

Challenges of Automated Software Testing with Robotic Process Automation RPA - A Comparative Analysis of UiPath and Automation Anywhere

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Abstract

The research work in this study explored the topic of Robotic Process Automation (RPA) and how it is being applied to modern software testing. Comparative analysis was designed to discover the features available from two of the leading RPA companies, UiPath and Automation Anywhere. The purpose of this study was to examine modern software testing challenges, utilization of RPA, and how RPA is being applied to solve significant challenges that cannot be addressed by manual software testing. RPA can heavily automate human tasks by emulating the same steps that a human would take, mostly in the form of UI interactions, but also in software scripts that emulate the process or tasks within a workflow commonly referred to as “bots” or “robots” [1]. Repetitive tasks automated with bots save money and increase the longevity of support by automating the tasks and generating quicker results than a human software tester. Implementing RPA into an organization adds value to business software management, performance, and processes of any complexity. Highlights of this study discussed strengths and weaknesses of RPA from the features available in both UiPath and Automation Anywhere when being applied to specific software testing challenges. The analysis of the information being collected for this research project mentioned authors’ opinions, case studies, indicators, and other comprehensive applications. Comparisons being made included pros and cons, cost savings, and effective decision making when selecting automation. Future research needs to be conducted into improving RPA software testing of business logic with Artificial Intelligence (AI) and Machine Learning (ML).

1. Introduction

Organizations and businesses are constantly trying to find new, exceedingly efficient, ways to do more work at consistently lower monetary costs. Most organizations do not want to just automate their entire workforce but are seeking to optimize their existing human resources’ time and effort being spent on routine operational tasks that can be improved by automation. Many organizations are now implementing Robotic Process Automation (RPA) to improve productivity, reduce costs, improve quality, and increase accuracy and therefore

it is important to understand how to utilize RPA and how it can be applied to different organization’s operational tasks which has been shown by a recent uptick in the adoption of such solutions that integrate RPA into existing operational practices. Banking, insurance, engineering, retail, HR, IT and other businesses or departments within organizations can all benefit from RPA ability to automate their workloads. In fact, in 2019 it was predicted that 90% of large to medium sized organizations would be integrated with some form of RPA solution by 2020 and that the search term ‘RPA’ only started to become a trendy topic in search engines in 2017 [2]. Implementing RPA can alleviate existing employee/contractor resources’ workloads that are repetitive and predictable. By shifting these human resources’ focus to other more innovative tasks that are not repetitive and not predictable then the organization can create greater value to their products or services. Every department within any industry’s organization can integrate RPA in some way to optimize their efficiency, including the software industry, a company’s digital teams, or software development teams.

Software complexity is increasing rapidly and scaling with this growing complexity is just one challenge that many software development teams are currently facing. RPA can add value to software testing challenges and help improve the efficiency with which any organization carries out testing, does business, or provides solutions that can then be realized by their leaders, users, customers, and partners in terms of value.

This paper explores the topic of RPA and how it can be applied to modern software testing challenges by providing a comparative analysis that highlights features available from two of the leading RPA companies, UiPath and Automation Anywhere.

2. Robotic Process Automation

RPA can heavily automate human tasks by emulating the same steps that a human would take, mostly in the form of UI interactions, but also in software scripts that emulate the process or tasks within a workflow commonly referred to as “bots” or “robots” [1]. All the tools in an RPA platform are then linked together in a control dashboard or orchestrator to manage their core capabilities, key

components, integrations, view reports, manage security, and administrate other related assets or features. Repetitive tasks automated with bots can save money and increase longevity of support by automating the tasks and generating results quicker than a human would be able to do so [1]. RPA is part of a bigger solution movement of “low code” or “no code” tools that are different from traditional software coding which allows for faster and easier deployments for End-to-End E2E testing automation [3]. So rather than coding the automation solution manually for each case RPA companies have develop suites of tools that allow their users to integrate specifically tasked bots for process automation using visual workflows that is similar to what one might find in Unified Modeling Language (UML) diagramming tools or flowcharting software with some special integration for specific systems included to allow access to specific infrastructure in the target environment.

