Business Horizons (2023) 66, 109—121

Available online at www.sciencedirect.com

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Deciding on the robotic process automation operating model: A checklist for RPA managers

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KEYWORDS
Robotic process automation;
RPA deployment;
Software robots;
Open-source software;
Cloud deployment

Abstract Robotic process automation (RPA) has emerged as a technology promising various quick wins: fast deployment, immediate efficiency gains, and low investment requirements. While these promises have resulted in large-scale deployment of RPA in diverse industries, the choice of operating model remains tricky. This article identifies three key decisions for RPA managers: (1) the who decision, pertaining to selection of internal versus external resources for RPA development; (2) the how decision, on whether the organization will pursue RPA deployment on-premises or through the cloud; and (3) the what decision, on whether to employ proprietary RPA tools or an open-source solution. To shed light on how these decisions are made and to pinpoint their interdependencies, seven organizations' choices connected with these three decisions are presented. The study's main contribution is a decision checklist that can facilitate RPA managers' navigation of the decision-making process, their gathering of relevant information, and their choice of the model best matching the organization's needs.

1. The rise of RPA

Robotic process automation (RPA) is a software solution "to automate tasks previously performed by humans that uses rules to process structured data to produce deterministic outcomes" (Willcocks, 2020, p. 287). It is considered ideal for automating "swivel chair" tasks carried out by humans (Asatiani & Penttinen, 2016; Lacity & Willcocks, 2021): mindless and repetitive tasks that involve moving and manipulating data through several information systems in line with an identifiable set of rules. Finding transaction data in spreadsheet documents and pasting the data into

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https://doi.org/10.1016/j.bushor.2022.03.004

the appropriate fields within an enterprise resource planning (ERP) system is one example. While scholars are turning their attention to intelligent automation (Lacity & Willcocks, 2021), which combines RPA with AI elements, pure RPA still merits study. The advantage it offers over some other automation tools lies in its noninvasive nature as a purely rules-based system with no elements of intelligence. Software robots (i.e., RPA instances) operate on top of an organization's existing IT architecture, where they interact with other software's user interfaces (UIs). Thus, they mimic the actions of a human worker, only acting more quickly and with fewer errors.

Studies looking into organizations' RPA implementations suggest that the automation produces tangible benefits: It yields high return on investment and full-time equivalent (FTE) savings, produces quality improvements, and results in greater customer and employee satisfaction (Lacity et al., 2016; Lacity & Willcocks, 2016). But the materialization of these benefits is contingent upon successful deployment, which, in turn, hinges on the underlying RPA operating model. As RPA deployments become widespread, so do RPA failures. In 2020, Gartner situated RPA in the "trough of disillusionment" in its technology hype-cycle report (Gartner, 2020). Leslie Willcocks (2019), who studied more than 400 RPA deployments, recently claimed that only about a quarter of organizations reap the full benefits of their automation.

As with the deployment of any other enterprise software, implementing RPA involves a set of decisions that require careful consideration. While there are many RPA operation models to choose from, which of them would best suit the relevant organization's context and business objectives is not always clear. This lack of clarity affects RPA vendors too: They may face a host of difficulties in understanding the context and specific needs of their customers. Bringing clarity as to new technologies' capabilities, appropriate business applications, and the associated risks is especially important for emerging technologies surrounded by hype (Canhoto & Clear, 2020).

Our research focused on one aspect of RPA deployment, the operating model, which is especially relevant for RPA managers: those individuals within an organization who are tasked with realizing the RPA projects initiated by the various business units. Individuals may be hired specifically for this role or chosen from among existing employees (e.g., members of IT or operations teams). Here, we examine RPA's operating-model underpinnings to improve understanding of the key decisions encountered by RPA managers and to identify the options available at each decision point. The discussion is informed by our study of seven organizations that had deployed RPA to automate their business processes. We discuss three key decisions and their associated options within the context of our findings. We then introduce a checklist we developed for RPA deployment. This constitutes a tool that RPA managers can use both before embarking on their RPA journey and along the way.

2. The key questions in RPA deployment

By examining seven Finland-based organizations that had deployed RPA, we were able to identify three key questions that RPA managers should ask when they deploy RPA: (1) Who should develop the RPA, (2) how should it be deployed, and (3) what technology should be used? Naturally, organizations will need to make various other decisions regarding RPA in addition to these operating-model-related ones. For instance, before deployment, an organization must carefully ascertain which business processes to automate with RPA. At the other end of the journey, the organization must monitor and review the performance of the RPA deployed and make critical decisions about the life cycle and potential discontinuance of the RPA. The discussion here, however, focuses specifically on the organization's three critical decisions about the operating model made in the RPA deployment phase.

