



G-Cloud 15

PwC Operate Digital Testing Services

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Transforming Business using the Cloud

Enabling business and enterprise transformation using cloud is a complex, strategic consideration facing many private and public sector organisations. We have worked with many Central and Local Government clients to support the implementation of their business objectives using cloud technology.

Cloud technology and services have the potential to reduce cost, remove technology bottlenecks, and facilitate rapid business innovation. As a result, for most organisations globally, adopting cloud technology has become a question of “when and how” rather than “if”.

Opportunities for enterprises generally include a combination of one or more of the following:

- Implementing private and/or hybrid clouds for infrastructure and applications
- Smarter use of public cloud infrastructure for optimising existing business functions
- Using cloud for implementing new business services or digital operations
- Reducing cost by moving to consumption based pricing models that only charge for the actual IT capacity and services used.

Migration or adoption of cloud must be properly choreographed for success. We understand the realities and the business and technical risks that should be fully considered, understood and mitigated before such a move. Critical considerations include:

- **Alignment of business and technology objectives.** This is essential to fully realise the targeted benefits of any cloud transformation or any refinement of existing cloud services. There can be a tendency to adopt cloud systems to fit current ways of working, rather than adopt and standardise processes where possible. The trade-offs between business, customer and technology requirements must be considered to make informed design decisions
- **Availability and reliability of services.** The avoidance of operational downtime to mitigate in lost revenue, unnecessary operational cost or reputational damage that can disrupt a business' operations
- **Decentralised support structures.** The need to tailor and revise the approach to operational security to cover the support structures employed by cloud service providers that will have a different risk profile for sensitive information

- **Data handling practices.** Data classification and data-handling practices that reflect the data flow within a cloud environment must be understood and tailored accordingly to protect customer data
- **Data privacy.** Compliance with GDPR to understand where and how information can be stored or processed. The cloud model enables data to bounce swiftly around the world by using available server capacity in various geographic locations, but this must be within the bounds of what is permissible. This is ever more of a concern as organisations review their front office, back office and out of office experiences
- **Future Technology Trends.** Cloud applications are the stated direction of travel for the major application vendors, but any upgrade path must also cater for the future technology needs of the organisation and seek to minimise technical debt where possible.

A careful assessment of an organisation's needs and different cloud service provider's controls is required, enabling concerns to be addressed and the correct path to the cloud is selected.

As a trusted advisor PwC provides the framework, and the wealth of private and public sector experience, to consider the combination of Business, customer experience and Technology activities outlined above. There is no single answer that covers each and every client organisation; we tailor our frameworks to client circumstances to better support clients:

- As a partner through the complete lifecycle of strategy through to execution
- With business issues encountered during implementation or running the business.

Operate Digital Testing Services

We offer a range of services tailored to your testing needs providing high quality delivery and innovative solutions across testing types. We can perform a range of activities across the testing landscape from an audit of your test function to providing post-production support. Our Testing services are underpinned by an extensive service catalogue and accredited frameworks that allow us to deliver fully managed test capability in a flexible and scalable way to help meet changing needs in complex environments.

Service

- Our catalogue allows you to select those services that are right for your business. We bring the tools and frameworks that are most suited to the complexity of your change
- We provide a range of expertise, covering test strategy and approach, planning and execution through AI and automation, for internal and external clients.

Credentials

- Testing professionals from diverse industry backgrounds, ranging from seasoned professionals with 20+ years' experience through to PwC recruited and developed associates.
- Testing SMEs with programme level experience in:
 - Technologies including SAP, Oracle Cloud, Salesforce, Guidewire, Workday and bespoke web/API delivery
 - Industries/Sectors including Government, NHS, Healthcare, Finance/Banking, Retail, Insurance, Travel/Aviation, Energy, Manufacturing and Construction, Digital Transformation
 - Deep expertise in emerging technologies including GenAI enabled rapid execution of testing through a range of tools and accelerators.

Capability

- We have a dedicated team of 2,100+ personnel with expertise in delivering outsource testing services across multiple industries and geographies including the UK, India, Egypt and South Africa
- All staff are either ISTQB/TMMi certified and deliver multiple skills covering our service catalogue.

