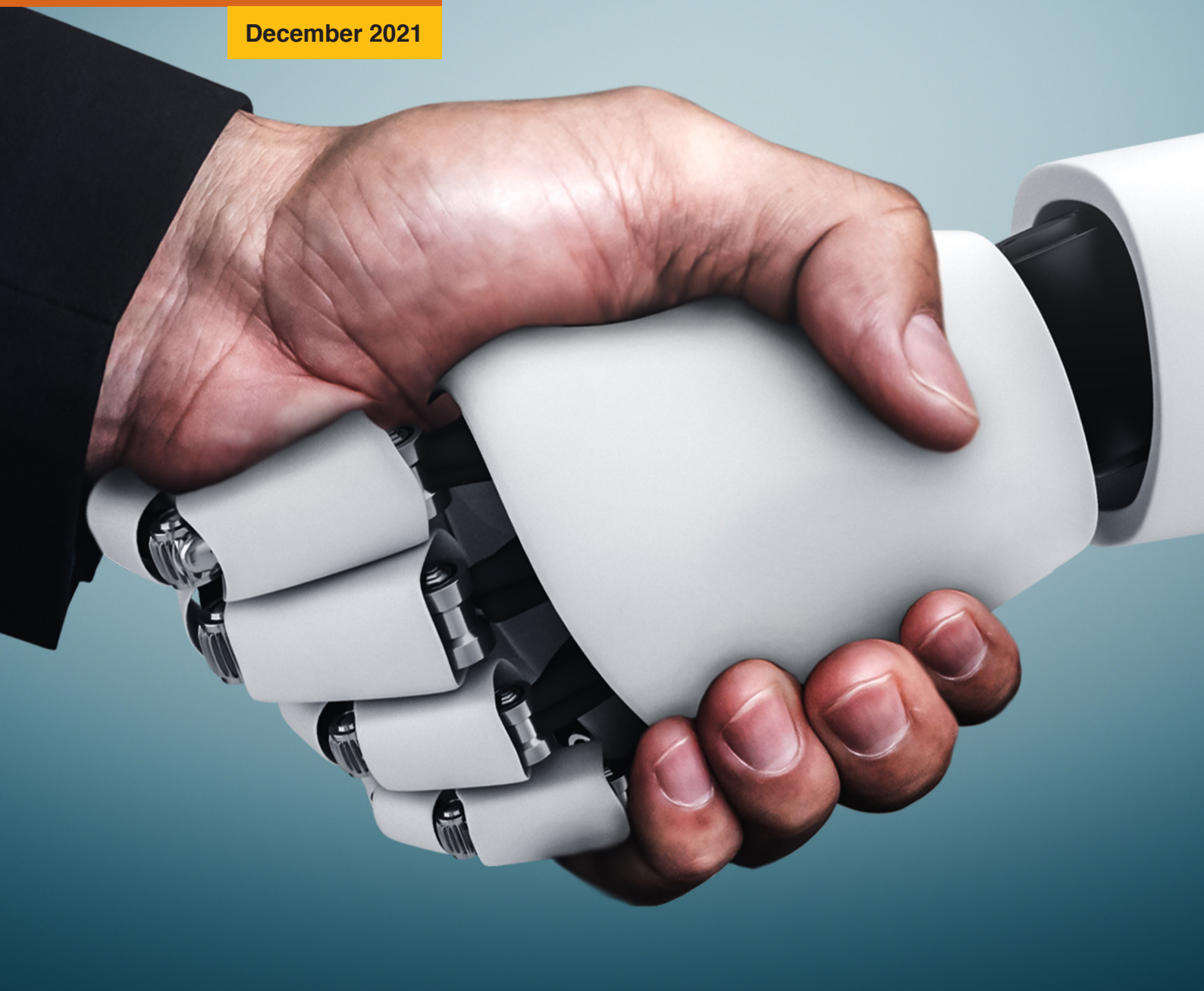


Cognitive automation: The next level of value creation through human-machine collaboration

December 2021



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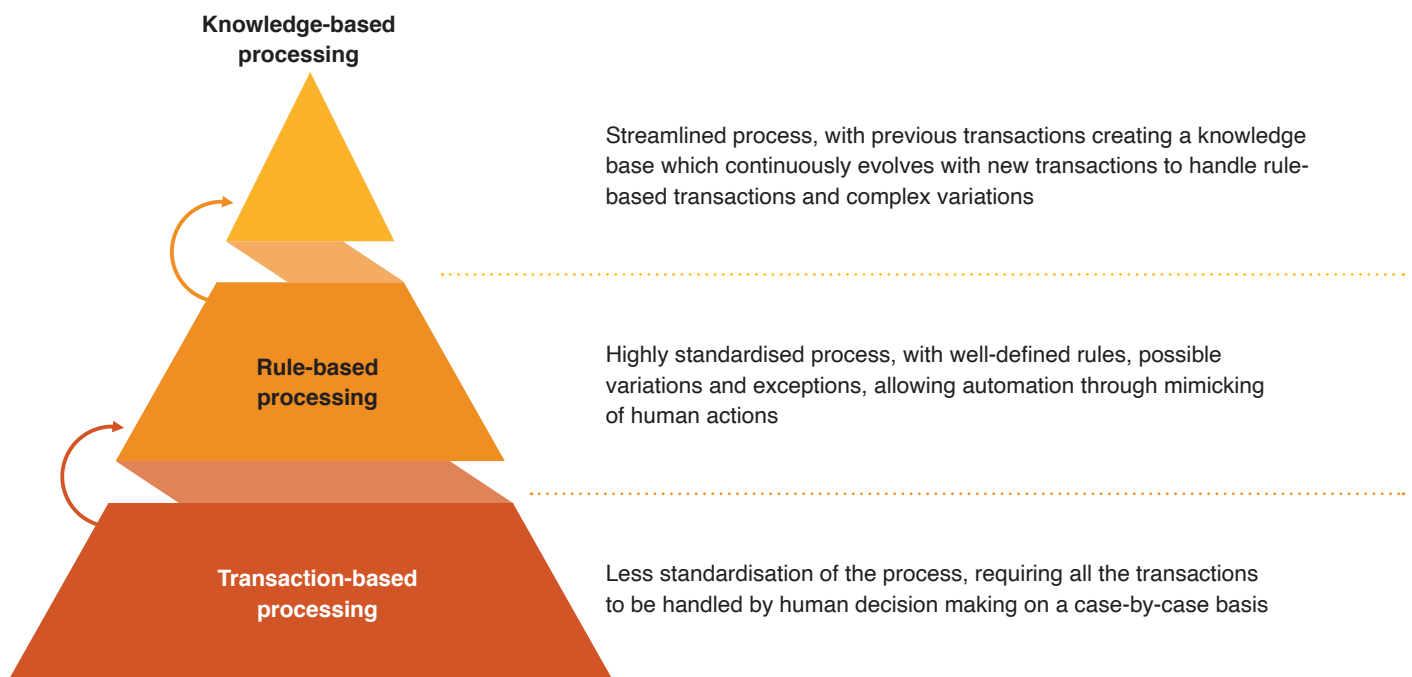
The automation horizon is expanding

Enterprises today are undergoing a radical transformation as the increasing adoption of software robots is changing the very definition of work. Organisations are increasingly benefiting from digitisation and automation, and implementing operating models where processes and capabilities are constantly evolving in line with technological innovation. With robotic process automation (RPA) proving its utility in automating processes via the user-interface route and seamlessly including legacy applications in connected IT ecosystems, CxOs are prepared to implement RPA for advanced functions. Enterprises are now looking forward to using cognitive technologies to automate more processes by increasing scope and decreasing the time required to deploy. With emerging technologies such as virtual personal assistants and chatbots rapidly being adopted in workplaces, routine work done by employees across departments and roles is being automated.

