Examines the market and the leading enterprise vendors for RPA.
Infosys, 2020 [56]	Effective Adoption of Robotic Process Automation in the Enterprise	Outlines the roles and benefits of RPA and implementation pitfalls.
Infosys, 2020 [57]	Security Considerations in Robotic Process Automation	Examines how RPA could increase security risks and how to mitigate the risks.
International Group of Controlling, 2020 [58]	Robotic Process Automation in Controlling - Results of an Empirical Study	Investigates RPA in the context of controlling processes.

Name of the authoring organization and year published	Title of the document	Description of the content
LogiSYM, 2020 [59]	Capitalizing on Supply Chain Digitisation with Robotic Process Automation	Explores areas in which RPA can help in supply chain management.
Macedon Technologies, 2020 [60]	The Role of RPA in Digital Transformation	Provides an overview into RPA, complementary technologies, vendor selection and handling implementations.

3. RPA definition, evolution, and categories

Most pieces of the analyzed grey literature do not clearly define RPA but instead focus on what RPA does (i.e., describing the types of processes that it can automate) and its benefits. To define and describe RPA, all pieces of the grey literature use a wide range of diverse terms and phrases, ranging from generic phrases like "RPA is a particular type of digitization" [39], over definitions of the term robot alone (e.g., robots "actually are software tools" [40]), and metaphors like "RPA creates a digital workforce that works side-by-side with your employees" [41], to detailed explanations of what RPA can do, e.g.:

"The Institute for Robotic Process Automation (IRPA) defines RPA as the application of a technology. This technology allows employees in a company to configure computer software or a robot to capture and interpret the existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems." [42]

While this plethora of definitions for RPA has resulted in ambiguity, it is possible to identify common themes across most of these definitions:

- The use of robots, or 'bots', in RPA: bots are software tools, i.e., virtual or digital assets;
- RPA as a software-based approach/application of technology to automate processes;
- Location of processes: office-based, computer-based, software processes;
- Nature of processes: most commonly referred to as rules-based, repetitive, and manual;
- Relationship with humans: bots mimic human activities and automate processes previously carried out by humans.

By combining these common themes into one single, unified definition of RPA, this study proposes and defines RPA as follows:

"RPA is the application of software-based technology to automate repetitive office tasks and rule-based processes, which were previously carried out manually by humans on a computer. RPA does this with the help of robots ('bots' for short), which are advanced software tools that mimic human activities and can be described as digital, virtual employees that work alongside the human workforce."

RPA follows in the footsteps of much earlier advances in machine and manufacturing automation, allowing machines to mimic manual tasks previously carried out by humans [43, 44]. During the 1990s, in order to also achieve cost reduction and standardization of office-based computer processes, organizations have previously looked towards IT systems, such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems, and labor arbitrage through offshoring, outsourcing, and the generation of centralized global shared services [42, 45-48].

The grey literature still refers to traditional information technology (IT) systems and labor arbitrage as alternatives to RPA. However, both options are fraught with emerging inadequacies: traditional IT systems have their limits, they require extensive IT support, often take a long time to implement, and do not make use of the latest technologies, such

as advancements in Artificial Intelligence (AI) [39, 49-51]. Previous benefits from offshoring/outsourcing, on the other hand, are eroded due to rising labor costs, skill shortages, and increasing turnover in developing countries [39].

Therefore, since the 2000s, organizations have started to look to robotics to automate their processes in an attempt to continue to achieve their cost reduction and standardization objectives [48]. Similar to the development of other new technologies and cost reduction strategies (including outsourcing), the development of RPA has also started with a "Hype and Fear" phase [52], during which RPA adoption has increased [45]. This seems to have ended around 2016 when organizations moved into a return on investment-focused phase, where they combined proof of concept and pilot projects to develop learning and good practice guidelines; this largely focused on back-office processes [45]. Mature organizations have then moved into a "triple win" phase, where they can reap benefits for shareholders, employees, and customers. In 2017, very few organizations moved into phase 4, in which RPA is institutionalized and integrated into the business [52]. The ongoing evolution of RPA demonstrates that organizations are now looking to automate all manner of processes, not merely back-office processes [45]. This development has very recently been expedited through the social distancing and lockdown requirements imposed during the COVID-19 pandemic: many organizations were forced to implement drastic cost-cutting and efficiency-improving measures, such as automation of simple, repetitive tasks to reduce the workforce or free up human resources to execute more value-adding tasks [53-60]. Moreover, the pandemic also required organizations to facilitate remote working – this meant that particularly paper-based legacy systems and associated processes were no longer possible, thus leading to organizations needing to re-think their processes [53-60].

Many of the grey literature pieces analyzed in this study suggest that RPA can be categorized into "types of automation" [49], "levels of automation" [48], "automation classes" [39], or even "stages of RPA" [61]. Deloitte [62] referred to this as the "automation spectrum", whereby RPA can be categorized according to the level of automation it provides, as defined by the type and amount of data it can process, as well as the nature of activities it can perform. The grey literature suggests that RPA can be classified either into three or five such categories, ranging from Basic Automation, over more Cognitive or Intelligent Automation, to true Artificial Intelligence. Similar to the before-mentioned ambiguity in terms of RPA definitions, the types of RPA presented in the grey literature are also confusing as some reports use different terminology to describe the same types, while others group different types together and use their own terminology to describe those.

Since the purpose of this study is to provide an extensive overview of RPA, we are grouping the literature categories into three overarching types of RPA, which could be placed on the ends and middle of the automation spectrum:

1. *Basic Automation* (also referred to as Class 1, Stage 1, Level 1, or RPA itself): Most of the current RPA falls in this category. Robots make use of structured data, can process large amounts of data at once, are able to operate between different applications, but they merely mimic human action in routine, repetitive, rules-based, simple, and somewhat complex tasks. Humans are required to become involved to deal with exceptions. Some examples of Basic Automation are data entry, document workflow, task scheduling, and procurement [61, 63, 64]. [53-60] refers to these robots as 'doing bots.'

2. *Cognitive or Intelligent Automation* (also referred to as and/or including Structured Rules, Pattern-based Decisions, Class 2, Enhanced Process Automation, Level 2 and/or Level 3, AI-aware RPA): Some of the currently existing RPA falls into this category. However, in comparison to Basic Automation, robots in this category can carry out more sophisticated processes, can deal with non-routine processes, unstructured data and/or natural language – in [53-60] words, these are 'thinking bots.' Robots in this category may start to mimic human judgment and exception handling by relying on machine learning and/or human aid. Examples of Cognitive Automation include speech tagging and language processing [39, 61, 64].