Operate Digital Testing Service Features

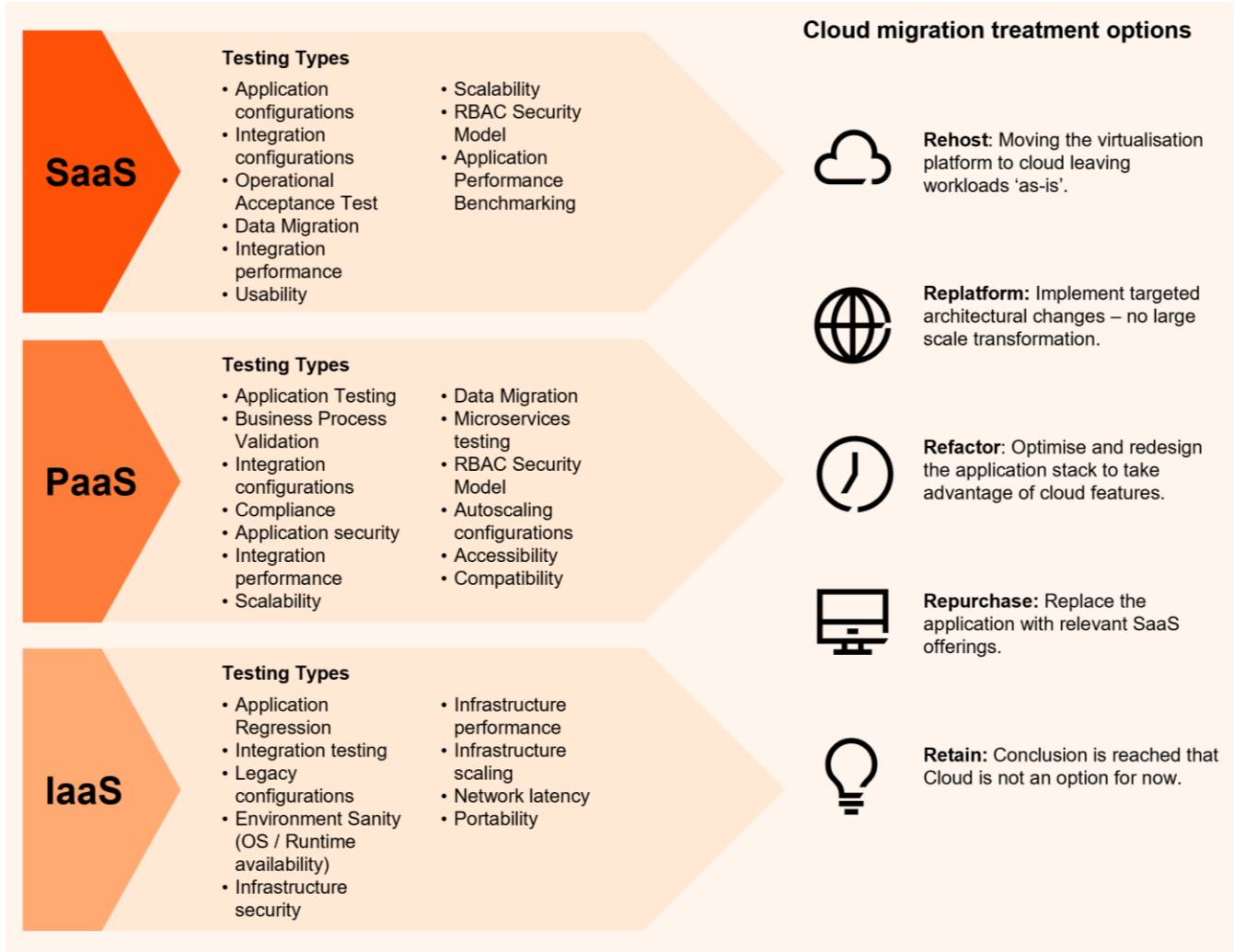
- Test Maturity Assessments
- Test role profiling
- QA transformation and support
- Test role profiling
- QA transformation and support
- QA delivery confidence review
- Test reporting and planning
- Test strategy
- Automation frameworks
- Functional and non-functional testing, cloud testing
- Test data management and support
- Cutover and Data Migration.

Operate Digital Testing Service Benefits

- Risk based testing approach, identify risk at the earliest stage
- Cost efficient, rapid mobilisation, ability to scale-up or down
- Quality driven approach using the latest tools and methodologies
- Cost efficient price point
- Lean testing processes to deliver testing at speed
- Automation capability to build reusable testing frameworks.

Cloud Testing Services

Based on the adopted Cloud Service Model, our Managed Testing Services would provide end-to-end support for following testing types for organisations to bring value as part of your Cloud Transformation journey.



How do we mitigate cloud risks?

Early engagement of testing during the requirement and design phase allows our teams to mitigate risks delivering value to our clients. With a blend of test maturity assessments, performance and quality engineering capability and deep expertise across a range of data platforms, we identify issues at the earliest point of the process ensuring resolution costs remain low throughout the testing lifecycle.

Risk profiles	Cloud risks	How Testing Can Help
 Higher costs	FOs often get higher cloud bills during or post transformation programme due to tech compatibility issues leading to multi-vendor involvements, high resource utilisation, failure to predict infrastructure needs etc.	• Early engagement for testing during design phase. • Performance testing, resilience testing and consideration of future re-platform risks.
 Security	Organisations often face setup & maintenance, patching, vulnerability management and configuration issues.	• Testing RBAC access model • Vulnerability testing • Penetration testing.
 Functional	Regression risks and integration issues are common during cloud migration treatments. Findings also suggest that firms often try to implement enhancements during the migration, needing new development or changes to the functionality.	• Functional, regression and integration testing of all the technical entities and applications.
 Performance & Compatibility	Inefficient autoscaling configurations to utilise cloud elasticity. Network bandwidth throughput concerns and Up/Downstream scalability issues.	• Performance Testing to identify autoscaling configurations threshold for the business growth. • Performance engineering to optimise scale to support and network throughput demands. • Cater services for other areas of Non-functional testing – Compatibility, Accessibility and Disaster recovery.
 Data Platforms	Loss of data integrity, duplication of data, inefficient storage usage, compatibility issues, referential integrity issues and data migration strategy failures.	• “Data entities testing” like data warehouses, data lakes, ETL/ELT platforms, big data, data marts, reports, BI solutions and data migration.
 Tech Enablers Regression	Tech enablers like CI/CD pipelines, automation frameworks, RPA bots etc. serving delivery models are usually not considered during cloud migration impact analysis leading to compatibility issues.	• “Testing of Tech enablers” to ensure the compatibility & integration with cloud platforms
 Skills & Readiness	Lack of cloud awareness & skills within Business as well as in tech teams often impacts the pace of transformation programmes.	• Performing a “Cloud Test maturity assessment” to identify potentially impacting factors.

Data Transformation: Migration Types & Entities

PwC provides 'Testing' services on cloud transformation programmes where companies are moving their 'Data assets' and 'IT resources' to cloud platforms across various technology stacks.

Transformation types

Full 'On premise' to 'Cloud' Migration

Testing of enterprise data entities going through 'Host lift and shift' (IaaS / PaaS) OR 'Tech Change' (SaaS) transformations.

'Hybrid' Migration to Cloud

Testing of data entities which are migrating in an hybrid manner in cloud as part of transformation.

'Cloud' to 'Cloud' Migration

Testing of transformation programmes where data entities are moving from one cloud service provider to another (ex: AWS to GCP).

'New application' built in Cloud

Testing new data entities directly built in cloud, part of which may be integrated with on premise applications in a hybrid manner.