First, who should develop the RPA? While RPA software offered by third-party vendors provides the fundamental RPA functionality, each software robot needs to be further developed and configured to perform tasks specific to the organization's needs. For this, the business process must be mapped, optimized, and translated into a set of unambiguous steps and rules, and then the robot systems have to be configured to handle the process. The managers responsible need to decide whether to perform these steps with in-house resources, to outsource the task to RPA service providers and consultants, or to use a combination of these two options (i.e., a hybrid solution).

Second, how should the RPA be deployed? The robot is a piece of software, so the deployment options available to an organization implementing RPA are similar to those with any other software (e.g., an ERP system). Managers need to decide whether to deploy RPA on the premises, in the cloud (in the robot-as-a-service, or RaaS, option), or via a hybrid.

Third, what technology should be used? One could head directly down the path of investigating and benchmarking various RPA software offerings; however, our findings lead us to urge managers at this stage on the RPA journey to focus on choosing between two main classes of RPA software: open-source and proprietary. We found that the licensing decision has a huge impact on the extent to which one can control each RPA instance and on the extent of options available in RPA development, customization, and deployment. Hence, we concluded that, at least earlier on, deciding which sort of software license fits the organization's needs is more important than the specific features of each offering. We believe this decision to be more complex and to have greater ramifications in the long run.

Next, we turn our attention to each decision and the options involved, presenting these in greater detail. This description also presents some of the rationale for specific decisions made by the case organizations. The seven organizations and their respective RPA use cases are characterized in Table 1. We collected empirical data by interviewing key stakeholders from each case organization at two points: in 2019, when most organizations were taking their initial steps in the RPA area, and in 2021, when the case organizations had gained experience with RPA deployment.

2.1. Decision 1: Who should develop the RPA?

Organizations with plans to adopt RPA can choose to develop the software robots in-house, to hire external consultants, or to employ a hybrid model. The outsourcing decision—in essence, forcing the organization's managers to take a stance and to articulate the boundaries of the firm—has been subject to in-depth study, with researchers arguing that outsourcing, by allowing strategic utilization of outside vendors to perform certain activities, leads to lower processing costs, higher process quality, or both (Raiborn et al., 2009). Insourcing, in contrast, involves the use of in-house expertise rather than of hired external consultants. Representing a third path, the hybrid model, also known as mixed outsourcing (Allen & Chandrashekar, 2000), acknowledges that an organization might opt for some combination of internal and external expertise.

At the early stages in their RPA initiatives, five of the organizations studied chose to adopt a hybrid approach, in which both internal and external RPA developers were involved in developing the software robots. Importantly, hybrid solutions are far from identical in practice. In four of the five cases, the main focus was on cultivating internal RPA capabilities while using external developers as a buffer in the implementation process when all the internal developers were occupied. In these cases, the outsourcing decisions were made in response to each situation as the internal development teams went through the automation backlog.

Among the commonly cited reasons behind opting for a hybrid model were flexibility and scalability brought by the external developers. For example, some case organizations used external developers to get a proof of concept (POC) up and running quickly when internal developers lacked either the requisite time or RPA experience. Use of external developers and consultants was more typical in the early phases of RPA adoption. As the RPA within the organization matured and the internal developers gained experience with the technology, the organizations started showing a tendency to favor internal developers, and they began using external developers mainly to fill gaps in projects as resource needs arose.

EnergyCo completely outsourced its RPA development work. This decision stemmed from the organization's policy of using a best-of-breed outsourcing model for acquiring IT services. The organization wanted to utilize external developers because it appeared dangerous to tie the RPA knowledge to specific people, and the managers felt that developing robots in-house would limit the options for scaling up the operations later.

The final case organization, referred to here as GambleCo, performed all of its RPA development work internally without relying on external aid. GambleCo could afford to adopt an in-house development model on account of the organization's extensive development experience and resources. Internal developers were able to present a compelling business case for in-house development vis-à-vis outsourcing and to highlight the synergistic benefits it could bring.

In some cases, decisions on whether to outsource or not were reevaluated for each new automation project. The organizations that had outsourced some of their early development work or utilized external consultants in the RPA setup phase indicated that the most important factors in their decisions were related to the uncertainties involved and to a lack of experience and know-how. Conversely, for GambleCo, which performed all the development work in-house, the key factors behind this decision were related to existing experience and availability of internal resources. In-house experience seems to play the central role