Enterprises are looking to build digital workforces as part of their automation strategy by combining elements of RPA, optical character recognition (OCR)/intelligent character recognition (ICR)

and cognitive intelligence. The pandemic has further accelerated the adoption of emerging technologies, with 48% CFOs looking to reimagine the new normal through increased usage of automation and other new ways of working.¹ The crisis has augmented the propensity of enterprises to use digital technologies to repair (run business as usual in a disrupted environment), rethink (address vulnerabilities in existing operations) and reconfigure (make fundamental changes to their operating models for lasting competitive advantage).²

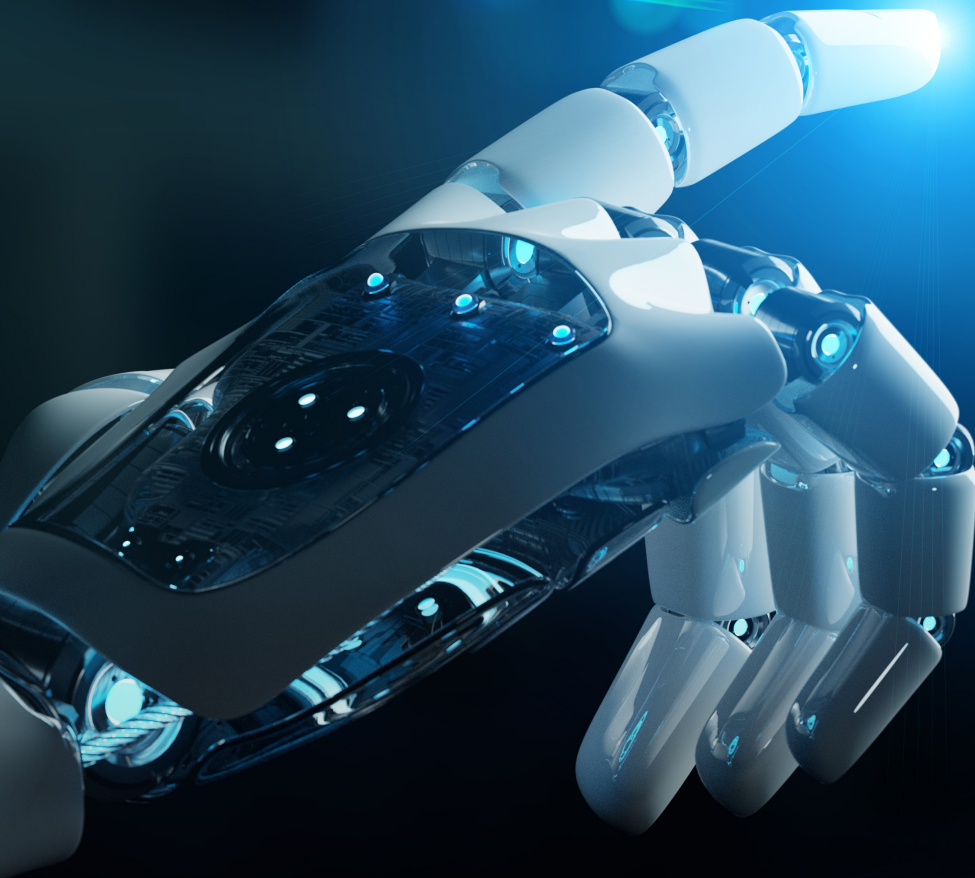
Cognitive technologies are becoming mainstream and allowing organisations to shift their focus from automation of rule-based processes to knowledge-based processes. While RPA tools are capable of executing manual and repetitive activities in a quick and efficient manner, adding OCR and cognitive intelligence capabilities enables complex decision making and eliminates the requirement of defining all business logic, variations and exceptions in advance.



1 <https://www.pwc.com/gx/en/issues/crisis-solutions/covid-19/global-cfo-pulse-survey.html>

2 <https://www.cnbcvt18.com/videos/technology/coronavirus-impact-india-witnessed-highest-increase-in-use-of-ai-compared-to-major-economies-says-report-7686911.htm>

Additionally, as enterprises worldwide adopt automation on a large scale, there is an increasing need for skilled professionals who can help organisations reach their digital workforce objectives. Data from a professional networking platform shows that hiring for roles in artificial intelligence (AI) and machine learning (ML) has grown by 74% annually in the past four years. Hiring for roles in robotics has also grown exponentially and the demand for technical professionals with expertise in robotics is expected to increase by 40% over the next year.³



3 <https://www.forbes.com/sites/louiscolumbus/2020/01/05/ai-specialist-is-the-top-emerging-job-in-2020-according-to-linkedin/#628653157495>

02

Cognitive intelligence is increasingly being leveraged to enhance automation

Cognitive intelligence enables software robots to move beyond executing specific, rule-based activities and become an intelligent digital workforce. An added layer of intelligence, along with RPA, helps expand the scope of tasks that can be automated. Also, since robots have seeing, listening, pattern-recognising and decision-making capabilities, all variations no longer need to be preconfigured at the outset.

Organisations are evolving in their automation journey by adding cognitive technologies and foresee the following benefits:

Ability of models to get better with time and information

Humans are particularly efficient at heuristics and employ a wide variety of techniques to complete tasks more efficiently with every iteration. Most of these techniques are applied at a subconscious level and are partially responsible for difficulties encountered by organisations when they attempt to standardise rules and procedures. Organisations can use cognitive intelligence to create programs that learn from new information and decrease the possibility of bots failing to tackle non-configured variations.

Working with unstructured data

In addition to non-standardisation of rules, unstructured data is an immutable part of how operations are run today. With more data generated from numerous sources in various formats every minute, business functions can use AI to sort and scan multiple documents in order to quickly compare data and extract relevant information. With better AI algorithms currently available, it is no longer necessary to train programs for each document variation, which subsequently frees up important human time for innovation.

Straight-through processing instead of a band-aid approach

Typically, all process steps that require decision making have to be kept out of RPA's scope and are either handled separately or by bots, with such steps being routed to humans. Organisations can now process entire transactions as cognitive intelligence enables machines to take decisions.

Seamless customer service

People are most likely to frequently interact with AI-based chatbots. Organisations today are rapidly adopting conversational AI, and virtual customer service agents are helping resolve queries in real time, leading to improved response time, error reduction and better customer satisfaction. This enables human resources to focus on more complex customer concerns. Voice bots and email bots are increasingly being used to complement human-enabled services and chatbots to provide better customer service.

Increased scope of automation

Incorporating cognitive capabilities into RPA increases automation potential and decreases average handling time post automation, increasing cost savings. With an increasing number of organisations adopting RPA + cognitive intelligence tools, licence and infrastructure costs are expected to further decrease. This will increase the scale of automation adoption and further improve return on investment (RoI) in both short and long terms.



03

Key aspects to consider while adopting cognitive automation

Cognitive intelligence has the potential to drastically improve the way companies function. However, organisations must consider some major challenges at the outset.

Business alignment

Adopting cognitive intelligence is not only a technological investment but also a business consideration. Responding to a PwC survey conducted in September 2019, only 11% CxOs from over 1,000 organisations worldwide said that AI-integrated business strategy guides their AI investments. This points to a lack of well-coordinated strategy in alignment with an organisation's present capabilities. The proof of cognitive intelligence's success for an organisation is not in how advanced the standalone tools and models are, but how effectively the workforce can leverage them.