Data entities

EDW Applications

ETL Servers / Applications

Operational Databases

OLAP Systems

BI / Reporting Systems

Data Marts

Data Lakes / Big Data

'Data Quality' Issues experienced by Organisations



Data integrity loss



Structural compatibility /
Referential integrity issues



Automation compatibility issues



Integration failures



Security RBAC issues



Migration strategy issues



Data duplication



Devops compatibility issues

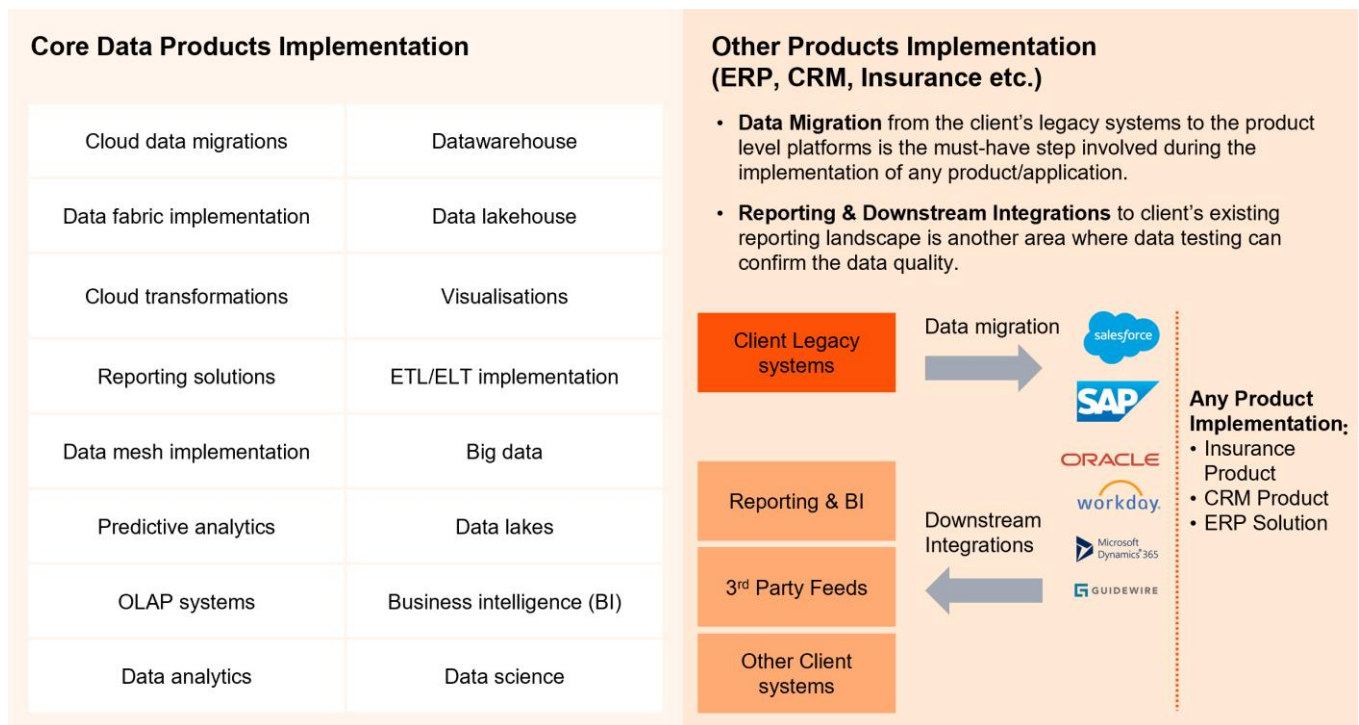


Maintenance issues
(post migration)

Data Transformation: Value Proposition

Our data testing service can also support any next generation large-scale data products implementations like data lake houses, data mesh, data fibre, business intelligence reporting and data science solutions. Our tailored strategy puts the primary focus on data platforms instead of treating it as a secondary part of the solution which is usually observed leading to long-term issues.

Data Products we can Support



Our data engineering and analytics testing services can bring the following benefits to a client's cloud transformation initiatives.

Achieve Faster Delivery

- Data focused Efficient Test Strategy
- Pre-defined automation frameworks
- Delivery of innovative tools and accelerators
- Continuous Improvement throughout the lifecycle of the transformation.

Higher Test Coverage

- Risk Based Testing (RBT)
- Automated test scripts
- Test Data Management (TDM)
- Automated high volume 'Test Data Generation.

Optimise Cloud Usage Costs

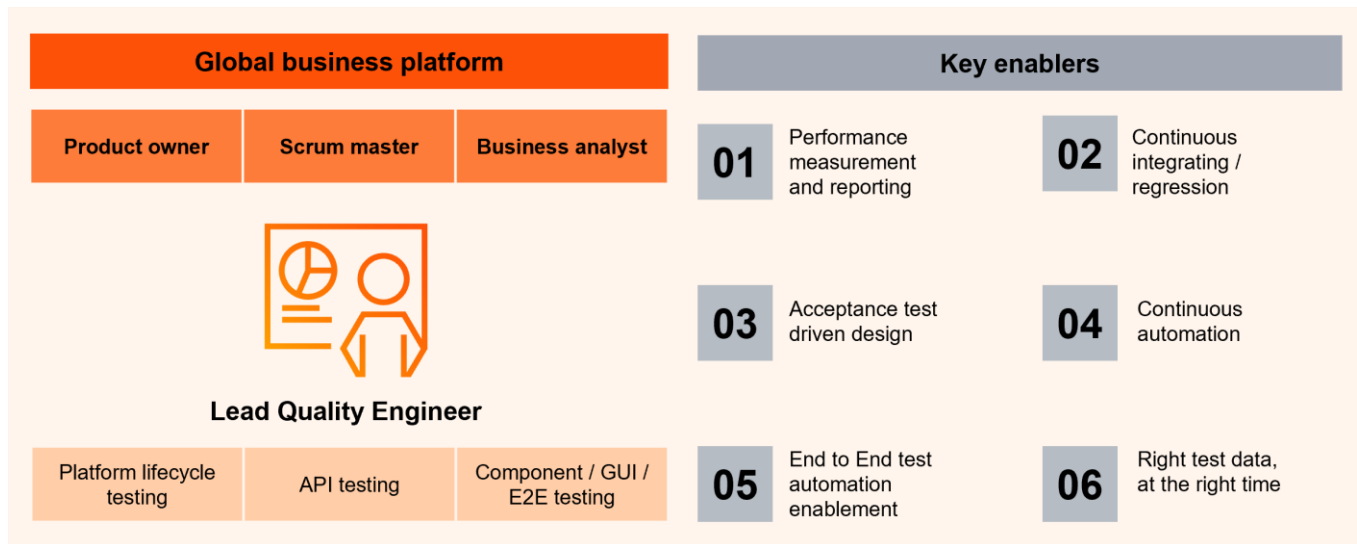
- Need-based data usage
- Optimised test execution strategy
- Controlled test phases & cycles
- Avoid duplication of data storage