According to the Gartner Magic Quadrant Study, conducted by Ray, S., Villa, A., Tornbohm, C., Rashid, N., and Alexander, M, UiPath and Automation Anywhere are the two leading companies in the RPA space that are scoring very high in the quadrant [1]. RPA platforms are offered in on premise, cloud, and hybrid deployments and have many features that allow them to integrate with other types of popular Enterprise Resource Planning (ERP) solutions and Business Process Management (BPM) tools, software, web-based interactions, and other modern technical solutions or architectures. This is the key selling point of RPA which monetizes the prospect that anything that can be done by a human with a screen, mouse, and keyboard can be replicated by a bot with the definable steps coded that the human also follows to accomplish these tasks, for example data entry, data validation, or data transformation. RPA takes this a step farther too, as the most advanced RPA systems can perform complex calculations and even be equipped with artificial intelligence, machine learning, natural language processing, natural language generation, and computer vision to create intelligent automation solutions that can interact with humans and adapt more rapidly to changing input conditions that other products are not able to beyond the recording of the steps taken for playback.

RPA has therefore positioned itself to be able to service a wider variety of industries and are often seen in the wild in the form of service bots or chat bots that you might interact with when getting assistance from companies like Amazon on an order purchased, as a first line to resolve your issue before sending you to a human agent if it is unable to satisfy your request. In fact, today the buzzword ‘Forth Industrial Revolution’ is quite widely used to describe the impact that automated technologies like RPA will have on the economy [3]. Although the

scale of which automation will initially be deployed seems to get exaggerated, studies show that 5% of total jobs may be totally replaced by some form of automation in the future [3].

For this study we examined some specific challenges related to the software development industry has towards the testing of software and how the RPA tools could be integrated to relieve the human testers of the burdens of repeated tedious task to the bots thus increasing the quality, accuracy, productivity, delivery, efficiency. And overall lower the costs of operating the testing routines being carried out.

3. Software Testing Challenges

Automation and software development are two different terms, although each borrows some aspects from one another and are often found co-existing together in many modern enterprises’ and organizations’ system architectures. Alok Mani Tripathi, author of Learning Robotic Process Automation, states that if some portion of a workflow can be programmed to be done without human intervention that it could be called “automation” [4]. Software that ties together systems and workflows within in an enterprise environment are known as Business Process Management (BPM) [4]. Enterprise Resource Planning applications such as SAP, Oracle, Microsoft Dynamics, and BPMs such as Pega systems and Appian can all be integrated with some form of RPA [4]. Additionally, custom software applications built on .NET, Java, command-line, or mainframe terminals are easy to port use with RPA [4].

Bath and McKay discuss the automation of testing as simply “automate the automatable”, and they recommend that consideration should always be given to the potential for automated test execution [5]. Bath and McKay’s opinion is that if automation is determined to be viable then the automation coding should occur during the test implementation stage of the test process [5].

Tripathi also separates automation into processes that can be automated and processes that should be automated [4]. Therefore, various aspects should be taken into consideration when selecting automation candidates. Processes that Tripathi says should be automated include repetitive steps, time-consuming steps, high risk tasks, tasks with a low-quality yield, tasks involving multiple people and that also might involve multiple steps [4]. Then, to determine if the process is a good candidate for automation Tripathi recommends reviewing the candidate process for the following characteristics: well defined and rule-based steps, logical, an input to the task can be diverted to the software system, input can be deciphered by software systems with available

techniques, the output system is accessible, and benefits are more than the cost.

Automation techniques that programmers have been using with enterprise include custom software, runbooks, batch file processing, wrappers, browser automation, desktop automation, and database/web design service integrations [4]. Some of the most common software testing challenges include repeated regression testing, business logic testing, and scaling combinatorial testing. Regression testing seems to meet the criteria that Tripathi lays out as the tests that can be performed to verify the correct results after a code change can be carried out with well-defined testing criteria that follow a logical path to completion and report a result. Additionally, business logic could also be considered automatable but there is some debate that will be presented in the section Automation of Software Testing / Cons that advocates the use of oracles of business logic to evaluate and tests systems manually for adherence to business logic. Finally, combinatorial testing is also a good candidate for automation with RPA because of the high number of permutations that can be tested in short amounts of time by RPA.

3.1. Automation of Software Testing Pros

Perhaps one of the biggest pros for the automation of software testing with RPA is that the robots can work 24/7 non-stop thus relieving the stress and time consumed by human resources at the same processes. When effectively tuned to the processes being automated the bots can process greater amounts of work at less risk for error and the results of which can also be logged the same ways a human tester would which translates into better quality information being presented to the human testers to analyze [2].

For test cases with well documented, logical, repeatable, and predictable input/output, like regression testing, test automation can provide a positive cost-benefit and can increase the speed and accuracy at which the testers perform the test cases and retrieve results. Therefore, the implementation of scripted testing or automation coding should always be considered when designing around the type of testing and the automation framework's capabilities [5].