Governance

An automation governance framework is necessary to ensure that proper controls are in place. It specifies approved tools, security standards for system access, mechanisms and requirements for regulatory compliance, as well as addresses configuration and testing, backup and recovery, ongoing maintenance and support, among other things. Depending on the level of autonomy granted to business units, a framework might include controls to validate code or check tool output, as well as documentation to define artefacts that should be retained for compliance and audit. Governance also means ensuring that business users are aware of all their technology options and have a methodology to understand value and risk, so that they can take advantage of the right tools for the right problems. The COVID-19 pandemic has brought these challenges to the forefront, as demonstrated by PwC's report 'AI: An opportunity amidst a crisis'. One in five organisations finds it challenging to create AI-related governance policies across the business.

Infrastructure requirements for hosting models

ML performance is highly dependent on underlying infrastructure. Infrastructure that supports seamless training, testing and deployment of models at enterprise scale is as important for long-term viability as the models themselves. The right combination of high-speed storage, processing power, software aligned with underlying hardware and flexibility for in-cloud/on-premise deployment are some key considerations for infrastructure. For most businesses, without sufficient in-house technological expertise, this can prove to be a herculean task.

Skill set

Most organisations are open to exploring opportunities in cognitive intelligence but don't have the required in-house skilled talent to execute their AI strategy. Responding to a PwC survey conducted in September 2020, 28% firms reported training and recruiting skilled AI professionals as hurdles to the expansion of their AI strategy.

Organisations are realising that it is much harder to attract and retain skilled talent to keep pace with the speed of technological change. They are also understanding the importance of upskilling their future workforce and enabling them to become adept at using AI systems. Such organisational outlook has resulted in a renewed focus on democratising automation and upskilling all employees to leverage cognitive intelligence. Citizen-led automation necessitates a no-code ecosystem that can be easily replicated by citizen developers and scaled within an organisation.

Integration and change management

Integrating ML into existing systems is a complicated process. It requires model training and testing the effectiveness of the developed model, and creating a continuous feedback mechanism to improve accuracy. Once solutions are in place, people have to be trained to use them, including how to receive outcomes produced by ML models and interpret results.

4 <https://www.pwc.com/gx/en/ceo-agenda/ceosurvey/2020.html>

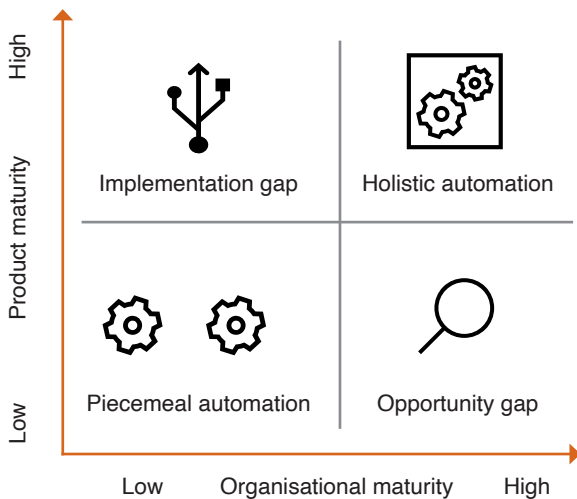
5 <https://www.pwc.in/assets/pdfs/data-and-analytics/ai-an-opportunity-amidst-a-crisis.pdf>

6 <https://www.pwc.in/assets/pdfs/data-and-analytics/ai-an-opportunity-amidst-a-crisis.pdf>

04

Evolution of the cognitive intelligence ecosystem to drive value creation at scale

Implementing holistic automation at scale requires an amalgamation of high product and organisational maturity. While organisations can automate more processes, it becomes pertinent to have inbuilt capabilities within a product to realise the benefits of expanding the automation pipeline. In the absence of better features in software products, organisations continuously struggle and face constraints, leading to many high-value processes being excluded.



In a democratised automation environment, citizen developers cannot be expected to be equally adept at coding and implementing digital solutions. Product companies are increasingly focusing on creating an ecosystem fit for no-code, easy-to-leverage and fast-to-deploy solutions. This will enable employees with non-technical skills to run automation programs successfully. Therefore, it is necessary for automation tools to have inbuilt capabilities that solve challenges such as integration complexity and hosting of solutions, and have a continuous feedback loop to improve product capabilities.

Democratising cognitive intelligence

As organisations look towards strengthening citizen-led automation instead of hiring technology specialists, expectations from tools are changing. Organisations require tools that have a no-code approach and an easy interface. Prebuilt models that can be easily tailored by business users to suit their requirements can ensure that cognitive intelligence is usable for everyone. To retain key talent, organisations are focusing on employee experience in addition to customer experience. Cognitive automation allows everyone to be involved in creating solutions, irrespective of their proficiency in coding and familiarity with the technical landscape.

Flexible infrastructure

Due to high infrastructure costs, many organisations are unable to begin their automation journeys. Organisations that explore cognitive intelligence without adequate capital to continuously invest in infrastructure face constraints as processing power and storage requirements grow with the increasing volume of data. The flexibility to host solutions in a cloud environment can reduce this burden for organisations that wish to explore cognitive intelligence. Hosting solutions in a cloud environment also reduces upfront investment as organisations can scale up infrastructure in line with their requirements at minimal cost, ensuring that usage of solutions is not restricted due to security considerations.