Improve Data Quality through Testing

- Data integrity validations (Transformation Rules)
- Structural validations
- Regression checks
- Data performance engineering
- Verify load strategies
- Data migration strategy validation
- 'On premise' Integration checks
- ETL / ELT Stability
- Data Visualisation / Reports Validations.

“Managed Squad” – A proven Quality Engineering model

Our Quality Engineering teams or Managed Squads support all technology stacks and solutions. With this model, we can provide experienced resources, with the ability to alter the resource mix, or scale up/down team size.



Key Benefits

Outcome-based: The Quality ‘team in a box’ will create outcome-focused results, with the ability to flex team size based on backlog need

Contextual: It provides Quality Engineers with relevant / deep experience in the relevant industry, in addition to Selenium BDD, Cypress and API Automation

Ownership: The Lead Quality Engineer will work with each Global Platform team to define the product path, foster collaboration among teams, fine tune team performance to achieve committed velocity, and review/validate findings to innovate continuously

Flexibility / Controls: Flexibility to replace specific resources for a different skill set.

Performance Engineering

Cloud providers only operate elastic resources but are not responsible for application Performance, Efficiency and Scalability. Scaling resources does not simply mean scaling your application. We know that performance testing is crucial to benchmark and track key performance counter SLA’s based on the application system design, architecture across all cloud platforms.



Cloud Performance Testing Objectives

- Validate the overall performance of the target infrastructure for hosting applications.
- Evaluate the effects of applications running simultaneously on the same infrastructure.
- Identify bottlenecks of critical resources of the virtualised infrastructure, such as hot spots, unbalancing, hypervisor overload, resource overcommitment.

Performance Engineering

- Cloud has introduced new challenges along with benefits and opportunities across infrastructure, platform and services.
- Engineering services will be the key element to optimise the performance of the cloud services to handle significant challenges on horizontal/vertical scaling and containers issues.

IAAS/PAAS/SAAS

Business software performance is dependent on what kind of service model it is going to address (IaaS, PaaS, or SaaS). The response time, performance, and concurrency for provisioning, deprovisioning, resizing, and deleting virtual machines is dependent on what is in the virtual machine image.

Cloud Monitoring

Monitoring cloud metrics considered as the key role for the site reliability engineers to check whether metrics are under SLO & SLI's. It helps to visualise entire environment and anticipate risk before they become catastrophic. Resources monitored using latest APM tools – VM's, Servers health, Containers and storage

Tools to support

LoadRunner Cloud

SOASTA Cloud

DataDog

NewRelic

Cloud Watch

Azure Insights

Prometheus

Services offered



Cloud load testing



Auto scaling configurations



Cloud performance tuning



Serverless performance benchmark & optimisation



Docker/container performance testing



Optimising cloud resources usage

How we deliver value

Potential benefits



Cloud migration performance test strategy

65%

Ideal performance test strategy on migration from On Premises to Cloud based on the application architecture, components and platform will have a potential to **reduce 65% of the overall cloud billing rates.**



Optimise cloud resources for existing cloud platforms

30%

Numerous parameters causing performance bottlenecks and this issue will not be fixed by adding resources to scale. We deliver performance optimisation techniques based on the application need which has potential to **save 30% of OpEx cost.**



Observability and performance engineering

55%

Observability helps to monitor, troubleshoot and optimise dynamic/Hybrid cloud infrastructure for the performance bottlenecks. APM's and Engineering capabilities help to **mitigate up to 55% performance issues** in the early stages.