Table 1. Brief description of the case organizations

Name (pseudonym)	RPA start	Business process(es) targeted	Main intent for RPA and rationale behind the choice of business processes	Operation model	
EnergyCo	2017	HR operations, market-fee data, archives, and price calculations	The aim was to free business experts' time for more productive work. For selection of candidate processes, the company had a specific point system based on process complexity, prior automation efforts, and FTE savings potential. EnergyCo saw RPA as a tool in the automation toolkit, and its focus had recently shifted toward software development.	Who?	Outsourcing
				How?	On-premises
				What?	Open source
GambleCo	2018	Internal travel expenses, logistics, and HR operations	Initially, RPA was implemented for high-volume, back-office operations. It is noteworthy that the company had recently expanded the scope of its RPA to more strategic core operations, such as anti-money-laundering efforts.	Who?	Insourcing
				How?	On-premises
				What?	Open source
InsuranceCo1	2018	Back-office operations and customer-service requests	RPA was deployed for both high-volume, back-end operations and customer-facing processes, yielding improved service and even new services (such as sensitivity analysis for pensions) quickly. Recently, the company had started coupling RPA with artificial-intelligence tools.	Who?	Hybrid
				How?	On-premises
				What?	Hybrid
InsuranceCo2	2018	Customer-service and claims-handling work	RPA was regarded as among the tools for automation and, hence, as enabling the strategic goals of improving the customer and employee experiences. As the scale of operations suitable for RPA has grown, the range of process types covered has expanded. In addition to the continuous active processes, RPA had just been implemented for one-time tasks of transferring data from legacy systems to more modern ones.	Who?	Insourcing
				How?	Cloud (RaaS)
				What?	Proprietary
ForestCo	2018	Finance, HR operations, and the various supply-chain processes	The primary reason for RPA was cost savings in manual back-end operations, with a secondary reason being elimination of errors from manual processing and, through this, quality improvements. To seek process candidates, speed-dating workshops were instituted wherein suitable processes for RPA are probed in a collaborative effort between business experts and RPA specialists.	Who?	Insourcing
				How?	Cloud (RaaS)
				What?	Proprietary
DeliveryCo	2018	Finance, accounting, invoicing, HR operations, and sales support	RPA is used to improve operations' efficiency by automating manual tasks. DeliveryCo sees RPA as a tool that enables it to automate processes on top of a legacy environment that involves extensive use of customized IT systems.	Who?	Insourcing
				How?	Cloud (RaaS)
				What?	Proprietary
TelecomCo	2017	Internal back-office operations and customer service	Implementation of RPA was driven by business needs, and the main criterion employed is return on investment. In addition to FTE reductions derived from implementing RPA in back-end operations that tie up considerable manual resources, the company has been able to use RPA to improve data quality.	Who?	Hybrid
				How?	On-premises
				What?	Proprietary

also in the long-term evolution of outsourcing-model decisions. Three of the five organizations that opted for a hybrid model gradually shifted toward entirely or mostly insourcing-based models as they accumulated in-house RPA competencies.

The decisions of the case entities suggest that the organization's capabilities and resources with relevance to RPA—and to software development in general—critically influence the outsourcing decision. Absence of resources and expertise encourages greater reliance on external developers, especially in the first few stages of RPA development. As the organization builds its internal capabilities of RPA development and learns from the external consultants, however, an insourcing model may grow more attractive in the long run.

All in all, the decision on outsourcing was the easiest of the three key decisions to make, according to the informants, because it was influenced mostly by either a clear company policy or the organization's existing internal capabilities and resources. The biggest challenge mentioned by the organizations' representatives in connection with opting for outsourcing was external consultants' lack of familiarity with the organization's processes and ways of working. For those utilizing internal developers, the most commonly cited challenge was managing the workload for the personnel involved, who have to work on multiple projects simultaneously.

2.1.1. The first part of the decision checklist

Drawing from the data, we created four questions for the first part of our checklist. The answers to these should help managers decide who should develop the RPA. Table 2 summarizes their meanings and presents an illustrative use case for each question behind the decision.

First, managers planning to set out on the RPA journey need to find out whether the organization's sourcing policies or strategy documents prescribe a specific sourcing model for IT projects. While this should be a fairly straightforward question to answer, in that such policies are often explicitly documented and communicated, the answer nonetheless can be a deal-breaker, ruling out certain sourcing approaches. In such cases, the managers must investigate whether the terms of the policy/strategy are negotiable. If the policies are relatively inflexible, the personnel making the decision about RPA development might not have power to override them. Therefore, managers must possess a clear sense of the range of genuine options before evaluating other factors in the decision, and they need to consider whether the RPA project could succeed within the given limits.

Second, managers need to evaluate the organization's relevant software-development capabilities. Not all software-development skills are directly transferable to RPA development, but synergies could emerge between RPA and existing

Table 2. The RPA development sourcing decision (Who?)