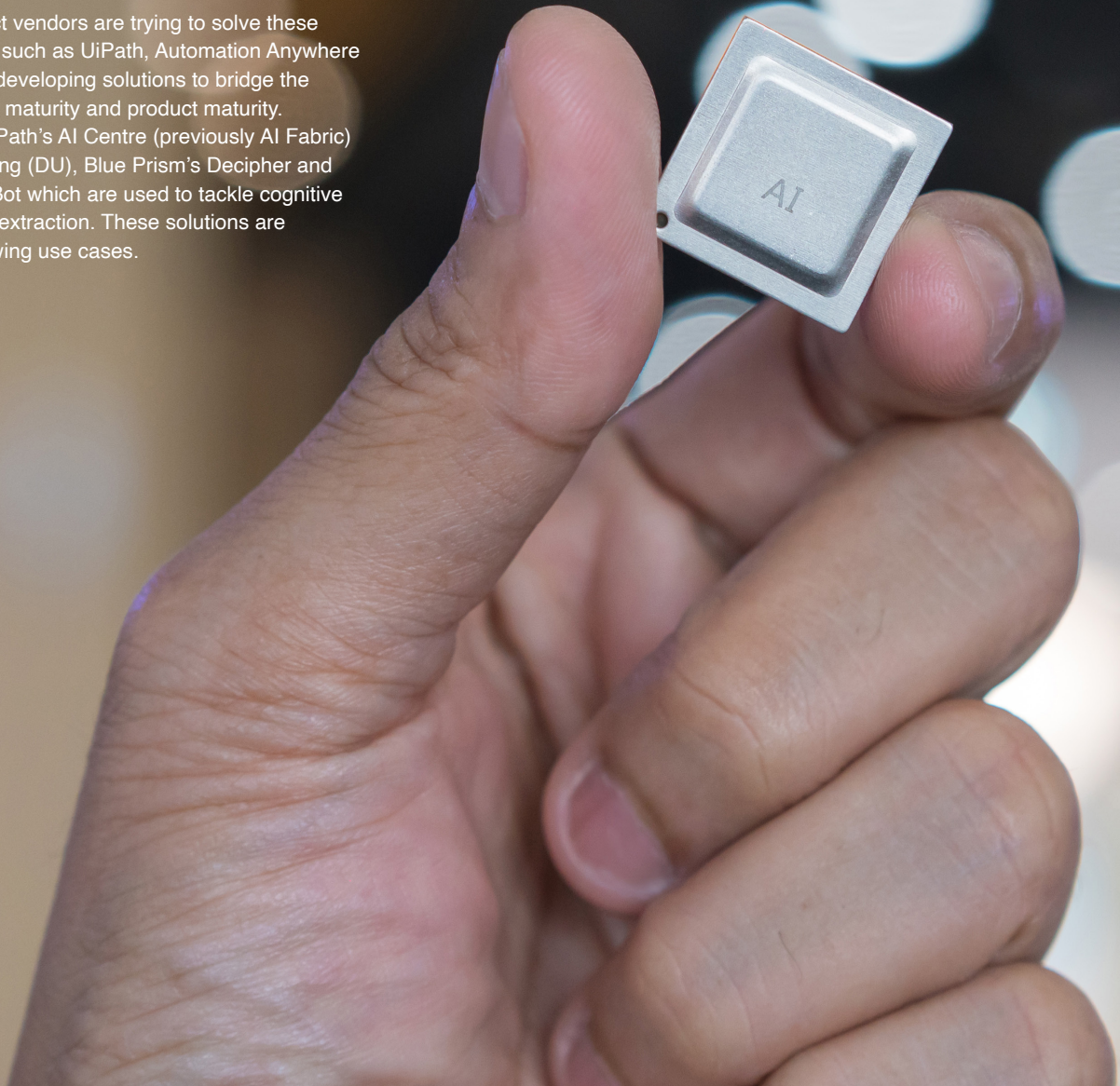
Continuous learning

To incorporate feedback during runtime, a human-in-the-loop (HITL) model can be used and these skills can be honed by conducting training sessions on unseen data, additional scenarios and anomalies. A continuous learning curve can significantly improve decision-making processes and encourage successful knowledge transfer from humans to robots.

Explainable ML models

Lack of understanding of how ML models/applications make decisions erodes trust in using cognitive intelligence and significantly limits its applicability in critical functions and processes. Enhanced transparency of an ML model's functionalities and ease of monitoring/tracking input data and model output can help overcome this barrier. Once operations teams understand how an ML model works, it becomes easier to use and human capabilities can be complemented by cognitive intelligence.

Different automation product vendors are trying to solve these problems. Leading vendors such as UiPath, Automation Anywhere and Blue Prism have been developing solutions to bridge the gap between organisational maturity and product maturity. Examples of this include UiPath's AI Centre (previously AI Fabric) and Document Understanding (DU), Blue Prism's Decipher and Automation Anywhere's IQBot which are used to tackle cognitive automation and smart data extraction. These solutions are explained through the following use cases.

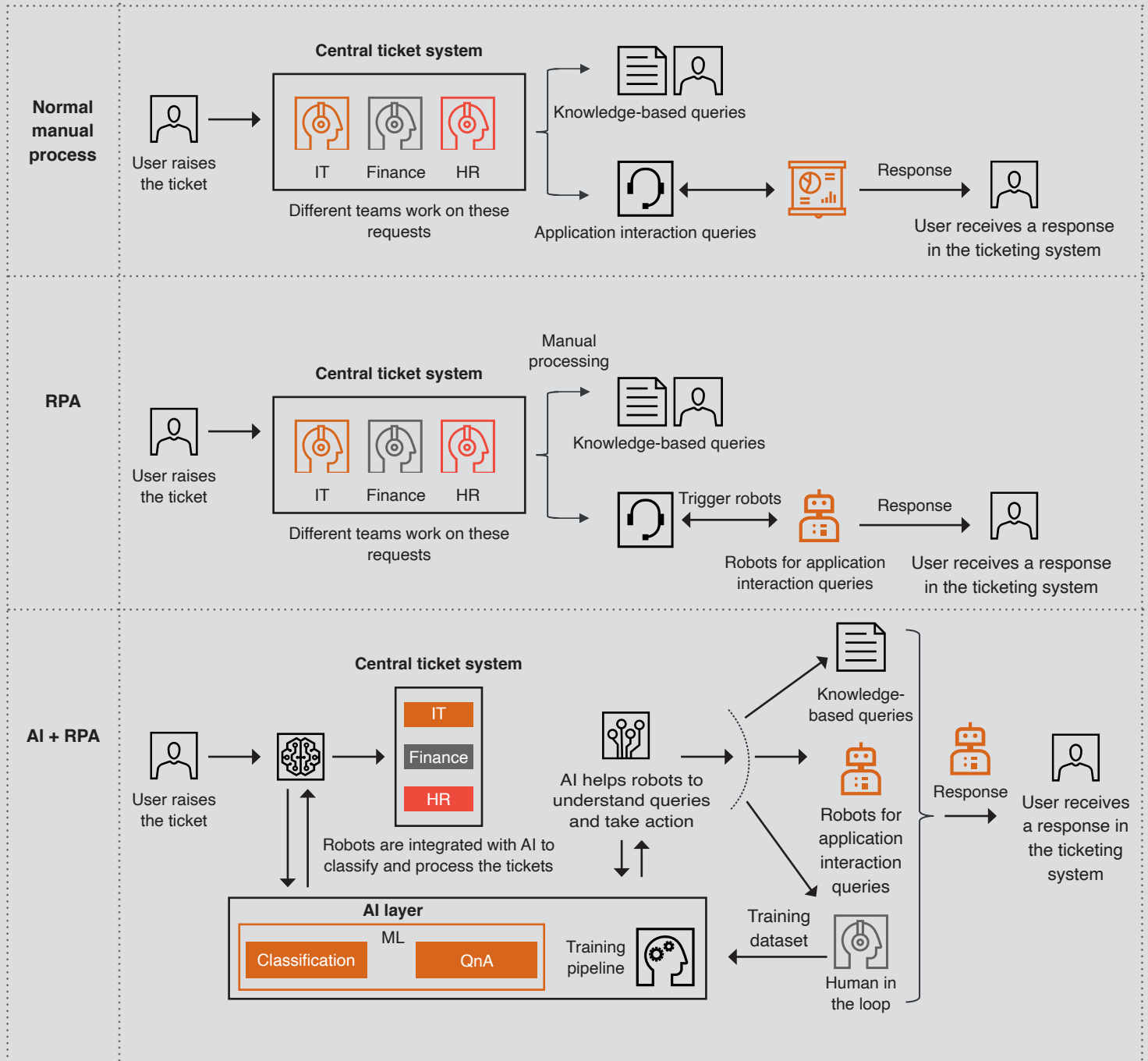


End-to-end automation of ticket classification and servicing requests

Ticketing systems in organisations help employees and customers raise queries pertaining to applications and services. Support teams end up spending a lot of time and effort on addressing such requests and maintaining the turnaround time (TAT) and service-level agreement (SLA). At peak volumes, support teams find it difficult to address concerns raised via such tickets and often have to work for extended hours. While organisations have attempted

to automate ticketing management by using RPA, the result has often been partial automation of standardised process steps. This band-aid approach has been unable to reduce dependency on humans. So far, the primary bottleneck in automation has been the inability of RPA to understand the intent of unstructured queries, match them with historical questions and identify the appropriate responses.

The following use case will allow us to take a closer look at this aspect and explore solutions:



Source: PwC analysis

Normal manual process

Users across organisations raise numerous types of queries related to HR policies, system issues and salaries. The respective teams log into the ticketing system and work on the queries addressed to them. Generally, these queries are either process related and require prior experience or requests that require some action to be taken within the system. Teams take appropriate action and then respond to users on the ticketing system to resolve queries.

RPA

In any ticket management solution, teams classify requests manually. While teams are required to handle standard queries, RPA can be leveraged to answer application-based queries. Bots interact with the application and provide the required output to assist operations teams in their work. Teams can focus on customer interaction, while bots assist in system interaction and a human-bot handoff can be designed to respond to requests effectively.