Backup & disaster recovery across private/multi cloud

15%

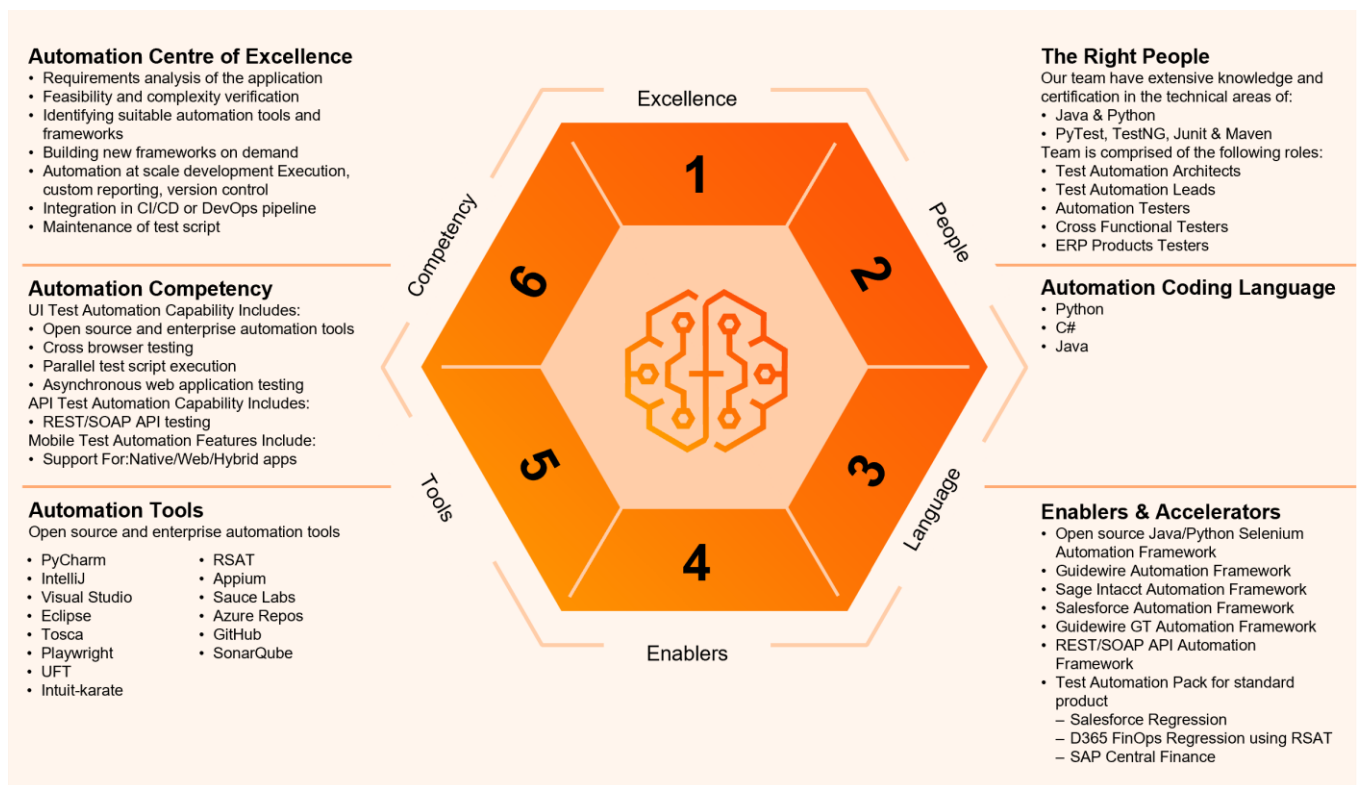
Gartner researched more than 65% of the enterprises having multi or private cloud infrastructure. Ideal DR test strategy will save around **15% of the billing rates across data backup and Business Continuity Plan for the multi & private cloud environments.**

Tools and accelerators

PwC invests in tooling and accelerators that we can make available to you as your trusted Agile Testing Partner, a key benefit to working with an experienced organisation with scale and experience.

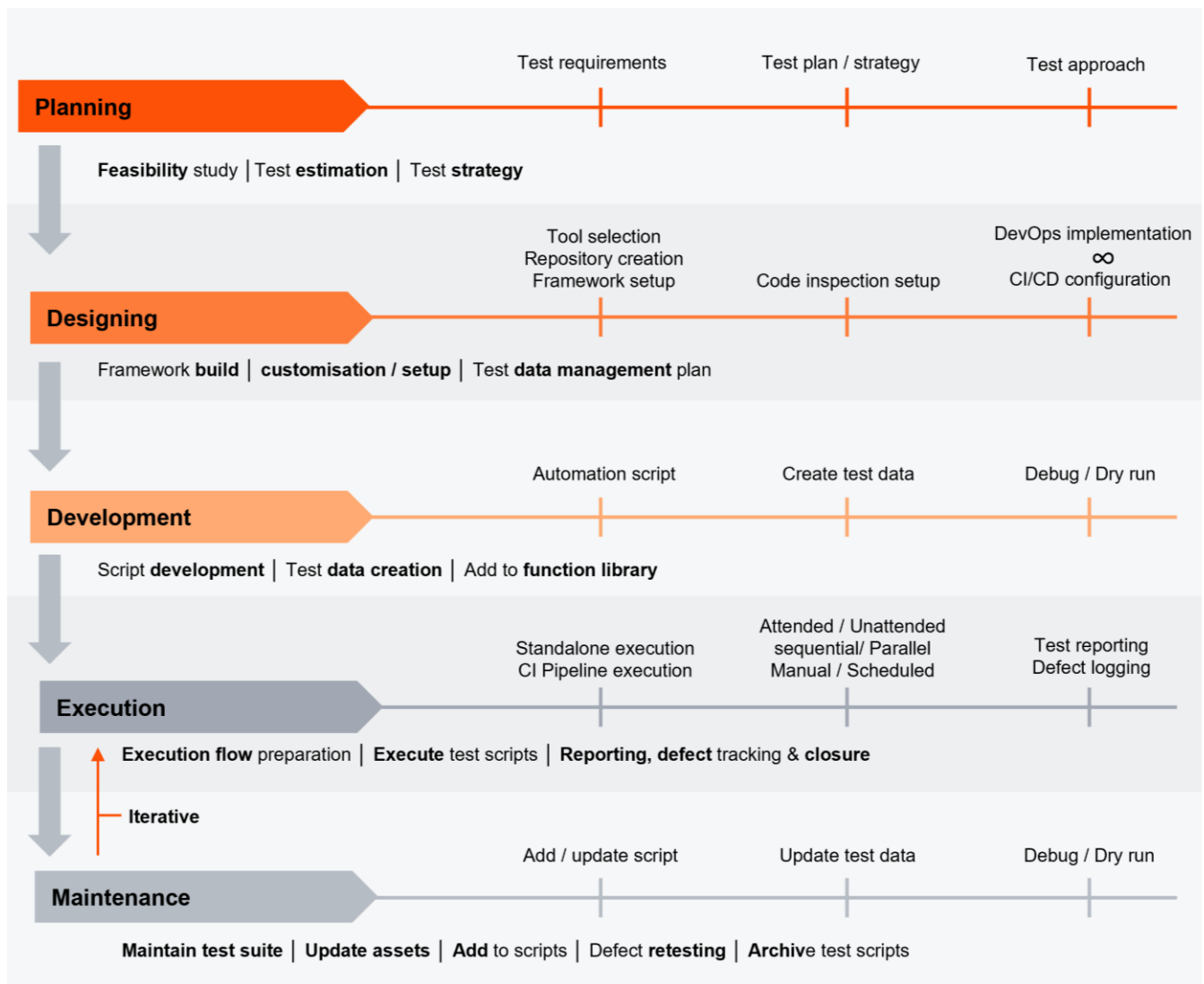
PwC Operate Test Automation Value Proposition

PwC helps clients to continuously remain aligned with user expectations and market standards by delivering applications which have been tested via our Test Automation Services team. We will help organisations move towards efficient, time saving, cost effective and detailed solutions.