3. *Advanced Automation or Artificial Intelligence* (also referred to as Level 4 and/or Level 5; Multiple Decision Making; Cognitive Intelligence, Computing, or Platform; Autonomous System; Class 3): This category of RPA self-manages, adapts/learns from self-analyzed data and experience (including knowledge external to the specific applications it engages with), and is able to make decisions and improvements that require judgment. It may even go as far as to be able to think and learn like humans, entirely autonomously without human

involvement – hence, [53-60] nomenclature of 'learning bots.' However, RPA is not currently at this stage of development (yet). An example of such Advanced Automation is if a bot was to make decisions based on it sensing the mood of the user it interacts with [39, 61, 64].

In addition to these types of RPA, the grey literature also refers to other distinctions of RPA tools, from which organizations can choose:

- *Unattended or enterprise-level RPA* whereby automation takes place at the server level, and bots operate silently in the background without human involvement vs *attended or desktop-level RPA* which operates assisted by a human, often at the individual workstation level, and may be referred to as Robotic Desktop Automation or RDA [62, 65, 66]. There is also a possibility for hybrid RPA, whereby organizations deploy a mix of desktop-based and server-based RPA [53-60].
- *Generic RPA tools* which may be suitable for various different processes vs. *process-specific tools* that are designed specifically to automate very particular processes [62].
- *Do-it-for-me services* whereby organizations purchase bots and potentially also the management of those through RPA vendors and consultants vs *do-it-yourself solutions* whereby organizations build and deploy their own bots [45, 67].

4. Benefits and challenges of RPA

The grey literature highlights a large number of various benefits that RPA can provide to various organizational stakeholders. Although these benefits mutually affect one another, they can be grouped into the following themes: *monetary benefits; simplicity; efficiency and productivity; flexibility and scalability; reliability and consistency; compliance and governance; benefits for customers; benefits for employees; and long-term organizational benefit*.

The main benefits of RPA, as presented in all pieces of grey literature, are of a monetary nature: cost saving in comparison to traditional forms of process optimization and quick return on investment [65, 68, 69] [53-60]. This includes savings in terms of:

- Facilities: bots do not require office space [48, 70];
- Personnel costs: implementing RPA reduces headcount, which also reduces the cost of recruitment, training, and managing Human Resource issues [45, 48, 70];
- IT costs: RPA does not require expensive IT upgrades [67]; and
- Costs of offshoring and outsourcing: bots do not require supervision or negotiation with outsourcing partners [48] and are geographically independent [53-60].

These monetary benefits are seen rapidly, with short payback periods, because RPA is quick to implement due to its second main benefit: simplicity. RPA is non-invasive as it sits on top of and complements existing infrastructure [68]. Organizations do not need to replace, redesign or reconfigure legacy interfaces and systems [67, 71]. Deployment and management of RPA bots do not require extensive involvement from the IT function as its configurations, controls, and interfaces are simple and accessible to non-IT specialists [72, 73]. There is even the option of robotic self-help in case issues need to be remedied [50]. Deployment is non-disruptive to the organization's day-to-day operations [68], and can thus be considered a low-risk automation option [53-60].

Another benefit mentioned in all pieces of literature is the increased efficiency and productivity that RPA can provide to organizations. Bots do not require time to adapt to a new working environment, there is no learning curve, and they are able to work 24 hours a day, 7 days a week, 365 days a year [45, 68]. By being able to multitask in the background, they can operate side by side with humans and complete the repetitive and low-value tasks that stifle their human co-workers' productivity [74]. Bots complete these tasks in a fraction of the time that a human would require, thus increasing cycle time, response time, transaction turnaround time, and throughput [45]. RPA integrates data from

different systems, thus replacing the inefficient human 'swivel chair' movements of switching between different applications to complete the same process [65, 68]. This integration also enables the automation of processes in the 'white spaces' between different technologies as it facilitates collaboration and data sharing between different organizational units and even between organizations and external partners [71-73]. Since RPA is centrally managed, it does not require inefficient maintenance on each individual desktop, and it operates with minimum need for human intervention [52, 74, 75]. The implementation of RPA facilitates standardization of all elements relating to the process (e.g., consistent naming of files) and compression of activities while highlighting other processes, especially those that add little value to the organization, that further deployment of RPA could also improve [68, 73, 76].

This leads to the fourth key benefit of RPA: flexibility and scalability. RPA can be implemented on any scale, allowing organizations to pilot and experiment with bots on individual processes, or even sub-processes, at the start of their RPA journey or at any point of expansion [45, 73]. RPA is easy to scale up and down, and it adapts to changing business needs, which makes it highly useful for organizations that deal with seasonal variations, peak and trough times, data surges, variable labor availability, or uncertain environments [70, 77] – the latter has proved a particular benefit during the recent COVID-19 pandemic, in which many organizations had to deal with unpredictable or even unprecedented demand [53-60]. As RPA can be redeployed elsewhere on short notice, it adds to an organization's agility and resilience [46], which is also developed through RPA's reliability and consistency, which the grey literature highlights as a fifth key benefit of RPA.

Reliability and consistency derive from the fact that RPA bots do not lose concentration as their human counterparts would, and they always operate with 100% accuracy and predictability and do not make human errors [45, 53-60]. This not only reduces the number of processes that need to be re-worked but also increases the quality of outcomes [47, 78]. RPA operates within and between multiple systems at once, and it has much higher processing power than its human counterparts. As such, RPA can gather and process vast amounts of data in real-time, automatically feed them into business analytics and reporting, and seamlessly integrate data from multiple IT systems [43, 67, 68, 77]. This allows organizations to access highly accurate management information that supports forecasting and planning, decision making, and resource allocation [46, 71].

Accurate management information further supports the achievement of another key benefit of RPA: increased compliance and governance. All process steps, which RPA completes, are documented transparently and constitute further data that can be analyzed for reporting and monitoring purposes [79]. RPA not only eliminates some of the biggest compliance threats, including human error, data leaks, and criminal intentions but also monitors human transactions for unusual activities. In comparison to traditional outsourcing, organizations that use RPA retain full control over how processes are completed [45, 46]. By providing 100% accuracy in processes, RPA increases organizations' ability to comply with regulations and governance requirements, which also reduces non-compliance fees and time to remedy [78]. Given that RPA can adapt to changing circumstances, it can implement new regulations quickly and cheaply, thus providing added benefit in industries that face regular changes in regulations [52, 71].