No.	Question	Example use case
1	Does your organization have a sourcing policy or strategy in place that prescribes a specific sourcing model for IT projects?	EnergyCo opted for external RPA developers because of the organization's best-of-breed procurement policy for IT and related services. The policy strictly prescribed that all IT and related services be acquired from the market, with the best available solution for the problem at hand being selected.
2	What are your organization's relevant software-development capabilities at present?	GambleCo chose to perform all RPA development in-house. GambleCo recognized that it possessed the relevant software-development capabilities and that teams with such capabilities possessed sufficient capacity and resources to take on the RPA projects planned by the management.
3	What are your organization's relevant process-development capabilities at present?	DeliveryCo chose a hybrid model in which initial configuration of the robot was done mainly in-house, while further maintenance and development of the robot was outsourced. Initial configuration was kept in-house because of superior internal knowledge of existing processes built around legacy IT systems.
4	Do you foresee a need for rapidly scaling the RPA projects up or down?	InsuranceCo2 chose a hybrid model. The company used external consultants as a buffer, obtaining additional help on a contractual basis when requests to develop new robots exceeded its internal capacity.

development projects. Managers should hold discussions with the organization's internal development teams to evaluate the capabilities in question. Also important is identifying whether software-development teams with relevant capabilities have the capacity to carry out RPA projects at the desired scale. Managers looking to develop RPA in-house need to estimate what resources would be required for the planned RPA project and to be sure the in-house resources can actually be mobilized. Alongside people with relevant capabilities, other resources should be considered: appropriate funding and suitable technical infrastructure to support those people. Where the necessary software-development capabilities are present and sufficient, managers should consider in-house development of RPA. If, on the other hand, such capabilities are absent or insufficient, decision-makers need to consider outsourcing some or all of their RPA development.

Software development is only one piece in the puzzle. The third question RPA managers need to consider is whether their organization has the relevant process-development capabilities. This is vital because directly translating existing processes to RPA without attending to their development—and that of surrounding ones—could end up yielding less substantial efficiency gains. The managers involved must seek out people who are experienced in business processes' development and evaluate the suitability of their expertise for specific RPA projects. Prior experience with RPA-specific process development is a considerable advantage. Just as with software-development capabilities, availability of sufficient relevant resources is critical. If in-house process-development capabilities are absent or if they display gaps, outsourcing at least part of the RPA development should be considered.

A final factor to examine is the likelihood of a later need for rapidly scaling several of the RPA projects up or down. The decision makers have to identify whether the associated projects are fixed-term or continuous in nature, a stepping stone to large-scale automation or instead a fix for a specific problem. Resource and capacity requirements grow with every additional RPA project; therefore, the managers determining the sourcing model need to estimate not only the immediate demands but also medium-term needs. If they foresee a need to scale up several RPA projects swiftly, or if the projects are for meeting transitory needs or are designed to provide a one-off solution (with the RPA efforts getting scaled down once the project is completed), the managers responsible should consider outsourcing the entire endeavor or employing a hybrid model. Rapidly amassing and allocating resources to RPA capabilities can be prohibitively expensive and present practical difficulties (e.g., related to the availability of relevant experts for hire). Such concerns would speak against going the in-house route. Likewise, it makes little sense to invest in developing in-house RPA capabilities if the projects are temporary in nature.

2.2. Decision 2: How should the RPA be deployed?

The second major decision pertains to the deployment model for RPA. Three major paths are possible: The managers may choose to deploy the robots on the premises, in the cloud (Cusack & Ghazizadeh, 2016), or with a hybrid approach (Hartley & Sawaya, 2019) combining on-premises robots with their cloud-based counterparts. While cloud solutions are off-site, they may still be maintained by the organization itself, or the organization may turn to third-party vendors that provide an all-in-one RaaS solution.

Three of the case organizations chose to handle all their RPA fully on-premises. The organizations opting for this deployment model cited familiarity with the process of in-house deployment as opposed to cloud deployment. Here too, organizational policy played an important role in some cases. For example, an EnergyCo representative stated that the company's policy was to have all of its critical IT systems on the premises so that it could manage risks related to downtime and performance.

The benefits of moving to the cloud were likewise questioned by GambleCo representatives when we interviewed them in the first phase of the study, in 2019. GambleCo too preferred to have the robots in the vicinity of the local data centers where the internal systems were running. At the same time, an informant from GambleCo stated that all of the robots are developed to be deployable either on-site or in the cloud. The door thus remained open for a later switch to cloud provision. Our second-phase interviews, conducted in 2021, revealed that the company had indeed made a transition to the cloud.

Most of the case organizations that initially chose in-house RPA solutions had since evaluated the possibilities related to moving at least some of the robots to the cloud. Cloud-based RPA offerings have matured, and many organizations are much more aware of them now. With the initial deployments already accomplished, however, the case organizations' representatives stated that the

business case for such a change would have to be good enough. In fact, the deployment decision appeared the most enduring one, with only GambleCo switching models from on-premises to cloud.

Of the four organizations not utilizing an on-premises model, three had all of their robots deployed in the cloud, and one relied on a hybrid model. All three that had chosen exclusively cloud-based deployment had decided to have a vendor deploy the robots in an RaaS environment. This was seen as an expeditious and cost-effective solution that would not require substantial maintenance efforts or prior knowledge of RPA work.

Additional motives for pursuing a cloud-based deployment model came from the general trend toward moving all IT services to the cloud, or even from an explicit organizational policy of doing so. The three cloud-only organizations had been concerned about issues of limited internal scalability, needs for continual maintenance, and their lack of resources for and expertise in pursuing an on-premises approach. Overall, the organizations perceived cloud solutions to be more scalable and flexible.