PwC Operate Test Automation Delivery Approach

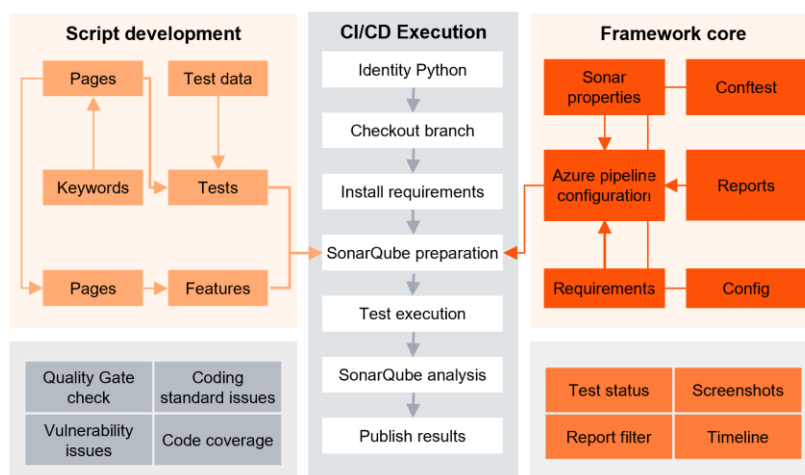
Our test automation approach and framework supports a variety of testing methodologies and DevOps strategies. It usually provides ROI (returns) during the entire software lifecycle depending on various use cases and client requirements. Our test automation framework is customisable according to the testing needs of the client and built with a focus on long-term utilisation that provides great benefits.

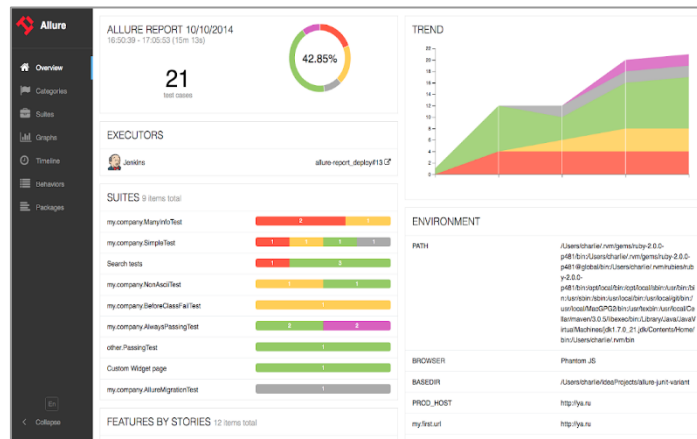


PwC Operate Test Automation Frameworks

PwC test automation framework is designed to support automated testing across multiple languages and tools, including Java, JavaScript, and Python. The framework seamlessly integrates with both Selenium and Playwright, providing a versatile solution for a range of automation needs.

Framework architecture





Key Features

- **Hybrid Framework:** Offers flexibility and ease of setup, enabling quick development of automation suites in keyword or data driven format as well as BDD format. This hybrid approach provides a streamlined workflow for creating and maintaining test scripts
- **Versatile Applications:** The framework is suitable for UI, API, and mobile test automation, demonstrating its versatility and scalability. It has been used to deliver various projects, including both small and large-scale implementations
- **DevOps Ready:** The framework integrates with Azure DevOps for seamless CI/CD pipelines. This integration allows for automated test case updates, automatic test evidence attachments, and continuous feedback loops
- **Rich Reporting Capabilities:** Upon test execution, the framework generates detailed test reports in Allure format. These reports include key performance indicators (KPIs), step-by-step test execution details, and screenshot evidence to support test outcomes

UI Testing

The framework can accelerate script development of UI tests with the use of built-in reusable function libraries and supports parallel execution of tests to further reduce execution time. It supports cross browser testing and manages test data using csv data files present inside.

Integration with Azure DevOps

- The framework is designed to work harmoniously with Azure DevOps Test Management Tool, offering automatic updates of test cases under Test Plan during test execution.
- Test evidence, including screenshots and other relevant information, is automatically attached to the respective test cases.

- Integration with CI/CD pipelines adds test automation to the wider organisation level continuous delivery process if available, contributing to more efficient software delivery and reduced time to market.

API testing and Service Virtualisation

- The framework is also capable of testing both Rest and SOAP APIs
- The framework allows to chain multiple APIs to achieve end-to-end validation
- An additional capability has been developed to support Mocking of external APIs allowing users to simulate real-world behaviour of external APIs
- It also supports a vast array of authentication mechanisms for testing APIs
- From a reporting perspective, API logs & responses are captured and added to the reports.