Organizations that comply with regulations provide more accurate service to customers, which means that RPA also increases customer satisfaction and quality of service delivery [52, 78]. RPA can even support organizations in revamping their entire customer experience as bots can not only speed up straight-through processing, but also provide customized solutions that require less effort from customers, for instance, by using bots to offer self-service options [39, 48, 65].

Employees are another stakeholder group, which benefits from RPA as the latter carries out the repetitive, low value, monotonous and boring tasks and thus frees up employees to focus on exception handling and tasks that require emotions, human relationships, intelligence, judgment, and interpretation [53-60]. This releases talent into more interesting and challenging activities (e.g., innovation), which better uses people's skills, improves working conditions, work-life-balance (particularly during peak times) and increases employee motivation, which in turn positively affects staff engagement, attrition, and employee health [43, 45]. As such, employees can be redeployed rather than laid off, as they can now focus their efforts more on those activities that add value to customers, which supports customer satisfaction [39, 64]. RPA also augments talent as it requires organizations to redesign job roles and allows employees to make use of upskilling opportunities, which – in the long run – enhances their value in the labor market [52, 70].

Overall, the above-mentioned benefits of RPA can produce additional, long-term benefits for organizations: RPA can be seen as one step towards digital transformation and lean management, which can support organizational growth, competitive advantage, and the development of new capabilities that allow organizations to better compete with born-digital start-ups. Organizations that embrace RPA are seen as innovators and high-quality service providers, which has reputational benefits [45, 67, 71, 80].

Despite these significant benefits, RPA is not without its challenges. The grey literature discusses the main challenges, which can be grouped as follows: awareness and perception of RPA; uncertainty about how to prepare for RPA; change management challenges while implementing RPA; and challenges associated with RPA vendors.

Stakeholders' awareness and perception of RPA pose a significant challenge to companies considering RPA implementation. Many organizations report limited awareness of RPA and its benefits and drawbacks, while others report various diverse perceptions; the latter range from the highly negative misconception that RPA will threaten humanity [51], over the traditionalist skeptics who argue in favor of the proven benefits of offshoring as a barrier for RPA [81], to the extremely positive myths that RPA is a panacea that automatically standardizes organizational processes [79]. Although awareness of RPA has increased since 2017 [82], some lack of understanding of the reality of RPA persists, which may lead to distrust, negative attitudes, and active resistance to RPA by those with opposing views, while potentially leading to wrong, unclear, or unmet expectations and poor decision making on the part of those with positive views [45, 47, 61].

Insufficient understanding of RPA also means that many decision-makers lack knowledge of how to prepare for RPA. They may be unsure whether or how RPA could fit in their organization, how to build a business case for implementation, where to begin with RPA deployment, whom to involve, and which processes to automate [62, 77], [53-60]. A key challenge regularly mentioned in the grey literature is for organizations to ensure that RPA is not just considered a project. Instead, it needs to be seen as a strategic move that holistically fits into the overall IT strategy based on an appropriate business case and planned in detail [83, 84]. While preparing for RPA, it is also challenging for organizations to identify which processes can be automated, which RPA solutions to choose, and whom to involve in the process [52]. More recently, a shortage of RPA specialists who can design and implement RPA at scale seems to emerge and add to the challenges organizations may face when seeking to deploy RPA [85].

Once RPA is being implemented, it also carries various challenges, mostly relating to change management, the setting up of bots, and – more recently – concerns around cybersecurity, to which bots are not immune [82, 86, 87]. Change management is a key element of any RPA process as it requires a change in mindset for many stakeholders and will affect workforce management [62, 83]. Re-deployment and upskilling opportunities for employees, whose role will be affected by RPA, need to be developed, while Human Resource processes in terms of recruitment and training need to be amended [44, 46, 79]. Organizations have to communicate clearly and effectively with all stakeholders, and RPA deployment must involve diverse stakeholders as well as top management buy-in [88]. It is challenging to understand that deployment, despite being reasonably quick, requires organizations to make old legacy systems potentially RPA-ready and put in place exception handling systems and time to train the bots [52, 75, 88]. The more recent grey literature regularly refers to the importance of open communication with the IT function in particular as this may not be directly required to deploy the simple bots, but (perceived) lack of involvement of the IT function in the RPA implementation can result in negativity towards RPA [82, 89].

Implementation of RPA is particularly challenging and may become expensive if organizations choose in-house development of RPA [68], but the alternative – that is, to use vendors to support organizations with the choice, implementation [15], and maintenance of RPA – is equally fraught with challenges: The vendor landscape consists of many different vendors, which offer different services, use their own terminology, and may even rely on 'RPA washing' or 'RPA rebadging,' an unethical practice that involves vendors selling RPA-like systems as RPA and selling sub-par RPA systems [51, 52, 74, 90]. Deciding between do-it-yourself (DIY) and do-it-for-me (DIFM) also depends on organizations' current skill set and understanding of the relevant processes as RPA – despite its general simplicity to operate – does require RPA talent to operate and maintain the bots, particularly if errors are identified [64, 91]. Various items of the very recent grey literature [53-60] provided overviews of the different vendors in an attempt to map the RPA industry landscape and to highlight current and potential future industry leaders. Many organizations are drawn

towards the current leaders, although that choice may not be the best, particularly given that the industry contains a spread of niche players and emerging innovative and aggressively expanding challengers who may provide better services or more suitable RPA solutions [53-60] – thus, it is a clear challenge for companies to understand their own requirements, complete research into the various vendors, and eventually choose a suitable vendor [53-60].

5. Implementation guidelines for RPA and future outlook

Many pieces of grey literature are written by vendors that offer RPA solutions or consultancy services that support organizations in their choice of RPA solutions. As such, most pieces contain guidelines for implementing RPA that focus on the type of services the organizations offer. Nevertheless, there are several common guidelines, as well as steps that apply to all organizations wishing to deploy RPA. The key guiding principles to deploying RPA are twofold: A) to plan carefully, and B) to use a phased approach, starting with a small pilot project (e.g., one single process in one single business unit), and to gradually scale up once early, quick wins are reaped, and RPA capacity is being built [45, 47]. More specifically, the grey literature commonly suggests *three main steps of RPA implementation*:

- Step 1: Planning and initiating the RPA journey;
- Step 2: Proof of concept through a pilot project; and
- Step 3: Scaling up and institutionalizing RPA.