RPA software dashboards can allow the integration of reporting and monitoring of activity, scheduling of tasks, administration of settings, utilization, and analytics that can be exported to other tools to lend to the human decision making from management of teams in certain instances. This reporting can also be used to quickly find problems, errors, or bugs that can then be addressed by human programmers and mitigated quickly before a new release of software features or services.

Additionally, not all RPA is unattended. RPA assistants are bots that can be ran on demand on your local computer to automate even the simplest of tasks needing to be performed, like copy and pasting a lot of data from one application to another, or to multiple applications. After the process finishes control is returned to the human performing the task and allowed to continue with their workflow or manual operational processes [3]. This allows a user of RPA to customize, design, and automate only certain portions of their work to accomplish tasks faster and free of errors. By starting small to develop trust and understanding for automation before working towards a larger or more complex scale of automation a developer can gain insight and increase productivity using RPA. Furthermore, UiPath predicts that there will be an emergence of a gig economy based around customized, and even individually personalized RPAs that they describe as 'a robot for every person' [6]. This could certainly allow for early adopters of the technology like independent developers to design specific yet flexible bots to cover a variety of common tasks that they could monetize for testing client's applications and help make analysis and suggest recommendations in a consultant like market space. RPA is certainly a transformative technology, but it does still have its limitations and drawbacks which we will discuss in the next section.

3.2. Automation of Software Testing Cons

Whittaker [7] takes a much difference stance on automation. On his Microsoft blog Whittaker stated that he has been asked several questions surrounding manual vs automated testing. Whittaker's beliefs that manual testing had extreme advantages by using human testers whose minds are fully engaged during the entire process rather than automation that foregoes that same benefit as soon as it starts to run. Whittaker is opposed to examples like "automated testing is better at regression testing and API testing whereas manual testing is better for acceptance testing or GUI testing." [7]. Whittaker elaborated on his point asking his readers to think about our own code in terms of business logic and infrastructure code because he sees this as a similar division that separates manual vs automated testing. Whittaker advocated intuition of the human testers intuitively by arguing that manual testing should be better at testing business logic because the logical rules for business requirements in a software application are easier for a human to understand than they are to teach to a piece of automation.

Manual testers become domain experts who store business logic with the most powerful testing tool, their minds, resulting from the fact that manual testing is slow and thus manual testers use that time to analyze and understand the subtleties of business

logic [7]. Whittaker grants that automation excels at low-level details by detecting crashes, hangs, incorrect return values, error codes, tripped exceptions, memory usage, and that it is high speed, but also at the cost of a high drag coefficient meaning that tuning the testing for business logic can be risky or difficult. Therefore, it is recommended that test cases would have to be modeled in the test suites and once modeled can be ran repeatably against the software program or user interface's performance on related systems or even hardware/infrastructure.

Addressing the inadequacies of automation and RPA can be addressed with more research into the integration of AI and ML to enhance the capabilities of services like RPA to react to unpredictable data inputs and are already being integrated into many providers' products like UiPath and Automation Anywhere, making them more adaptable to a variety of use cases including using artificial intelligence, machine learning, natural language processing, natural language generation, and computer vision to create intelligent automation that rivals human abilities and greatly lowers the risk of common human errors.

4. UiPath

UiPath started as DeskOver in 2005, a company that got its start by building automation libraries and software development kits (SDKs) for companies like IBM, Google, and Microsoft [3]. By 2012 they had specifically started to target the RPA market and were working heavily with Business Process Outsourcing (BPO) providers like Cognizant, Accenture, and Deloitte to refine their tools for a variety of industries like the banking and financial services industry (BFSI), healthcare, telecom, media, and retail [4]. UiPath is headquartered in Bucharest, Romania and is currently headed by Daniel Dines as their CEO [3]. UiPath's RPA platform consists of 3 distinct software components: UiPath Studio, UiPath Robot, and UiPath Orchestrator (2020). UiPath Studio is the component that allows users to design the processes, UiPath Robot is for automating the tasks designed in Studio, and Orchestrator is used to run and manage the processes. UiPath Automation Cloud features both Community and Enterprise Editions. Therefore, there is both a free and a paid tier for utilizing the products and the information needed to operate the software tools whether you are a novice or managing a large deployment.

There can be too much information for an administrator or a smaller team to take in but there is also an online learning component offered by UiPath. UiPath has an online learning platform for advancing users' knowledge about the tools and services available from UiPath. It has a multitude of service offerings, training, and certifications to add

value to their platform and encourage the adoption and integration of their product into their customers' enterprises. The online learning platform offers all the information that one would need to deploy, operate, and scale their robotic factories, including managing licenses, multi-tenant support, user access, and orchestration services to create robots, environments, machines, processes, run jobs, create schedules, all from a centralized dashboard.