2.2.1. Part 2 of the decision checklist

For the second part of our checklist, we formulated three questions to assist managers in deciding how RPA should be deployed. Table 3 outlines these questions and presents use cases related to the decision.

The first question is connected with the organization's IT deployment policies. Just as with the sourcing-model decision, decision makers need to take into account the practices and policies established for IT deployment within their organization. Many organizations have detailed policies in place with regard to deploying IT in the cloud. These tend to be especially elaborate when addressing deployments in the public cloud that are controlled by a third-party provider offering the same service to other clients. For example, in light of increased awareness of data-privacy issues and regulations (e.g., the EU's General Data Protection Regulation), there might be requirements dictating the location of any software robots granted access to sensitive data. Where such policies are in place, RaaS providers that cannot guarantee the data's storage and processing on servers within the specified jurisdiction are automatically out of the running. Policies of this sort are likely to guide the choice of RPA deployment model. Yet again, rigid and specific policies can put certain deployment models out of reach right from the start. Managers need to evaluate whether the limits imposed by the organization's practices and policies influence the chances of the RPA project's success.

Table 3. The RPA deployment model decision (How?)

No.	Question	Example use case
1	Does your organization have established practices, policies, or strategies for IT deployment?	EnergyCo is among the companies that had a policy of having mission-critical systems deployed on the premises. This policy was due to the nature of the organization's operations and the fact that these had to continue even in the event of a shutdown, so company policy mandated that critical systems be on-premises.
2	Does your RPA project require direct control over the robot while it is performing the tasks?	EnergyCo applies a hybrid model, deploying RPA interfacing with critical systems on the premises while deploying cloud-based RPA to deal with the noncritical systems. The EnergyCo setting requires critical systems to be deployed fully on-premises: EnergyCo needs to guarantee constant supply of electricity to the grid, so it must maintain full control over all critical systems and have fail-safes to fall back on if anything goes wrong. Noncritical systems, on the other hand, are allowed to be deployed in the cloud.
3	Do you foresee a need for rapidly scaling up or down the number of robots deployed?	InsuranceCo2 used a cloud deployment model from the start, gradually shifting from license-based contracts (with fixed payment for each additional robot) to minute-based ones (paying for a robot per minute used). This decision was motivated by rapid growth in the number of automated processes, from zero to 30 in 3 years, and by irregular demand for the automated processes. An RaaS model permitted InsuranceCo2 to deploy additional robots on very short notice. Minute-based contracts made sure that the company did not pay for robots sitting idle while waiting for tasks.

Second, managers need to investigate whether their project will require direct control over software robots. In some cases, such control is necessary for the required speed, to avoid wasteful redundancy, and to guarantee the system's reliable operation. Deploying robots in the cloud may offer relatively limited control over each robot, with certain configurations available only via the system provider's intervention. Since this may or may not pose an issue, the managers need to investigate the control requirements and carefully evaluate their options. If control requirements do exist and the organization's existing infrastructure can guarantee that the system supplies the necessary functionality and reliability, on-premises deployment would be advisable. In other cases, managers are freer to consider hybrid or completely cloud-based deployments.

Finally, in a parallel to the sourcing-model decision, one must assess the importance of scalability in both the short and the medium terms. Deploying RPA is relatively fast; however, if the organization does not possess sufficient infrastructure and support staff, scalability may be significantly hampered. In such cases, a cloud or hybrid model would be preferable. On the other hand, if specific robots are required only temporarily (e.g., to migrate data from a legacy system to a new system in the absence of application programming interfaces to ensure compatibility), procuring new on-premises infrastructure may not be economically justifiable. In such cases, cloud or hybrid solutions may represent the better course.

2.3. Decision 3: What technology should be used?

The third decision point involves selecting appropriate RPA technology. The literature distinguishes between two main alternatives for software provision: commercial software and open-source software (Krishnamurthy, 2003), with the latter having its roots in users' desires to modify software to suit their needs and in goals of creativity, innovation, efficiency, and interoperability (Hicks & Pachamanova, 2007). As explained above, our focus here is on the type of licensing arrangements involved: Most of the popular RPA offerings have comparable features and differ most in their licensing terms. These fall into two broad categories: proprietary and open-source. Hence, an organization may pick any of three types of deployment: It may select commercial licensing of proprietary solutions, open-source solutions, or a hybrid solution combining these two license types. Most of the case organizations had chosen commercial solutions for their RPA operations. The reason interviewees cited most often for picking a proprietary technology was that open-source technologies were not as visible at the time of initial deployment; commercial solutions appeared to be the only viable option. In most cases, therefore, the primary comparison was among the commercial tools on the market. The evaluation was conducted either by the organization itself or with input from external consultants.