UiPath's AI Centre + RPA

In this combination, NLP and ML are integrated with RPA to understand a query's context and classify a ticket using AI Centre. Text classification and question-and-answer (QnA) skills are deployed in AI Centre and installed within the UiPath Robot. The ability of AI Centre to effectively handle standard queries and application-based queries end to end widens the automation scope and enables machines to make decisions, instead of depending on humans for processing each request.

In AI Centre, a bot downloads query tickets, passes on queries to an ML skill and decides the response from the ML model. A feedback loop is designed to continuously train and improve the model based on user inputs. Queries where predicted value lies within threshold value are answered directly by the bot. Other tickets are routed to a user and can be used for retraining the model, depending on users' response.

Apart from end-to-end automation, AI Centre solves a few challenges that continue to persist in an AI + RPA approach.

A simple, unified user interface allows organisations to bypass integration complexities associated with using ML models, along with RPA. The continuous learning mechanism is inbuilt in the tool and can be leveraged to increase accuracy through training of the ML model via HITL. Easy monitoring of how the ML model works ensures that business users are not hesitant to adopt the solution in daily activities as well.

AI + Automation Anywhere/Blue Prism

The ticket classification use case can also be tackled using a combination of an AI layer and Automation Anywhere/Blue Prism. There are two possible approaches here:

- integrate with external platforms
- deploy a custom NLP and ML solution.

The design methodology is similar to that used for the AI Centre, with only a difference in implementation and usage of the AI layer.

Approach 1

ML platforms can be leveraged to train a model, and this can be triggered through API calls within the RPA bot. In this methodology, the ML layers reside outside the bot landscape. An automated workflow can be created for retraining the model for exception scenarios and to keep on updating the training dataset with new unseen data for a better accuracy score. The bots orchestrate the whole solution and will perform application-level interaction, invoke APIs, take decisions as per the response, and action the tickets. The classification intent and QnA outcome shall be preserved through optimal design to perform a thorough audit and continuously monitor scope for improvement.

Approach 2:

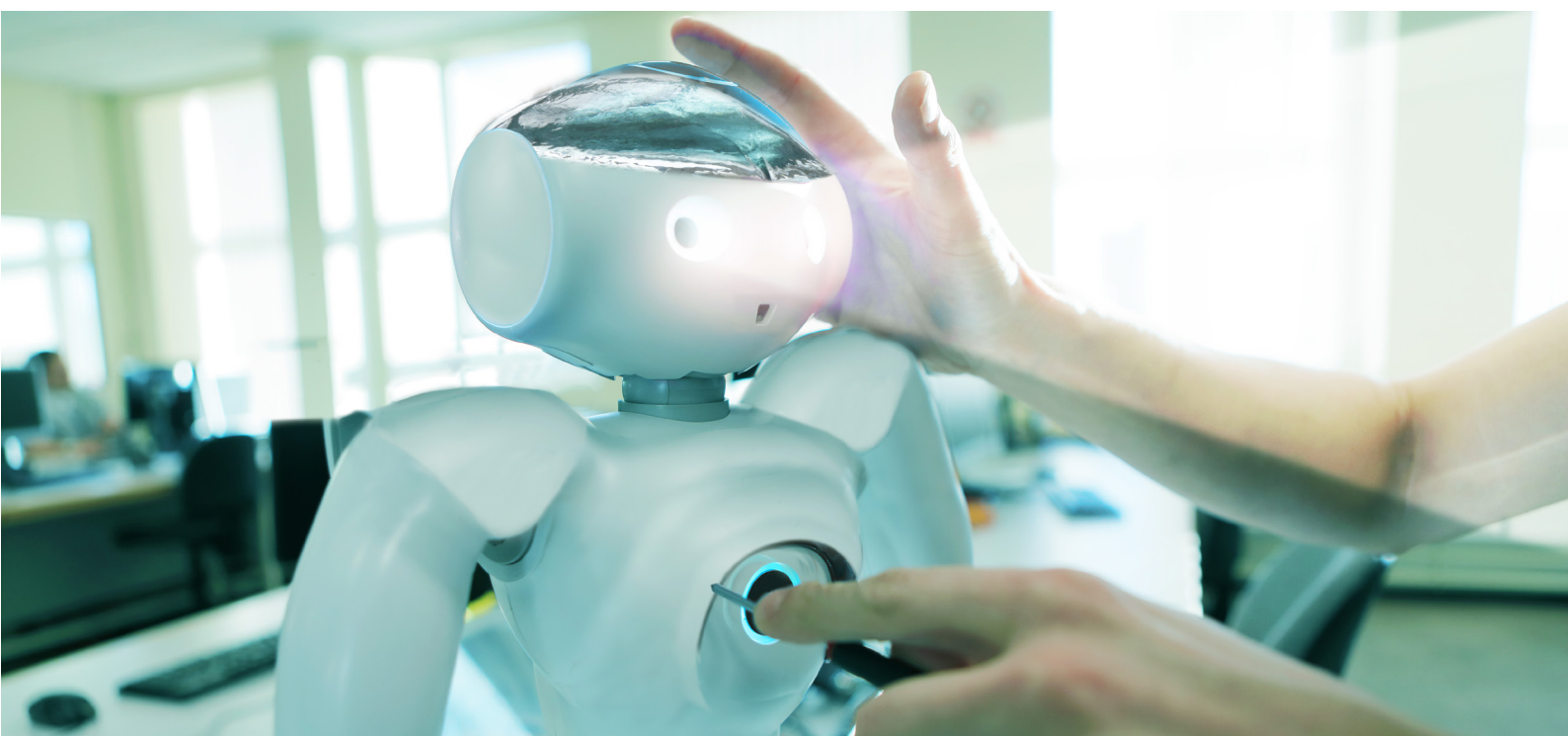
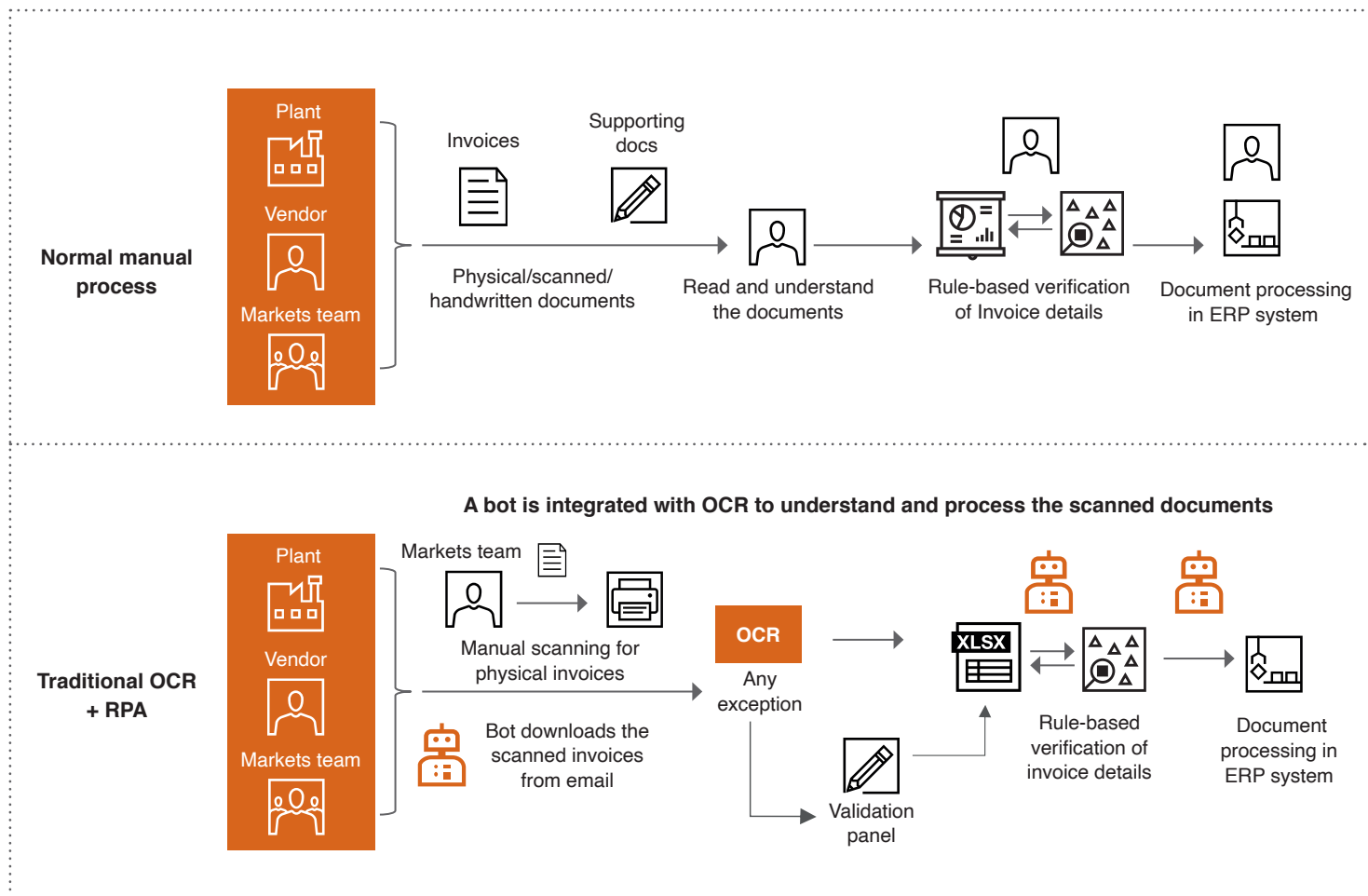
A custom solution can also be built mainly in Python or R which can be deployed either on premise or cloud. It is essential to have a proper error management framework for this approach since both the RPA and AI layer will have to be supported. The bot must gracefully handle exception tickets by routing them to business users without disturbing the current run.