To begin the RPA journey, organizations are advised to carry out an audit of their current operations to identify and prioritize the processes that are suitable for RPA [79, 92], to explore use cases [47], and to map suitable processes end-to-end [47]. Recent grey RPA literature, in particular, focuses on this preparatory phase as a key to RPA success: organizations must fully understand and optimize their processes already before RPA as RPA might otherwise perpetuate errors and do so at a much faster speed, more consistently, and without the intuitive knowledge that something is wrong that the human workforce possesses [64, 80, 82, 85]. While auditing and optimizing processes, organizations should also audit their RPA capabilities [40] and technology landscape [79]. This will allow organizations to build the business case [40], decide upon suitable implementation strategies [47], measures, metrics and benchmarks [92], design the RPA solution [78], mobilize appropriate human and financial resources [79] and begin the change management journey by raising awareness amongst their stakeholders [79]. Much recent grey literature focuses particularly on the importance of continuous communications between business and IT functions as RPA is often considered a business project but may be seen as a threat to jobs and responsibilities by IT staff [89, 93].

The second step is the proof of concept [92] or pilot [40] phase, during which key resources are being trained, the bots for a small-scale RPA pilot project are built or sourced and deployed, monitored, and evaluated [40]. If the pilot is successful, organizations start to build a governance framework and operating model and clarify future roles and responsibilities for automation teams [92]. A roadmap for scaling up is developed [79]. Some literature suggests that vendors are explored and selected here [79], while others recommend choosing partners during the planning phase [51].

The third step follows the successful pilot and involves more wide-scale implementation of RPA across the organization by continuing to build expertise [40], by developing a roadmap for further RPA implementation [92], and eventually by fully institutionalizing RPA in the entire organization [40]. This phase also requires the ongoing operation of RPA bots, monitoring, and evaluation [82].

The RPA market has recently been the fastest-growing segment of the enterprise software market, and the grey literature from 2020 suggests this development will continue into the future as the industry consolidates, current vendors continue to make significant investments to improve their RPA offerings, and new RPA providers from adjacent markets (e.g., software or cloud vendors) emerge [53-60].

For RPA itself, the future holds many opportunities as the technology continues to mature. RPA moves further into the direction of being able to automate increasingly cognitive processes: by leveraging elements of AI, machine learning, voice recognition, and sentiment analysis, bots will be able to complete increasingly complex and human tasks, or even make autonomous decisions while requiring less and less human intervention [39, 94, 95]. While RPA has become a

buzzword [96], it is not 100% foolproof [97]. However, the demand for RPA will grow in the future, and notably, the COVID-19 pandemic and resulting negative economic impacts are likely to drive further adoption of RPA [53-60]. The latter is true in the case of traditional RPA-users, such as the banking and insurance industries, but also in industries that have to date not used RPA to a significant extent, e.g., pharmaceutical and healthcare, manufacturing, government, and education [53-60]. The future outlook for people in the context of RPA suggests that the talent pyramid and talent mix will change as new job roles will emerge, and while some high-skilled jobs will be created, some currently existing jobs will be threatened [47, 61, 62, 65, 75].

For organizations moving forward, this means a change in talent recruitment, training and retention strategies and processes [46, 47]. Moreover, RPA will most likely remain a strategic priority, and an increasing number of organizations (including Small and Medium-Sized Enterprises) will implement RPA for increasing numbers of processes, in increasing number of organizational functions [39, 45, 67, 85] and in virtual environments [98]. This will transform not only individual organizations, but entire societies, particularly those currently offering offshoring of repetitive tasks: countries like India will see a reduction in organizations wishing to outsource repetitive tasks, while they are likely going to see an increase in demand for outsourcing of judgment-oriented tasks [42, 46]. More recently, cybersecurity concerns have emerged around the deployment of RPA bots, which suggests that organizations will need to expend resources (including human resources) into security and risk management [86].

The reviewed grey literature clearly shows that the future outlook for RPA in organizations is strong. Although the grey literature does not specify any particular implications for scholarly research in this field, the growing scholarly literature in this area suggests a need for RPA research to continue and intensify, alongside the solid future outlook for RPA in companies. In particular, scholars should conduct large-scale, independent studies of the various short and long-term benefits and challenges of RPA from the perspectives of diverse stakeholders affected by RPA implementation. Furthermore, the identified steps of RPA deployment can be explored by using case studies with primary data collection as a research method. Moreover, scholarly research needs to develop a theoretical understanding of RPA, for instance, by drawing upon the related but theoretically advanced fields of business process automation, digitization, and labor arbitrage, as well as the emerging field of AI.

6. Conclusion

This study is based on a narrative review of six years of organizational grey literature on the emerging topic of robotic process automation. It adds to the scarce academic literature in this evolving field, as it complements the existing RPA literature reviews, the focus of which was exclusively or significantly on peer-reviewed, scholarly literature. As such, this study provides a strong starting point for integrating RPA knowledge stemming from expert organizations into further academic discussions of this field. Due to the paucity of comparative and integrative studies, this study creates a better understanding of RPA, and the exclusive use of organizational grey literature provides strength to the paper's content as organizations are ahead of academic research in this field.

By systematically examining the organizational grey literature, this study has proposed a unified definition of RPA that draws from common themes in existing definitions. The literature categories of RPA were grouped into three predominant types: basic automation, cognitive or intelligent automation, and advanced automation or artificial intelligence. Other distinctions of RPA tools were also identified: unattended/enterprise-level RPA vs attended/desktop RPA; generic vs process-specific RPA tools; and do-it-for-me vs do-it-yourself RPA solutions. Many benefits of RPA were identified, which are grouped into monetary; simplicity; efficiency and productivity; flexibility and scalability; reliability and consistency; compliance and governance; customer satisfaction; employee efficiency; and other long-term organizational benefits. Despite the benefits, RPA adoption has its challenges, most notably: awareness and perception of RPA; uncertainty about how to prepare for RPA; change management challenges while implementing RPA; and challenges associated with RPA vendors. Three main steps of RPA implementation were identified that can guide organizations towards successful RPA deployment. The future for RPA suggests a strong focus on the incorporation of advanced automation, an enhanced implementation for a diverse range of business processes, and a change in talent acquisition practices to cater to RPA skill sets.