Those case organizations that outsourced the development or deployment of their RPA considered the preferences and recommendations of external consultants and RaaS providers when choosing a specific technology. They wanted to be sure their external developers and RaaS providers could support the RPA technology and seamlessly connect it with other relevant services.

Among the additional factors in the choice were license price, usability, availability of add-on services, and levels of customer support. DeliveryCo and ForestCo are illustrative of the various factors' contributions. An informant at DeliveryCo said that choosing between two vendors offering proprietary licenses was difficult because both were viable options. In the end, the pricing policy of one vendor changed while the decision-making process was underway, rendering the respective offering more cost-efficient for DeliveryCo's use case. ForestCo took a similarly value-focused approach, choosing the most cost-efficient option that included the features required.

Some companies deployed multiple tools in the POC phase to identify the best fit between a specific RPA technology and their use scenarios. For example, InsuranceCo2 experimented with solutions from the three major vendors in the POC stage before selecting one. The assessment was conducted as a two-phase process, with the first part during the initial POC work and the other after the robots were deployment-ready. The final decision was driven by the fact that the selected solution was the go-to RPA tool in the financial and insurance sector at the time. Moreover, the informants from the organization mentioned that the technology was easy to maintain and offered many reusable components out of the box.

EnergyCo and GambleCo chose to develop their RPA robots by means of open-source technologies. For both organizations, one of the main reasons for picking an open rather than a proprietary solution was the lower cost, coupled with the ability to opt out from features that were not perceived as valuable (e.g., a graphical UI). EnergyCo had initially considered proprietary options, but since the company chose to employ external developers,

it ended up seeing no need to pay for features not required by those developers. Moreover, EnergyCo stated that the most important criteria in its choice among RPA technologies were their reliability and the availability of external vendors with the ability to support and develop the technology.

InsuranceCo1 and TelecomCo opted for a hybrid model. In both cases, proprietary solutions played a major role in the completion of automated tasks, and open-source solutions complemented these by, for example, handling delegated tasks for which the proprietary solutions' features proved insufficient. An informant from TelecomCo mentioned that "patching up" some processes via open-source solutions guaranteed that no possible operations need be ruled out because of technological limitations.

Overall, it appears that the technology choice was often intertwined with the process of choosing suitable deployment and sourcing models. Those case organizations that did not develop and deploy RPA in-house relied on external vendors to recommend a system they could support. Once a narrowed-down list of possible solutions had been agreed upon with the external vendor, other factors, such as costs, features, and add-on services, helped the organization make the final decision. The choice between proprietary and open-source technology seems to hinge also on internal IT capabilities and experience with open-source software. For the two companies that had chosen open source, the decision was easy since both possessed a clear understanding of their technological capabilities and of the open-source domain.

2.3.1. Part 3 of the checklist

For the final part of our checklist, we identified five questions. The answers to these should help managers ascertain what technology should be used. Table 4 presents a summary, with the five questions and illustrative use cases for particular outcomes.

First, managers need to identify the features required for the RPA project at hand. This requires understanding which processes will be automated, what they consist of, and how they are to be redesigned. In general, the fundamental features of RPA are similar across all widely used solutions

Table 4. The RPA technology decision (What?)

No.	Question	Example use case
1	What are the feature requirements for your RPA project?	Although TelecomCo opted for an operational model that draws mainly on proprietary technology, the organization used an open-source robot framework in an RPA project wherein the RPA solution part was relatively small and RPA complemented a larger automation entity. In this specific use case, the small scale of the RPA meant that a proprietary solution was suboptimal.
2	What other/add-on services does your RPA project require, beyond the generic features?	EnergyCo chose an open-source RPA solution. One of the main factors in the decision was unwillingness to pay for features and services that the company's RPA projects did not require. Many proprietary solutions come with a bundle of services that often are useful for customers lacking technical RPA know-how. EnergyCo worked alongside external developers to identify precisely which features are actually needed for its use-case, then adopted an open-source solution enabling it to use only those features. This resulted in a leaner system and yielded cost savings.
3	Do developers within your organization prefer to work with any particular RPA technology?	GambleCo opted to utilize an open-source solution for development of its RPA. One of the reasons for this choice was that the solution used a programming language, approaches, and interfaces familiar to the internal developers from their regular work.
4	Do the external consultants prefer to work with any specific RPA technology?	For EnergyCo, another important factor was external consultants' ability to develop the RPA solution. Before selecting a specific tool, EnergyCo managers spoke with external consultants and other experts about the RPA tools that developers currently prefer to work with. The feedback played a role in the ultimate solution's selection from the short list.
5	How sensitive is your project to costs associated with IT procurement?	ForestCo narrowed its short list to two RPA solutions that satisfied the feature requirements and were aligned with the preferences of the internal and external developers. The balance between the two options shifted in favor of the provider that decreased its prices during the decision-making process.

on the market, whether open-source or proprietary; however, there do exist features that are specific to particular vendors. If such features are important, they could become a major factor in the choice of RPA technology. Also worth considering is whether the RPA project requires more extensive customization and control over the RPA software. In such cases, open-source solutions may be preferable, provided that the organization possesses the development capacities required.