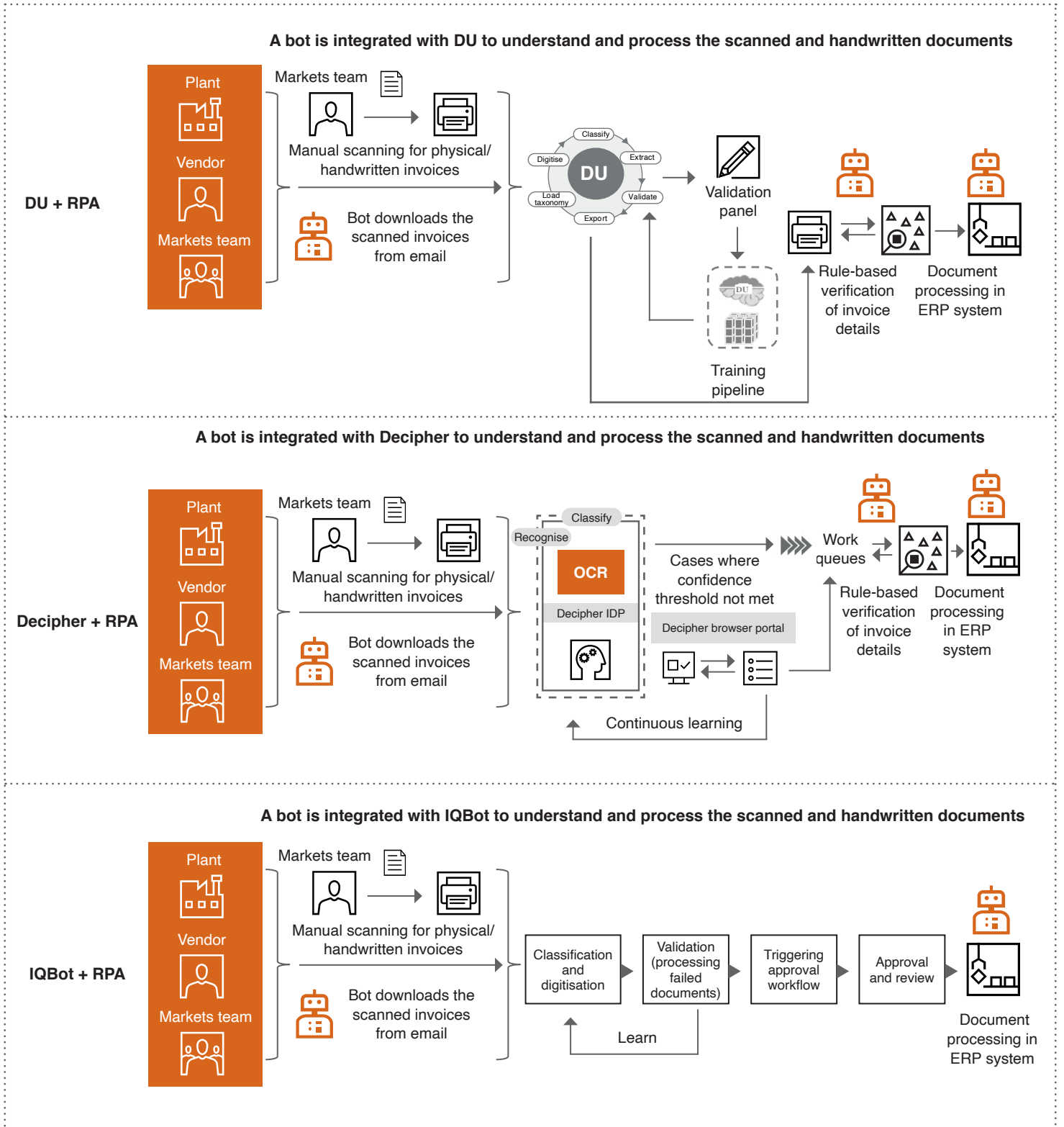


Working with unstructured data

An activity like invoice processing requires handling of invoices from multiple sources (vendors) in different formats. Invoice processing using traditional OCR has posed major challenges related to varying templates, handwritten documents, signatures, check boxes, stamps, low-quality scanned documents, and skewed pages.

The following use cases will allow us to take a closer look at this aspect and explore possible solutions:





Source: PwC analysis

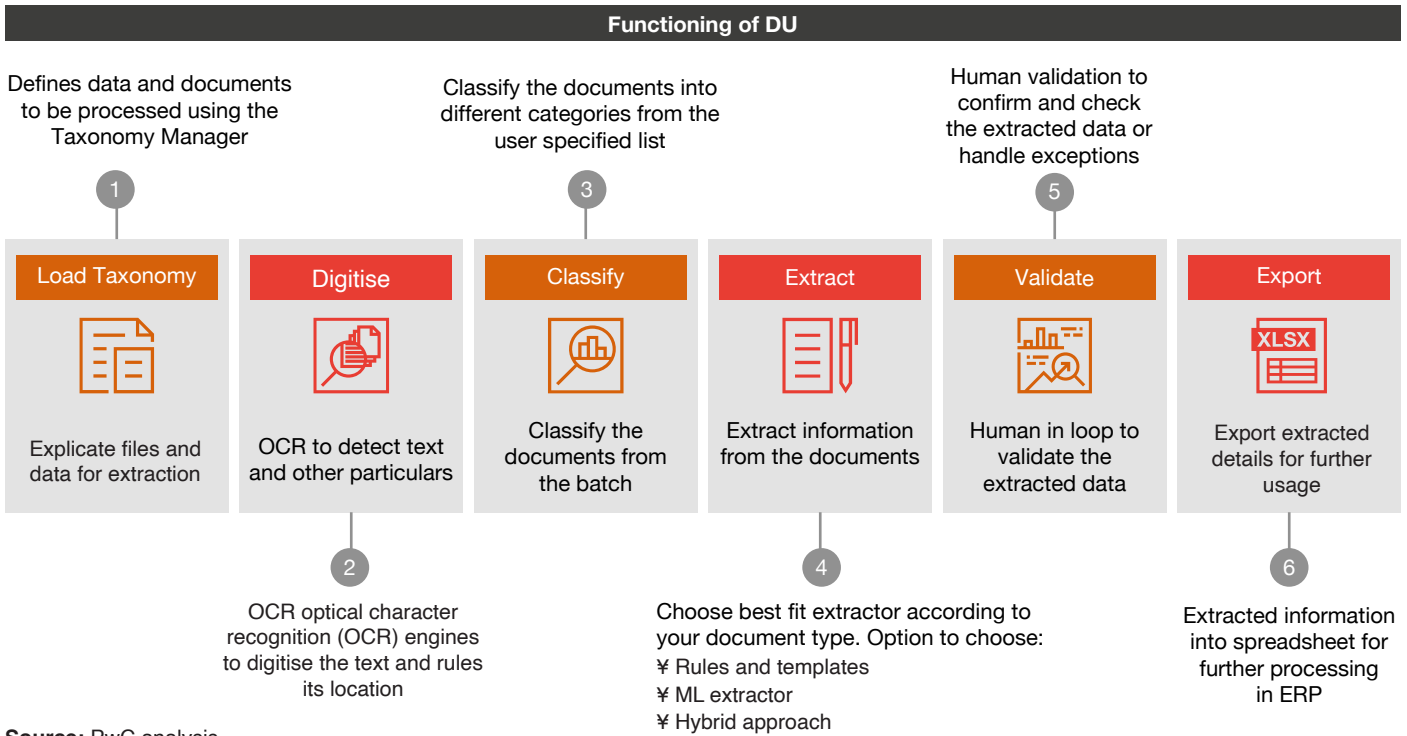
Normal manual process

Users receive physical/scanned documents like purchase order (PO)/non-PO invoices, supporting documents, receipts from different plants, vendors and market teams. Users identify these documents and then classify them into different categories. They verify each document's details, performing complex validation. Once validation is completed, they log in to the ERP system for invoice processing.

Traditional OCR + RPA

Physical invoices are scanned and stored in a shared folder by users. Scanned invoices and supporting documents received via email are downloaded by a bot in the same folder. The OCR then reads scanned invoices and extracts details such as invoice number, date, material code, amount, GST details and vendor name, and exports it to Excel. To increase the accuracy of OCR output, users can correct extracted values through the validation panel. The bot verifies these details extracted from invoices and performs various scripts, rules and validations before entering an invoice into the ERP system.





Source: PwC analysis

The configuration of DU starts with defining documents and data to be processed. Users scan physical copies of invoices and supporting documents, and store them in a shared folder. Invoices from emails are directly downloaded by a bot and DU utilises its OCR engine to digitise text in invoices. DU further classifies documents based on a user-specified list and extracts information using the DU model. In case of any exception, users are notified to validate details using the human validation panel. On validating details provided by users, an auto-learning skill is applied in the DU and the bot picks up extracted information to parallelly perform rules and scripts. As a final step, the bot processes the invoice in the ERP system.

While intelligent OCR and RPA can handle unstructured data to some extent, DU within AI Centre provides a convenient and less cumbersome method of extracting data from unstructured documents. A validation panel ensures that learning is continuous and prebuilt models can be easily tailored by business users to suit their requirements.

Blue Prism's Decipher + RPA

Decipher is an intelligent document processing platform that can classify, categorise, and extract key information from documents.

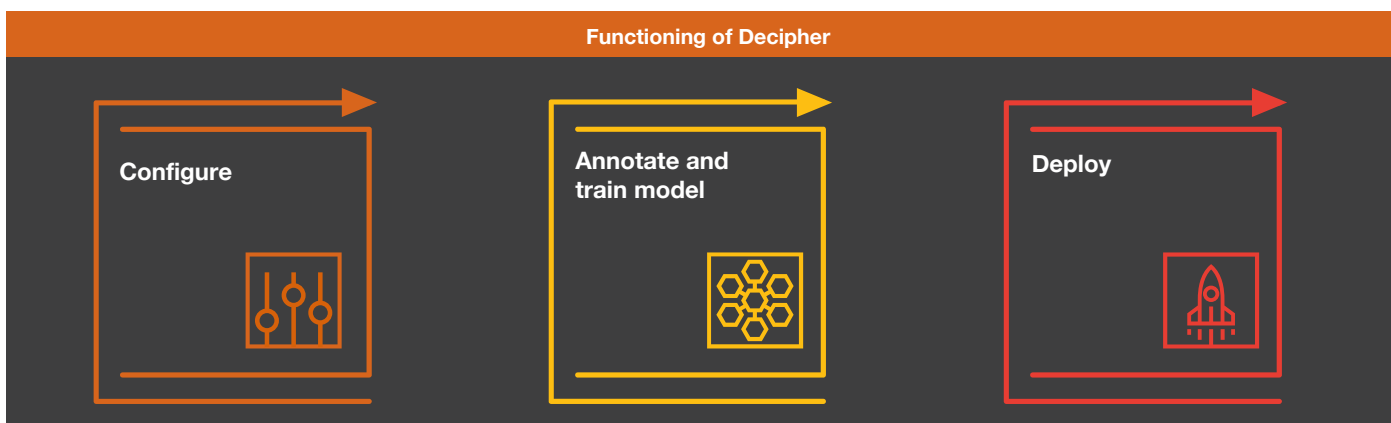
The configuration of Decipher starts with creating document form definition (DFD), batch type and document type. Once the tool is configured to receive the documents for OCR and the ML model is created, Decipher is ready to annotate. In the annotation phase, the level of manual verification will be high. Unlike traditional OCR tools, Decipher uses two methods of learning:

Rule-based learning system: It uses field labels, relative position and regions to extract data.

ML: It uses supervised learning. ML will start training the model based on annotations provided by the user.

ML offers a higher level of accuracy than the rule-based learning system.

Upon reaching an expected accuracy level of data extraction, Decipher will be ready to deploy and run live samples. Decipher IDP is part of the Blue Prism ecosystem, which enables organisations using this RPA tool easy to onboard additional document-processing capabilities in their portfolio with ease and limited upskilling.