This study has manifold implications. First, from a theoretical standpoint, it helps inform researchers by providing a conceptual, bird's eye overview of RPA from an industry perspective. Second, from a practical standpoint, it assists industry practitioners in avoiding or mitigating the identified challenges and adopt a streamlined implementation path.

As with any study, this one also has its limitations. First, the use of grey literature may be questionable as the sole evidence for a scientific claim, but it is justified due to the idiosyncrasies of this particular field: a lack of adequate scholarly RPA literature; the lagging of academic research behind practice; and the role that organizational grey literature plays in providing current contextual information complementary to scholarly literature. Given the rapid developments in this field, it is recommended that further reviews of academic and grey literature be carried out as it emerges over the following years. Second, the evaluation of literature is subject to inherent subjectivity and hence should be treated accordingly. Third, this study was conducted based on specific inclusion criteria (e.g., search for the specific phrase "robotic process automation" omitted literature that may have used alternate terminology). Finally, further research is needed to explore the identified steps of RPA implementation, particularly by using case studies with primary data collection as a research method.

The future outlook for RPA is strong, and this study has provided a conceptual, bird's eye overview of RPA based on organizational grey literature. Research in the RPA field should continue and focus on discovering the many benefits and challenges it can produce in the years ahead.

Acknowledgments

We acknowledge that this study did not receive any specific grant from the public, commercial, or not-for-profit domains.

References

[1] R. Syed, S. Suriadi, M. Adams, W. Bandara, S.J.J. Leemans, C. Ouyang, A.H.M. ter Hofstede, I. van de Weerd, M. T. Wynn, and H. A.Reijers., "Robotic process automation: contemporary themes and challenges," *Computers in Industry*, vol. 115, pp. 1-15, 2020.

[2] T. Korhonen. (2016, 22/06/2019). *Robotic process automation*. Available: https://www.fujitsu.com/fi/Images/Robotic%20Process%20Automization.pdf

[3] C. Le Clair. (2017, 22/06/2019). *The RPA market will reach $2.9 Billion by 2021*. Available: https://www.forrester.com/report/The+RPA+Market+Will+Reach+29+Billion+By+2021/-/E-RES137229

[4] McKinsey Global Institute. (2013, 22/06/2019). *Disruptive technologies: advances that will transform life, business, and the global economy*. Available: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Disruptive%20technologies/MGI_Disruptive_technologies_Executive_summary_May2013.ashx

[5] P. Fettke and P. Loos, "Structuring information systems in the era of robotic process automation," *Preprint*, pp. 1-8, 2018.

[6] W. M. van der Aalst, M. Bichler, and A. Heinzl, "Robotic process automation," *Business & Information Systems Engineering*, vol. 60, no. 4, pp. 269-272, 2018.

[7] J. Kiilunen, "Automating project management with RPA," *Turku University of Applied Sciences*, vol. Master's Degree Programme in Project Management thesis, pp. 1-86, 2020.

[8] J. Kaidalova, K. Sandkuhl, and U. Seigerroth, "How digital transformation affects enterprise architecture management:a case study," *International Journal of Information Systems and Project Management*, vol. 6, no. 3, pp. 5-18, 2018.

[9] J. Varajão, "The many facets of information systems (+ projects) success," *International Journal of Information Systems and Project Management*, vol. 6, no. 4, pp. 5-13, 2018.

[10] L. Willcocks, M. Lacity, and A. Craig, "The IT function and robotic process automation," ed: The London School of Economics and Political Science, 2015, pp. 1-39.

[11] J. Mendling, G. Decker, R. Hull, H. A. Reijers, and I. Weber, "How do machine learning, robotic process automation, and blockchains affect the human factor in business process management?," *Communications of the Association for Information Systems,* vol. 43, no. 19, pp. 297-320, 2018.
[12] W. M. van der Aalst, "Hybrid Intelligence: to automate or not to automate, that is the question," *International Journal of Information Systems and Project Management,* vol. 9, no. 2, pp. 5-20, 2021.
[13] Accenture. (2016, 22/06/2019). *Robotic process automation.* Available: https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_24/Accenture-RPA-Video-Transcript.pdf
[14] NASSCOM. (2015, 22/06/2019). *Seizing the robotic process automation (RPA) opportunity*. Available: https://www.gita.org.in/Attachments/Reports/8%20NASSCOM-ERI-RPA%20Market%20Opportunity%20-%20NASSCOM.pdf
[15] Forrester Research. (2017, 22/06/2019). *The Forrester Wave™: robotic process automation, Q1 2017, The 12 providers that matter most and how they stack up.* Available: https://www.forrester.com/report/The+Forrester+Wave+Robotic+Process+Automation+Q1+2017/-/E-RES131182
[16] J. Vom Brocke, W. Maaß, P. Buxmann, A. Maedche, J. M. Leimeister, and G. Pecht, "Future work and enterprise systems," *Business & Information Systems Engineering,* vol. 60, no. 4, pp. 357-366, 2018.
[17] Institute for Robotic Process Automation. (2018, 15/06/2019). *Definition and benefits*. Available: https://irpaai.com/definition-and-benefits/
[18] Deloitte. (2017, 22/06/2019). *Automate this: The business leader's guide to robotic and intelligent automation*. Available: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-sdt-process-automation.pdf
[19] McKinsey & Company. (2017, 22/06/2019). *A future that works: automation, employment, and productivity*. Available: https://www.mckinsey.com/~/media/McKinsey/Global%20Themes/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works_Executive-summary.ashx
[20] D. Fernandez and A. Aman, "Impacts of robotic process automation on global accounting services," *Asian Journal of Accounting and Governance,* vol. 9, pp. 123-131, 2018.
[21] L. Ivančić, D. S. Vugec, and V. B. Vukšić, "Robotic process automation: systematic literature review," in *International Conference on Business Process Management*, 2019, pp. 280-295: Springer.
[22] J. G. Enríquez, A. Jiménez-Ramírez, F. Domínguez-Mayo, and J. García-García, "Robotic process automation: a scientific and industrial systematic mapping study," *IEEE Access,* vol. 8, pp. 39113-39129, 2020.
[23] R. Beetz and Y. Riedl, "Robotic process automation: developing a multi-criteria evaluation model for the selection of automatable business processes," presented at the AMCIS 2019 Proceedings Cancun, Mexico, 15-17 August, 2019.
[24] F. Santos, R. Pereira, and J. B. Vasconcelos, "Toward robotic process automation implementation: an end-to-end perspective," *Business Process Management Journal,* vol. 26, no. 2, pp. 405-420, 2019.
[25] D. Farace, "Forward," in *GL'97 Conference Proceedings: Perspectives on the Design and Transfer of Scientific and Technical Information,* Amsterdam, 1998: TransAtlantic.
[26] D. J. Farace and J. Sch öpfel, "Introduction to grey literature," in *Grey Literature in Library and Information Studies*, D. J. Farace and J. Sch öpfel, Eds. Berlin/New York: Walter de Gruyter GmbH & Co. KG, 2010, pp. 1-7.
[27] G. White, J. Thomas, P. Weldon, A. Lawrence, H. Galatis, and J. Tyndall, "Grey literature in Australian education," *The Grey Journal (TGJ),* vol. 9, no. 2, pp. 103-108, 2013.
[28] R. J. Adams, P. Smart, and A. S. Huff, "Shades of grey: guidelines for working with the grey literature in systematic reviews for management and organizational studies," *International Journal of Management Reviews,* vol. 19, no. 4, pp. 432-454, 2016.
[29] T. Sharma, M. Choudhury, B. Kaur, B. Naidoo, S. Garner, P. Littlejohns and S. Staniszewska, "Evidence informed decision making: the use of "colloquial evidence" at Nice," *International Journal of Technology Assessment in Health Care,* vol. 31, no. 3, pp. 138-146, 2015.
[30] K. M. Benzies, S. Premji, K. A. Hayden, and K. Serrett, "State-of-the-evidence reviews: advantages and challenges of including grey literature," *Worldviews on Evidence-Based Nursing,* vol. 3, no. 2, pp. 55-61, 2006.