Second, in addition to the basic feature set, some software vendors offer various add-on services. Among these may be ready-made interfaces for popular enterprise applications and online services, robot-management solutions (e.g., dashboards), and built-in options for cloud deployment. Also, add-on services may include the vendor's customer- and technical-support services. Depending on project requirements and on the in-house resources available, the managers making the RPA decisions may wish to pay attention to these services when assessing which technology is right for the organization. For example, many community-built, open-source solutions are not accompanied by any support apart from documentation or user forums. Therefore, if an organization lacks the abilities necessary for deploying, maintaining, and troubleshooting the robots independently, such solutions would not be recommended.

The third question to address is whether the developers within the organization have particular preferences for a specific technology. Distinct RPA solutions are built on distinct underlying technologies. In cases wherein managers rely on in-house personnel to develop the RPA, those developers' preferences may be key to the choice of RPA solution. For example, people who work extensively with the Python programming language may feel more comfortable with RPA tools written for a Python environment. This consideration is especially important for an organization opting for an in-house development model. The managers must make sure their technology of choice matches the skills of the developers involved in order to flatten the learning curve as much as possible.

Another group to take into account in the selection of any specific RPA technology consists of external consultants. Such consultants often have extensive experience with a particular RPA software vendor, and there may even be an existing partnership in place. Consulting may produce better results when the organization selects the tool recommended by the external consultants, so in cases wherein the managers would prefer a specific piece of RPA software, it may be worth seeking out consultants who are experienced in working with the software in question.

Finally, the decision makers need to consider RPA license costs. Normally, the initial RPA software license costs are negligible relative to other expenses related to RPA. Yet organizations may be cost-sensitive when making decisions on IT procurement, especially in cases involving recurrent expenses connected with long-term license agreements. Hence, managers need to consider the existing IT budget and the policies on IT procurement. Cost may also play a tiebreaker role, as the deciding factor in a choice between two nearly identical competing solutions.

3. How to use the checklist

Some guidance is in order at this point with regard to the three key RPA-operating-model decisions identified in our analysis of the seven cases of RPA deployment. While our findings clearly suggest that there is no universal right way to approach the deployment, there is clear room for improvement in understanding of the decision-making process. This is why we developed the RPA operating-model decision checklist, to help managers analyze their situation and make more informed decisions. In Table 5, we present the complete checklist, including questions for all three decisions.

But how can managers participating in RPA-related decisions make the best use of the checklist? We suggest that it should be applied from the early stages of an RPA initiative. One option would be to hold a workshop with the key stakeholders in the RPA project whereby one attempts to find answers to all the questions shown. The checklist should help the participants narrow the set of options to those representing an RPA operating model appropriate for them. Cases in which participants struggle to come to a definitive answer may highlight areas in which they need to gather more information. For example, there might be knowledge deficits related to the development and deployment competencies present, or it may be unclear which policies and strategies might affect the decision. The managers need to investigate any such gaps further before making their decisions. We advise repeating the exercise once all the necessary details are known. Our analysis bears out the sense that RPA operating-model decisions are not static. As several of the examples above illustrate, many of the organizations we studied adjusted the model they applied as they amassed RPA experience or adjusted the scale of their RPA deployment. Therefore, we

Table 5. The full operating-model decision checklist

Decision		Questions
Who should develop RPA?		
1	Who?	Does your organization have a sourcing policy or strategy in place that prescribes a specific sourcing model for IT projects?
2		What are your organization's relevant software-development capabilities at present?
3		What are your organization's relevant process-development capabilities at present?
4		Do you foresee a need for rapidly scaling the RPA projects up or down?
How should the RPA be deployed?		
1	How?	Does your organization have established practices, policies, or strategies for IT deployment?
2		Does your RPA project require direct control over the robot while it is performing the tasks?
3		Do you foresee a need for rapidly scaling up or down the number of robots deployed?
What technology should be used?		
1	What?	What are the feature requirements for your RPA project?
2		What other/add-on services does your RPA project require, beyond the generic features?
3		Do developers within your organization prefer to work with any particular RPA technology?
4		Do the external consultants prefer to work with any specific RPA technology?
5		How sensitive is your project to costs associated with IT procurement?

recommend that managers consider returning to the checklist at times to reevaluate these decisions as their portfolio of RPA initiatives expands. The checklist could be used also for individual RPA projects in large organizations where competencies, resources, and policies vary across unit and function boundaries.