Source: PwC analysis

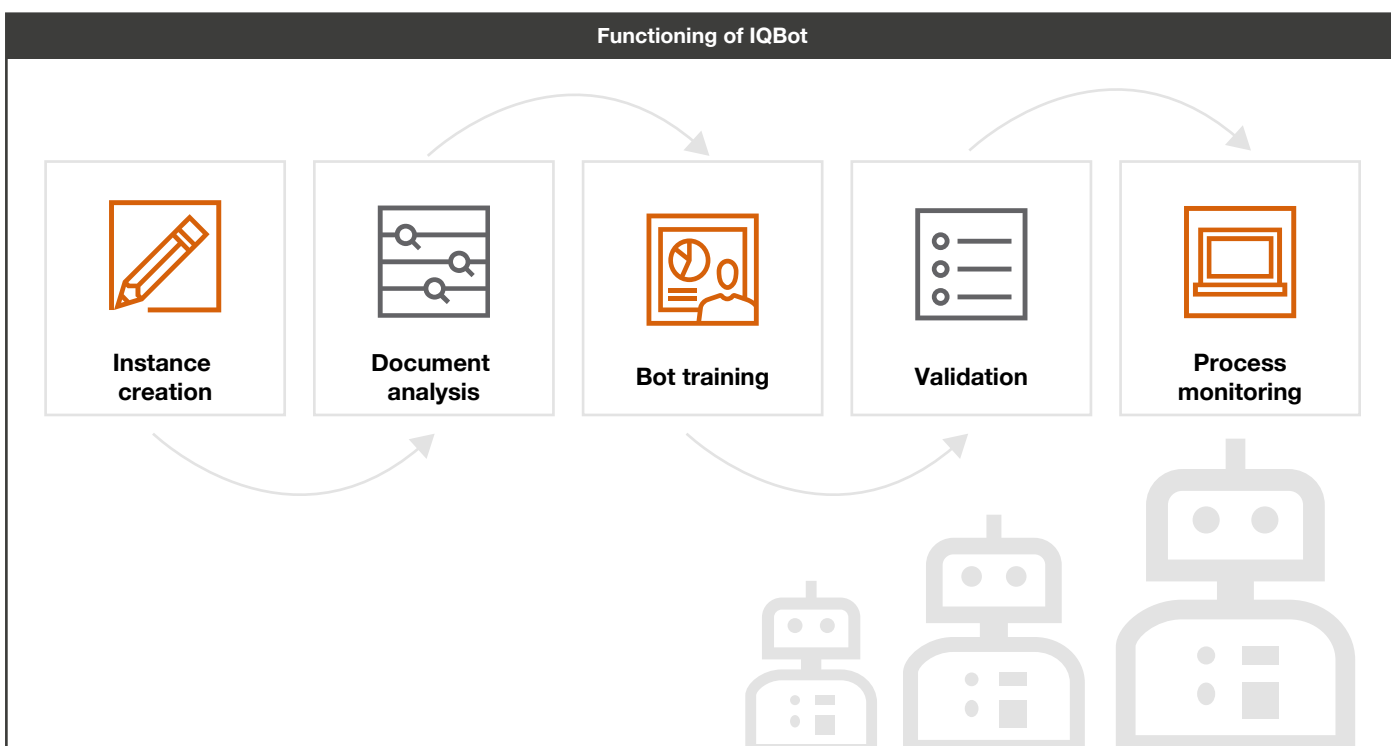
Invoice processing is a perfect example: Invoices are submitted to Decipher IDP through Blue Prism. OCR and ML recognise, classify and extract the required data from the invoices. Decipher IDP then flags invoices and data points that need to be verified in cases where the confidence threshold is not met. Once the data is validated, results are returned to a Blue Prism work queue where the data is further used for processing in the ERP system.

Automation Anywhere IQBot + RPA⁷

As opposed to traditional OCR, IQBot increases solution accuracy and enables greater training effectiveness by automatically creating a group of documents that requires further training and validation. The data extraction process, which otherwise requires a lot of manual intervention, can thus be automated end to end. After the user manually validates a document marked by IQBot for validation, IQBot automatically corrects the remaining documents

in the validation group, further simplifying the process. IQBot also has a panel for simple validation of the data extracted. It is capable of learning from humans through a feedback loop. Thus, the efficiency and processing time of the process can be improved.

The configuration of IQBot starts with learning instance creation. This is where the information that has to be extracted from the documents needs to be specified (e.g. document type, language and fields). The bot is then capable of document analysis, and it does so by grouping similar documents, similar fields, and identifying groups that require retraining. The bot is then further trained by the user via mapping of the required fields and setting up validation rules. The validation stage allows users to go through the validation errors and correct them, while IQBot simultaneously learns by observing human behaviour and is trained continuously. The IQBot dashboard helps in monitoring the progress of the learning instances in production.



Source: PwC analysis

7 <https://www.pwc.in/assets/pdfs/consulting/digital-services/iq-bot-a-practitioners-perspective.pdf>

Illustrative use cases of cognitive automation

Cognitive intelligence solutions

Auto classification

Classify unstructured text and numeric data based on patterns and fit into ML algorithms to identify the target class.

Email communication: Classify emails into different domain-specific categories, automatically segregate and action them.

Customer query/complaints: Identify the intent of user queries to align them to business functions and for automatic fulfilment.

Smart entity detection

Technique to extract and segment key values from free text and tag them to domain specific entities. This involves text-processing techniques to clean data, understand it based on grammar and parse sentence structure.

Customer onboarding: A variety of documents can be tagged to identify customer metadata and assist in KYC.

Trade finance: Leverage pre-built dictionaries and vocabularies for sanctions screening.

Model toolkit

Use pre-built models and plug-and-play solutions to find insights given a particular set of inputs from RPA.

Fraud investigation: Integrate with a pre-tuned fraud investigation model to validate transactions through documentation, database and applications.

Intra-day trading process: Connect RPA with algorithms to detect breaches and deviations, and identify patterns for risk managers.

Comprehension engine

Advanced text-processing methodologies to match, identify relations between documents and correlate phrases.

Auto-response: The RPA bot can automatically respond to user requests in an email or within a system by calling the comprehension engine and thereby infer meaning from any unstructured text.

Text similarity: Find syntactic and semantic similarity between sentences, documents or sections with a document.

Natural language generation

Provide insightful narratives to determine findings and create reports. Used to generate text in different languages.

Report creation: Reports can automatically be created in different formats by analysing underlying data and customising it as per business requirements

Translation: Language libraries are used to translate text from one language to another with a proper sentence structure and format.

Intelligent data extraction

Seamless training and instant field extraction from a wide variety of documents.

Invoice/receipt extraction: Pre-build models to extract all invoice data without creating templates. Train the models for further improvement.

Form extraction: Import templates and extract all the metadata from KYC forms or insurance and banking applications.

Cognitive intelligence opens up a wide range of possibilities and is definitely the next step of advancement in automation. However, challenges persist in the form of skill sets, right data and infrastructure. While evolution of products via enhancements is democratising cognitive intelligence and increasing the scope of automation, organisations should simultaneously work towards increasing their capabilities to harness the potential of RPA + cognitive intelligence. PwC is working on democratising RPA, OCR, NLP and cognitive intelligence to propel automation efforts of organisations to the next level. With the right implementation strategy and product ecosystem in place, RPA, in conjunction with cognitive intelligence, can be implemented relatively quickly for key processes, resulting in higher efficiencies, streamlined costs and more time for employees to focus on value-added work.

About PwC's Intelligent Automation (IA) practice

PwC's IA practice assists clients in their automation journey, right from developing strategy through execution. Helping organisations scale at speed is PwC's core value proposition, and taking the leap from RPA to cognitive technologies plays a major role in it. PwC's IA Centre of Excellence (CoE) comprises both domain and technology professionals, with extensive experience in generating significant outcomes using cutting-edge tools and technologies in the IA space. Our approach towards cognitive intelligence helps clients at every step of their automation journey.

How PwC can help you

Selecting the right use case

We leverage our expertise across industries to assist in identifying the right internal and external use cases.

Identifying the right technology

Our professionals assess leading solutions in the cognitive intelligence space to propose the optimal and best-suited platform for enterprise usage.

Setting up governance

Build an exhaustive governance structure considering the organisation's existing technology, risk and compliance frameworks.

Operationalising solutions from design to maintenance

Create best practices to build robust and scalable solutions. Leverage our IPs and utilities for rapid design to deployment. Build a continuous feedback mechanism to constantly improve accuracy.

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Contact us

Sumit Srivastav

Partner and Leader, Intelligent Automation

PwC India

sumit.srivastav@pwc.com

Mahesh Parab

Executive Director, Intelligent Automation

PwC India

mahesh.parab@pwc.com

Authors

Shrinath Gadiyar

Alisha Joshi

Anirudha Parsewar

Jasnain Singh

Madhushree Khapli



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