[31] P. Cronin, F. Ryan, and M. Coughlan, "Undertaking a literature review: a step-by-step approach," *British Journal of Nursing*, vol. 17, no. 1, pp. 38-43, 2008.
[32] J. Adams, F. C. Hillier-Brown, H. J. Moore, A. A. Lake, V. Araujo-Soares, M. White, and C. Summerbell, "Searching and synthesising 'grey literature' and 'grey information' in public health: critical reflections on three case studies," *Systematic Reviews*, vol. 5, no. 1, pp. 164-174, 2016.
[33] J. Tyndall, "How low can you go? Towards a hierarchy of grey literature," presented at the Australian Library and Information Association Biennial Conference, 2-5 September, 2008.
[34] W. Chung, "Web searching and browsing: A multilingual perspective," *Advances in Computers*, vol. 78, pp. 41-69, 2010.
[35] J. Hagen-Zanker and R. Mallett, "How to do a rigorous, evidence-focused literature review in international development: a guidance note," Overseas Development Institute 2013, Available: https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8572.pdf.
[36] C. Wagner, M. D. Gebremichael, M. K. Taylor, and M. J. Soltys, "Disappearing act: decay of uniform resource locators in health care management journals," *Journal of the Medical Library Association*, vol. 97, no. 2, pp. 122-130, 2009.
[37] R. Chugh, S. Macht, and R. Hossain. (2021, 14/10/2021). *Robotic process automation: grey literature from 2015 to 2020. Figshare*. Available: https://doi.org/10.6084/m9.figshare.13571168
[38] E. T. Rother, "Systematic literature review X narrative review," *Acta Paulista de Enfermagem*, vol. 20, no. 2, pp. v-vi, 2007.
[39] KPMG. (2018, 17/06/2019). *Robotic process automation (RPA): on entering an age of automation of white-collar work through advances in AI and Robotics.* Available: https://home.kpmg/content/dam/kpmg/jp/pdf/jp-en-rpa-business-improvement.pdf
[40] Fujitsu. (2016, 15/06/2019). *If you can teach it, you can automate it: robotic process automation.* Available: http://www.fujitsu.com/fi/Images/Robotic%20Process%20Automization.pdf
[41] Kofax. (2017, 17/06/2019). *Creating a digital workplace: how to eliminate manual tasks with robotic process automation.* Available: https://www.kofax.com/-/media/Files/Infographics/EN/ig_creating-a-digital-workforce_en.pdf
[42] EY. (2015, 15/06/2019). *Robotic process automation*. Available: https://www.ey.com/Publication/vwLUAssets/ey-robotic-process-automation-white-paper/$FILE/ey-robotic-process-automation.pdf
[43] Atos. (2016, 22/06/2019). *Robotic process automation for smarter and better working*. Available: https://atos.net/wp-content/uploads/2017/04/atos-robotic-process-automation-opinion-paper.pdf
[44] Protiviti. (2016, 17/06/2019). *Looking deeper into robotic automation*. Available: https://www.protiviti.com/sites/default/files/australia/insights/looking-deeper-into-robotic-automation-protiviti-global-a4_0.pdf
[45] Capgemini Consulting. (2016, 22/06/2019). *Robotic process automation - robots conquer business processes in back offices.* Available: https://www.capgemini.com/consulting-de/wp-content/uploads/sites/32/2017/08/robotic-process-automation-study.pdf
[46] Capgemini Consulting. (2017, 22/06/2019). *The automation revolution – a plethora of opportunities for organizations and individuals (special edition ed.).* Available: https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2017/07/robotic_process_automation_special_edition_summer_2017.pdf
[47] Everest Group and NASSCOM. (2015, 15/06/2019). *Seizing the robotic process automation (RPA) market opportunity*. Available: https://www.gita.org.in/Attachments/Reports/8%20NASSCOM-ERI-RPA%20Market%20Opportunity%20-%20NASSCOM.pdf
[48] Optimal Corporation. (2017, 17/06/2019). *The case for robotic process automation (RPA).* Available: http://optimalcorp.com/wp-content/uploads/2017/02/The-Business-Case-for-RPA_Optimal-Corp.pdf
[49] EY. (2017, 15/06/2019). *Insights on robotic process automation*. Available: https://www.ey.com/Publication/vwLUAssets/EY-insights-on-robotic-process-automation/%24FILE/EY-insights-on-robotic-process-automation.pdf