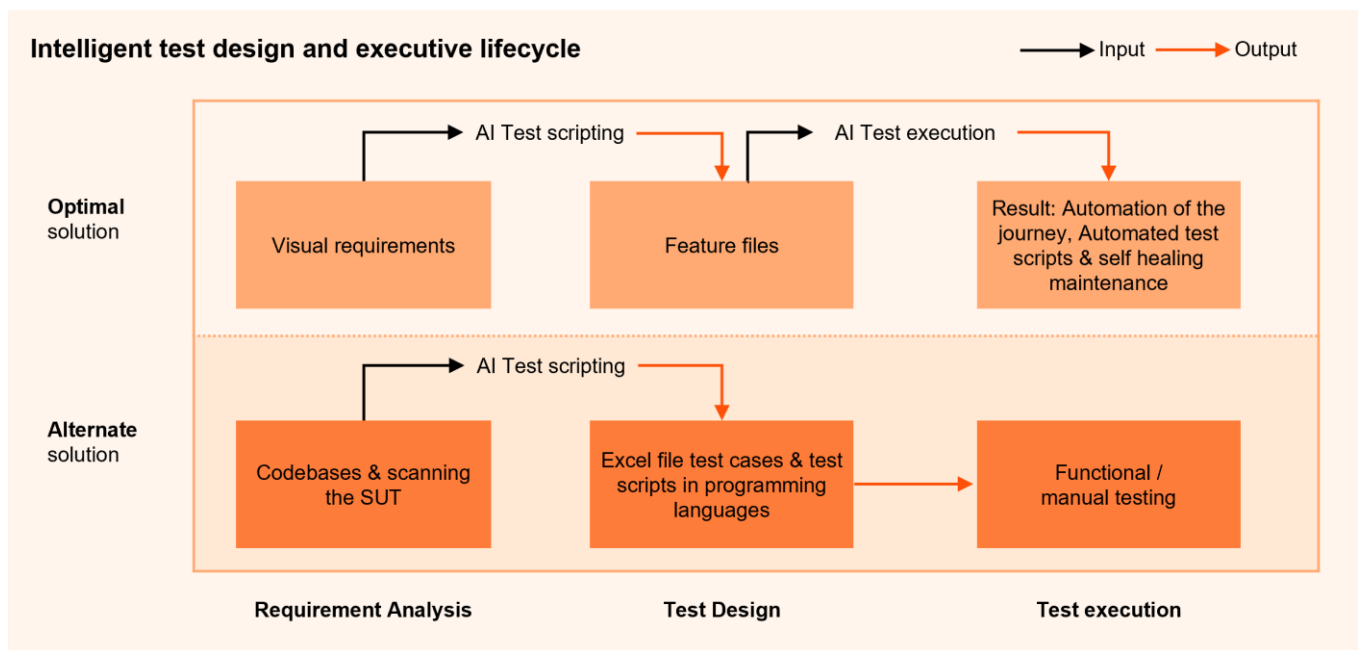
Mobile and Cloud Testing Capabilities

- The framework supports testing of Real Mobile devices and Emulators for Native, Hybrid and Web Mobile applications
- It has a large built-in library to support major gestures for Mobile application testing
- The framework has also been integrated with Cloud Platforms such as Sauce Labs etc, any other cloud platforms can easily be integrated in a plug & play approach.