In addition to all the features and information mentioned above, it is important to highlight that for this study we are going to look specifically at UiPath's Automation Testing product TestSuite which combines four UiPath products[8]:

- Test Manager
- StudioPro
- Orchestrator
- Robots

UiPath's TestSuite aligns with addressing the specific challenges we will discuss that come from software testing and software development that can be addressed with RPA. UiPath Test Suite is advertised as an End-to-End E2E Automation solution for software testing. Therefore, some if not all the most common software testing challenges, including repeated regression testing, business logic testing, and scaling combinatorial testing, could be address with the tools offered by UiPath.

4.1. Pros of UiPath

According to the study UiPath has more than 250 technology partners supporting integrations from all major enterprise products, there have also been over 1.5 million downloads of their product with a community of 750k developers who can share automation and AI libraries in its marketplace [1]. The three strategic strengths in UiPath as follows:

- integration and partner ecosystem
- operations
- product portfolio

Operationally, as discussed in the last section, UiPath has resources exclusively devoted to helping their developers and partners scale their RPA solutions by offering both free and paid versions, learning resources, online training, and certifications. This includes UiPath's TestSuite, which aligns with addressing the specific challenges faced by software testers and software developers that can be used to

address the challenges through the integration of RPA, their community, and their marketplace.

4.2. Cons of UiPath

The information in the 2020 Gartner Magic Quadrant study of UiPath further discusses the three strategic weaknesses which include

- pricing, customer support
- product upgrades
- deployment

With UiPath's rapid adoption, their pricing has evolved from a simple collection of products to a platform model with role-based pricing thus adding to the complexity of UiPath's pricing structure. This aspect might deter potential customers that have already seen pricing structures for cloud-based solutions in their organization and might not be ready to justify the additional investment in UiPath as their primary RPA vendor when other lower cost options might exist. Additionally, due to this same complexity and rapid growth, the Gartner Magic Quadrant report cites that despite their excellent operations they have noticed certain aspects of UiPath's customer satisfaction have been in decline over the years. This type of decline in customer satisfaction can directly contribute to a lack of consumer confidence and start to make potential customers hesitate from hearing of bad customer service experiences. Finally, the Gartner Magic Quadrant study also found product upgrades and deployment issues that customers using UiPath versions 2018.4 or older found when trying upgrade to the newest product version [1]. There is speculation that it is because UiPath has been focusing on more advanced features rather than the base set of features in the product thus effecting its overall quality of the user experience. But some companies may see this as a risk when trying to progress from one version of the RPA system to the newest version, especially with the amount of time and money they have already spent to create their RPA's current state. Therefore, there could be a potential issue with addressing the specific challenges faced by software testers and software developers that use UiPath for testing software systems if those systems do not align with their support model or not being forward compatible with newer versions of UiPath's automation tools when time to upgrade comes due.

5. Automation Anywhere

The Automation Anywhere, also a leader in the Gartner Magic Quadrant, is based out of San Jose

California and is led by CEO Mihir Shukla [4]. Also, a company that got its start with a vision for replacing manual scripting applications with process automation that could be designed by their users to automate business and E2E process, Automation Anywhere is pushing the envelope of innovation when it comes to RPA. The Automation Anywhere's control room is a centralized dashboard to develop, configure, and monitor bots with a high level of detail using a collection of web services that have plug-ins that can be installed on the local computer that access the control room [3]. Automation Anywhere also works heavily with BPO providers like Accenture and Deloitte to refine their tools for a variety of industries like the banking and financial services industry (BFSI) which makes up more than half of their revenue as well as healthcare, motor vehicle manufacturing, and telecom giants like General Motors, ATandT and JP Morgan Chase [3]. Automation Anywhere is also advertised as an E2E Automation solution for software testing. Therefore, some if not all the most common software testing challenges, including repeated regression testing, business logic testing, and scaling combinatorial testing, could all potentially be addressed and customized with the tools offered by Automation Anywhere.

5.1. Pros of Automation Anywhere

The A2019 release of Automation Anywhere has undergone a redesign that has enhanced the user experience and other features like multipersona, guided navigation, reusable ML libraries, strong security, improved analytics, and cloud delivery. The Automation Anywhere have three strategic strengths which that uses product portfolio, pricing and innovation. IQBots, Bot Insight, and other major components are all available within the enterprise package and with A2019 are offered in three bundled solutions that are competitively priced [1]. The three editions of Automation Anywhere are Community, which is free with limited functionality, Enterprise on-premises, and Enterprise Cloud. Automation Anywhere features a development client for creating bots, a runtime environment for deployment, and a centralized command center for managing bots and analyzing performance [4].