[50] Infosys. (2016, 15/06/2019). *Robotic process automation (RPA): now is the time to be future ready*. Available: https://www.infosysbpm.com/offerings/functions/robotics-process-automation/Documents/rpa-brochure.pdf
[51] Initio. (2017, 17/06/2019). *RPA: The automation of automation*. Available: https://blgsqr.files.wordpress.com/2017/03/rpa-the-automation-of-automation.pdf
[52] KCP. (2017, 17/06/2019). *Robotic process automation: benchmarking the client experience*. Available: https://static1.squarespace.com/static/58eceda617bffc97d03b69da/t/5b62bdeaf950b7f18d967216/1533197807521/RPA+-+Benchmarking+the+Client+Experience.pdf
[53] BDO. (2020, 04/01/2021). *Robotic process automation during COVID-19.* Available: https://www.bdo.com/getattachment/6dc5a0ee-84ad-4fa0-bbed-8b3b1f1d8a99/attachment.aspx?ADV_TBTS_Robotic-Process-Automation_Web.pdf
[54] Dell Technologies. (2020, 04/01/2021). *Bridging digital transformations through RPA.* Available: https://education.dellemc.com/content/dam/dell-emc/documents/en-us/2020KS_Hashim-Bridging_Digital_Transformations_Through_RPA.pdf
[55] Gartner. (2020, 04/01/2021). *Magic quadrant for robotic process automation*. Available: https://www.gartner.com/en/documents/3988021/magic-quadrant-for-robotic-process-automation
[56] Infosys. (2020, 04/01/2021). *Effective adoption of robotic process automation in the enterprise*. Available: https://www.infosysconsultinginsights.com/wp-content/uploads/2020/06/adoption-rpa-in-enterprise_pov_infosys-consulting.pdf
[57] Infosys. (2020, 04/01/2021). *Security considerations in robotic process automation.* Available: https://www.infosys.com/services/cyber-security/documents/rpa-security.pdf
[58] International Group of Controlling. (2020, 04/01/2021). *Robotic process automation in controlling - results of an empirical study*. Available: https://www.igc-controlling.org/fileadmin/downloads/IGC_Study_Report__22Robotic_Process_Automation_in_Controlling_22__2020__in_English_.pdf
[59] LogiSYM. (2020, 04/01/2021). *Capitalising on supply chain digitisation with robotic process automation*. Available: https://logisym.org/wp-content/uploads/2020/08/Automation-Anywhere_Whitepaper_Capitalising-on-Supply-Chain-Digitisation-with-Robotic-Proccess-Automation-10-Areas-of-Opportunities.pdf
[60] Macedon Technologies. (2020, 04/01/2021). *The role of RPA in digital transformation*. Available: https://macedontechnologies.com/wp-content/uploads/RPA-white-paper.pdf
[61] PwC. (2016, 17/06/2019). *People, change… and robots.* Available: https://www.pwc.com.au/pdf/robotic-process-automation-people-change-and-robots.pdf
[62] Deloitte. (2017, 22/06/2019). *The digital workforce is here: understanding and exploring robotic process automation (RPA)*. Available: https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-rpa-digital-workforce-noexp.pdf
[63] KPMG. (2018, 17/06/2019). *Delivering value in procurement with robotic process automation*. Available: https://advisory.kpmg.us/content/dam/kpmg-advisory/management-consulting/pdfs/2017/robotic-process-automation-in-procurement.pdf
[64] BPM-D. (2019, 04/04/2020). *Value-driven robotic process automation: enabling effective digital transformation*. Available: https://bpm-d.com/wp-content/uploads/2019/09/RPA-Whitepaper-A4-v2.pdf
[65] Contextor. (2017, 22/06/2019). *Robotic process automation: a pragmatic approach to digital transformation*. Available: https://contextor.eu/wp-content/uploads/2017/06/Livre_Blanc_Contextor_EN.pdf
[66] PwC. (2016, 17/06/2019). *Robotic process automation: creating a digital workforce.* Available: https://silkstart.s3.amazonaws.com/57e01a64893aaa4bbfba8d18.pdf
[67] DXC Technology. (2017, 22/06/2019). *Robotic process automation brings the future to your workplace*. Available: http://assets1.dxc.technology/au/downloads/MD_6241a-18_DXC_RPA_Paper_v2.pdf
[68] Kofax. (2015, 17/06/2019). *Complete the productivity picture: a guide to robotic process automation.* Available: https://www.kofax.com/-/media/Files/E-books/EN/eb_complete-the-productivity-picture-with-rpa_en.pdf
[69] T. H. Group. (2016, 15/06/2019). *Understanding robotic process automation: value proposition, deployment model and use cases*. Available: https://cbps.canon.com/assets/pdf/Understanding-Robotic-Process-Automation_White-Paper_Hackett-Group_Canon-Business-Process-Services-2017.pdf