3.1. Decision interdependencies

Through our discussions with the seven case organizations' representatives, we found that there were interdependencies among the three decisions. First, one must consider whether the chosen deployment model and RPA technology are mutually compatible. We discovered that not all deployment models and RPA solutions mesh with one another. For example, some RPA software vendors may not offer both on-premises and RaaS deployment options. Likewise, RaaS providers may support a relatively narrow range of RPA software products. When deploying a solution on the premises, one needs to make sure the existing systems and capabilities are compatible with the technology of choice. Deployment and IT procurement policies must be considered too: These may be at odds with a specific combination of decisions.

Second, one must contemplate whether the sourcing model and RPA technology selected match. That is, managers need to consider the compatibility between the chosen RPA solution and sourcing model. The preferences and capabilities of any internal developers and of any external consultants must be aligned with the RPA technology. One factor here is that established RPA solutions are more widely supported by external RPA consultants, and they tend to provide features better suited to working with various sourcing models. Also, one must consider the policies on sourcing and IT procurement. Again, these may be incompatible with a specific combination of decisions.

Finally, one must assess whether the sourcing and deployment models under consideration are mutually compatible. The two need to match. Furthermore, the internal capabilities and any external consultants should support the sourcing and the deployment model both. This may prove especially important when the choice involves hybrid models which can entail utilizing both internal and external resources, associated with both on-premises and cloud solutions. Here also, the sourcing and deployment policies require attention, since they may be incompatible with a specific set of decisions.

4. Additional recommendations

The RPA operating-model decision checklist is intended to help RPA managers navigate the key questions when deploying the technology. In addition to this checklist, we have articulated two higher-level recommendations.

4.1. Recommendation 1: Approach development of internal resources and use of external resources with the long term in mind

Naturally, RPA managers need to balance between internal and external resources when deploying RPA. While these projects can rapidly turn an idea into a robot in production use, the managers must think strategically about potential next moves. At the early stages in an RPA initiative, using external resources might seem appealing since most organizations starting to engage in RPA do not have idle workers with adequate expertise in deploying it. Therefore, using external resources, such as RPA consultants, is likely to offer a faster, more cost-efficient, and lower-risk solution for getting things started. At the same time, organizations with a goal of scalable RPA should invest in accumulating internal resources in the long run. Though external consultants may still provide crucial support for expansion of the RPA initiative, the organization should have access to internal resources that are up to the task of driving RPA projects in line with its needs. It seems that in practice, internal resources are much harder to replace entirely with external aid than they may initially appear. The necessity for internal resourcing is rooted in the inherent traits of RPA: It requires an understanding of the business processes' intricacies, the kind of understanding that may be hard to achieve for external consultants, who do not always have a broader perspective on the organization.

Taken together, the insights presented above from our multicase study highlight the vast importance of in-house resourcing in RPA deployment. One must bear in mind simultaneously that the automation market is hot at present, with highly active headhunting for RPA experts. Hence, retaining competent staff may prove challenging. For situations in which internal resources are not available, we recommend paying special attention to the process of selecting external consultants. We suggest prioritizing consultants who possess the resources to respond promptly yet who also are willing to commit to a long-term relationship, to study the organization and its internal business processes, and to follow the organization through the RPA journey.

4.2. Recommendation 2: Critically assess the current objectives for the RPA initiative, and adjust the deployment strategy accordingly

Our case organizations display a broad range of configurations for RPA operating models that have resulted in success stories, yet it must be borne in mind that one person's dream is another person's nightmare. We observed that mission-critical processes, while often suited to automation, may come with drawbacks: The organization's policies may restrict an RPA manager's range of choices either directly (e.g., by mandating on-premises deployment) or indirectly (e.g., by ruling out cloud deployment and, thereby, limiting the options for RPA software or external consultants). In such cases, the RPA manager cannot rely on external best practice and needs to find the best compromise.

Objectives and circumstances influencing RPA initiatives are subject to change. Over a relatively short span of time, we observed many of the case organizations changing their models of operation. This leads us to posit that there are multiple contingencies associated with RPA that organizations have to take into account. First, as technology matures, the features of various RPA software offerings evolve. When this factor is considered alongside the evolving needs of client organizations, various alternative proprietary or open-source offerings may grow more appealing than what was selected initially. Second, deployment approaches also develop and grow more varied. For example, relative to 2017—2018, when the majority of the RPA initiatives studied began, RaaS offerings are much more prominent today. In particular, promises of seamless integration with services for intelligent automation make off-premises deployment of RPA more appealing. In

addition, as RPA becomes a more fundamental part of the organizational IT toolkit, attitudes and formal policies pertaining to it may evolve and thereby allow for choosing a more optimal operation model for future RPA projects. Finally, objectives for RPA initiatives can evolve over time, and they clearly do. Such evolution may necessitate changing the operating model such that it accommodates the new direction. All these factors necessitate ongoing critical review of the RPA operating model for any organization wishing to keep up with the times. Our checklist should support RPA managers engaged in this process by highlighting the key questions they need to keep asking.

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