The Automation Anywhere no longer has a dedicated testing product suite like UiPath there are certain bots that can be customized around software testing. Previously the testing suite was called TestingAnywhere and is still available in limited release to some customers, but you must fill out a special form to get a copy of the software that is considered a legacy on-prem solution. The tools and bots from the TestingAnywhere solution were either discontinued or carried on into the development client and command center.

5.2. Cons of Automation Anywhere

The other three strategic weaknesses of Automation Anywhere are upgrade experience, customer service and attended bot deployment. Customers reportedly faced challenges upgrading to the latest version that will now require a formal migration process that is scheduled to be released in the second half of 2020 and Automation Anywhere is advising them to wait for the tool's release. Secondly, like UiPath, customers using an earlier version reported a lower level of satisfaction with the support of their deployment experience, which Automation Anywhere has addressed in the A2019 release [1]. Finally, existing customers referenced reported attended bot automation requires a lot of manual work to deploy and Gartner's Magic Quadrant report recommend that customers requiring these features take additional time to evaluate their capabilities before devoting significant development time to them unlike their unattended solutions which have stronger feature support but are more rigid in their implementation [1].

Previously, Automation Anywhere had a testing suite comparable to UiPath TestSuite called Testing Anywhere. It has now been depreciated but is still being made available in limited release to some customers in the form of an installable application, but you must first fill out a special form to get a copy of the software that may now be considered a legacy on-prem solution. The older tools and bots from the Testing Anywhere solution was either discontinued or carried over into the newer development clients and command centers of the newer releases. Therefore, with the upgrade experience being considered a con it might also be hard to migrate from legacy solutions forward into the newer versions of Automation Anywhere if a majority of the testing capabilities are not carried over into the newer solutions or could incur additional time and costs to rewrite the testing in the new application frameworks. These cons could indicate that trying to adapt to Automation Anywhere to certain software testing challenges might present a significant risk if the product and its features are not tested against the desired test cases and scenarios that they must be integrated with in the environment implementing RPA for testing.

6. Conclusion

The findings of this study revealed that manual testing is better at testing business logic and testing business logic with RPA can be risky or difficult and costly for both UiPath and Automation Anywhere to perform. Further research into the process for integrating Artificial Intelligence AI and Machine Learning ML with RPA could greatly increase improve RPA's position over human testers and

likely contribute to the retooling of workforces with more highly skilled human workers that could maintain the bot farms and process automation with their understanding of the business logic and processes. RPA has no problem testing many test cases and recording results faster than humans, but also does not provide the same level of knowledge, insight, or skills that human testers can perform when testing. However, even the greatest human testers are susceptible to error and RPA greatly reduces and minimizes the errors that human testers incur as workloads increase.

A considerable amount of due diligence must be performed to evaluate the RPA products fit in the environment and how well it will integrate with existing software. Also, even though they are advertised as low-cost low code and no risk they could have a considerable amount of risk and costs associated with the financial burdens of implementing the automation only to find out that it will not carry forward without a considerable amount of additional time and effort involved with upgrading or adapting to the next iteration of operational processes. Implementation costs of scripted testing or automation coding should always be considered when designing around the type of testing being performed and the automation framework's capabilities [5]. To add to the risk that one faces from choosing these types of solutions it is rumored online that the full license for a year for the enterprise editions of UiPath and Automation Anywhere are very expensive (in the 100s of thousands of dollars a year) making the implementation of such solutions risky for an enterprise that may simply opt for more traditional software automation and back-end testing integrations over investing in an entirely new approach without a through proof of concept.

Following Tripathi's recommendations as discussed to separates automation into processes that can be automated and processes that should be automated is the best first step when determining how much your organization will be able to be automate with an RPA solution. Then selecting only the processes that are most logical, rule based, repeatable, and time consuming for humans to perform and adding them to your RPA portfolio of bots. The cliché adage of 'think big and start small' is applicable in this regard in that you must think about the end goal for your automation of software testing but start with smaller tests and routines that are easily automatable and build from that initial success or failure to truly determine if RPA can be applied to your type of testing. Any gaps in the testing could then be filled with manual testers who have the business process knowledge and keen sense for the logic behind the tests and the automation.

7. References

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