[70] Avanade & BluePrism. (2017, 22/06/2019). *Robotic process automation: your catalyst for intelligent automation*. Available: https://www.avanade.com/~/media/asset/thinking/blue-prism-pov.pdf
[71] Now We Comply. (2017, 17/06/2019). *Robotic process automation: the new engine of business innovation*. Available: https://www.autologyx.com/sites/default/files/NWC-Whitepaper-Jan2016i-v2.pdf
[72] IBM. (2016, 15/06/2019). *Robotic process automation: leading with robotics and automation in a fast-paced, digitally disruptive environment*. Available: https://www-935.ibm.com/services/multimedia/dl_17119_rpa_flyer_04.pdf
[73] PwC. (2016, 17/06/2019). *Organize your future with robotic process automation*. Available: https://www.pwc.lu/en/rpa/docs/robotics-process-automation.pdf
[74] Kofax. (2018, 17/06/2019). *The ultimate guide to choosing the right robotic process automation solution*. Available: http://www.bernet.net.au/wp-content/uploads/2017/12/wp_guide-to-choosing-robotic-process-automation-solution_en-4.pdf
[75] Forrester Research. (2015, 15/06/2019). *The state of robotic process automation: a poor man's business process management, or possibly something more*. Available: https://www.nice.com/optimizing-customer-engagements/Lists/WhitePapers/The_State_of_RPA_-_Forrester.pdf
[76] VNC. (2019, 4/04/2020). *Robotic process automation*. Available: https://www.vncdigitalservices.com/wp-content/uploads/2019/07/whitepaper-rpa.pdf
[77] KPMG. (2016, 17/06/2019). *Rise of the robots*. Available: https://www.the-digital-insurer.com/wp-content/uploads/2017/07/943-rise-of-the-robots.pdf
[78] Brickendon Consulting. (2017, 22/06/2019). *Robotic process automation (RPA)*. Available: https://www.brickendon.com/wp-content/uploads/2017/10/Brickendon-Consulting-Insight-RPA-Digital-Version-1.pdf
[79] KPMG. (2017, 17/06/2019). *Accelerating automation: plan your faster, smoother journey*. Available: https://home.kpmg/content/dam/kpmg/my/pdf/accelerating-automation-plan-your-faster-smoother-journey.pdf
[80] APQC. (2019, 4/04/2020). *Leveraging emerging tools and technologies in finance: robotic process automation (RPA)*. Available: https://www.apqc.org/system/files/K09784_RPA_Leveraging%20Emerging%20Tools%20and%20Tech%20in%20FM.pdf
[81] Deloitte. (2015, 22/06/2019). *The robots are coming*. Available: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/finance/deloitte-uk-finance-robots-are-coming.pdf
[82] Protiviti. (2019, 4/04/2020). *Taking RPA to the next level*. Available: https://www.protiviti.com/sites/default/files/2019-global-rpa-survey-protiviti.pdf
[83] The Hackett Group. (2017, 17/06/2019). *A blueprint for getting started with robotic process automation*. Available: https://www.symphonyhq.com/wp-content/uploads/dlm_uploads/2017/05/Getting_Started_with_Robotic_Process_Automation_October2017.pdf
[84] Canon. (2018, 4/04/2020). *Key Strategies for Implementing Robotic Process Automation*. Available: https://cbps.canon.com/assets/pdf/Key-Strategies-For-Implementing-Robotic-Process-Automation_Canon-Business-Process-Services.pdf
[85] A.T. Kearney. (2018, 4/04/2020). *Robotic process automation: the impact of RPA on finance back-office processes*. Available: https://fr.majorel.com/wp-content/uploads/2018/07/Arvato_Whitepaper-Impact-of-RPA-on-finance-back-office-processes.pdf
[86] EY. (2018, 4/04/2020). *risk and control considerations within robotic process automation implementations*. Available: https://www.ey.com/Publication/vwLUAssets/ey-robotic-process-automation-implementation/$File/ey-robotic-process-automation-implementation.pdf
[87] Deloitte. (2019, 4/04/2020). *robotic process automation (RPA) within federal identity management*. Available: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/public-sector/us-gps-robotic-process-automation.pdf
[88] PwC. (2017, 17/06/2019). *Who minds the bots?* Available: https://www.pwc.com.au/publications/assets/rpa-risk-controls.pdf

[89] Deloitte. (2018, 4/04/2020). *Understanding the challenge of implementing your virtual workforce*. Available: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/strategy/deloitte-nl-so-understanding-challange-of-implementing-rpa.pdf
[90] Gartner. (2017, 15/06/2019). *Market guide for robotic process automation software*. Available: http://images.abbyy.com/India/market_guide_for_robotic_pro_319864%20(002).pdf
[91] KPMG. (2018, 4/04/2020). *Robotic process automation: how to move on from the proof of concept phase? a RPA governance framework*. Available: https://www.compact.nl/pdf/C-2018-1-Doesburg.pdf
[92] Chazey Partners. (2017, 22/06/2019). *Robotic process automation: enablement through digital transformation*. Available: https://chazeypartners.com/wp-content/uploads/2017/08/Chazey-Partners-RPA-Brochure-1.pdf
[93] Knowledge Capital Partners. (2018, 4/04/2020). *Keys to RPA success*. Available: https://static1.squarespace.com/static/58eceda617bffc97d03b69da/t/5bf52dbf2b6a2890e19e83e8/1542794689298/Keys+to+RPA+Success+-+Part+3.pdf
[94] FIS. (2019, 4/04/2020). *Robotic process automation enabled back office operations*. Available: https://www.fisglobal.com/-/media/fisglobal/files/pdf/brochure/robotic-process-automation-enabled-back-office-operations-brochure.pdf
[95] Skymind. (2019, 4/04/2020). *Introduction to AI and robotic process automation*. Available: https://skymind.ai/ebook/Skymind_RPA_White_Paper.pdf
[96] Wipro. (2017). *Robotic process automation: driving efficiency the smarter way*. Available: http://docplayer.net/storage/60/45036541/1549599983/lCsb09G5h0thPbbihxIxhg/45036541.pdf
[97] The Robotic Workforce. (2017, 17/06/2019). *A guide to robotic process automation*. Available: https://www.theroboticworkforce.com/media/attachments/2017/05/04/the-robotic-workforce---a-guide-to-robotic-process-automation.pdf
[98] PwC. (2018, 4/04/2020). *Robotic process automation in a virtual environment*. Available: https://www.pwc.in/assets/pdfs/publications/2018/robotic-process-automation-in-a-virtual-environment.pdf

Biographical notes

Ritesh Chugh
Ritesh Chugh is an associate professor in the School of Engineering and Technology at Central Queensland University, Australia. As an information systems socio-technological expert, his research focuses on the social role of emerging information systems and their influence on humans and organisations in real-world settings. He takes an inter-disciplinary approach in research which includes information systems management, social media, project management, knowledge management, educational systems and technology-enhanced learning. He has received several teaching awards that recognize his teaching excellence, commitment to improved student outcomes and engagement in reflective learning and teaching activities. Ritesh is a senior member of the Institute of Electrical and Electronics Engineers and the Australian Computer Society.

Stephanie Macht
Stephanie Macht is a senior lecturer in strategic management at Central Queensland University's School of Business and Law. She teaches in the areas of entrepreneurship, professional development, and research methods, and is an active supervisor of research higher degree students. Stephanie's most recent research interests revolve around sustainability, entrepreneurial finance, and learning and teaching in higher education.

Rahat Hossain
Rahat Hossain is a lecturer at Central Queensland University, Australia, with extensive teaching and learning experience across different areas of Information and Communication Technology. He completed his PhD in Computational Intelligence in 2013. Before his current academic position, Rahat acquired more than seven years of learning and teaching experience in the Department of Computer Science and Information Technology at the Islamic University of Technology, Bangladesh. He is currently supervising several Research Higher Degree students. Rahat's research interests are in information systems, machine learning, time-series analysis, and supply chain.