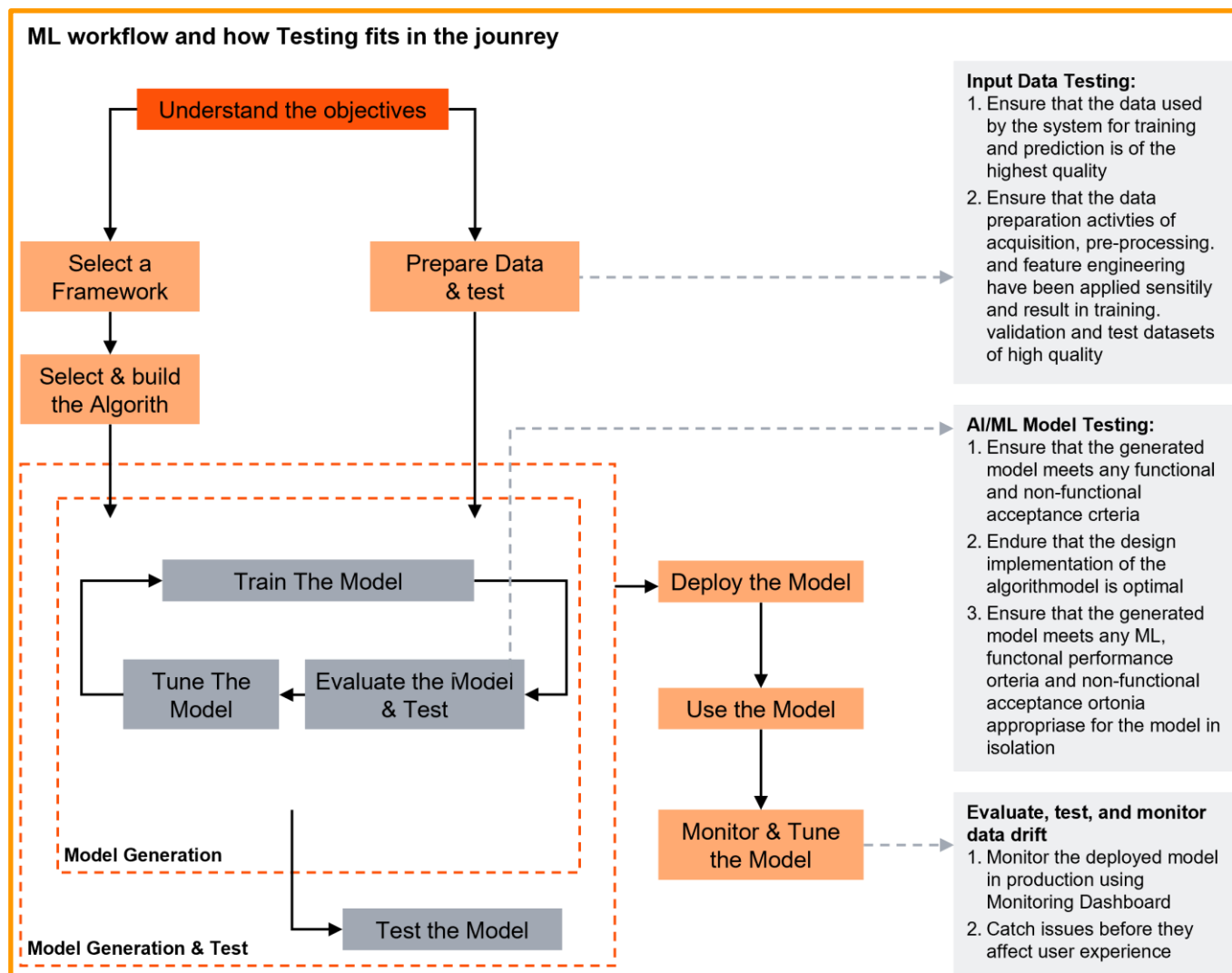
AI based intelligent testing

1. **Test Design Automation:** We have an in-built Gen-AI platform to Automate the test scenario, test cases and test data generation from Requirement documents, user stories, process flow documents, Mock UI Layouts etc. This platform also enables requirement analysis and test case review based on the review checklist. This enables the test design process faster and enables right coverage for any requirement changes
2. **AI enabled No-Code/Low Code Automation (licensed):** We have an Automation script capability using various No Code/Low Code automation tools (licensed)
3. **AI enabled No-Code/Low Code Automation framework:** We have a python-based Automation framework powered by large language models (LLM). This framework helps to generate various Automation scripts faster and cut down maintenance effort through Smart healing

4. **AI (natural language processing) enabled smart automation:** AI-enabled automation tools use large language models (LLM) to generate automation scripts much faster and with ease. It also enables a cut down script maintenance effort and may increase the automated script execution speed
5. **AI supported synthetic data generation:** We have an AI (Deep Learning)-enabled Open source (python based) Synthetic data generation utility which creates relational test data which can be extended to various use cases such as increased Test Coverage, high volume data generation for performance, lower dependency on data masking and live data copy, GDPR compliant test data.



6. **Testing AI/ML solution:** Our testing offerings help determine whether the AI/ML applications produce reliable and accurate results. Our AI/ML testing supports to improve the model's transparency and interpretability, boost trustworthiness and ease of use. This in turn establishes the public's safety and reduces data privacy risk



7. **Testing Gen-AI Applications:** We support testing of LLM ((Large Language Model)) powered Applications (Chatbot/RAG etc) identifying and mitigating quality, legal and security risks. We make the LLM application testing cycle efficient, with AI enabled automation.

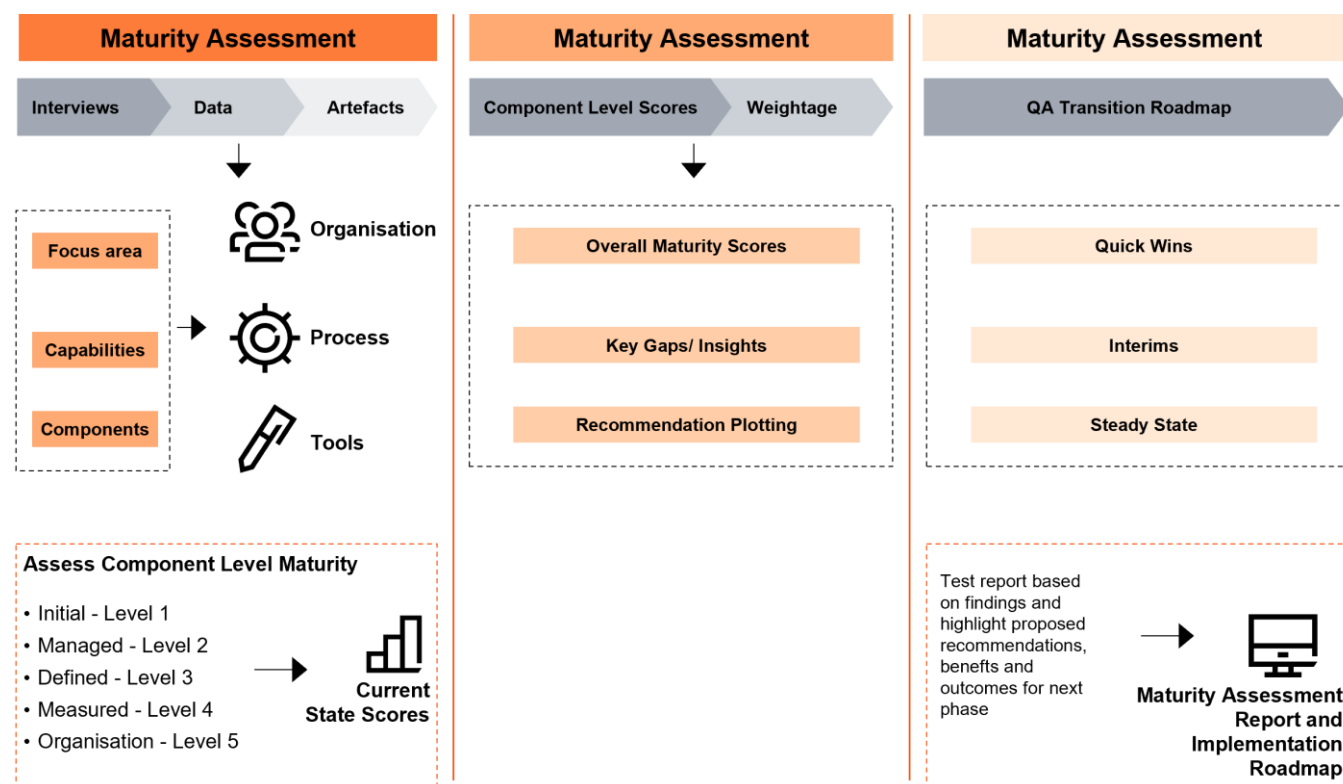
Test Maturity Assessment and Test Transformation

PwC's Test Maturity Assessment service offer is designed to assist clients in their journey towards Quality Assurance (QA) transformation. By utilising PwC's maturity assessment framework, clients can gain valuable insights into the current state of their QA function across three key areas:

- Organisation and Operating Model
- Process and Methodology
- Tools and Infrastructure.

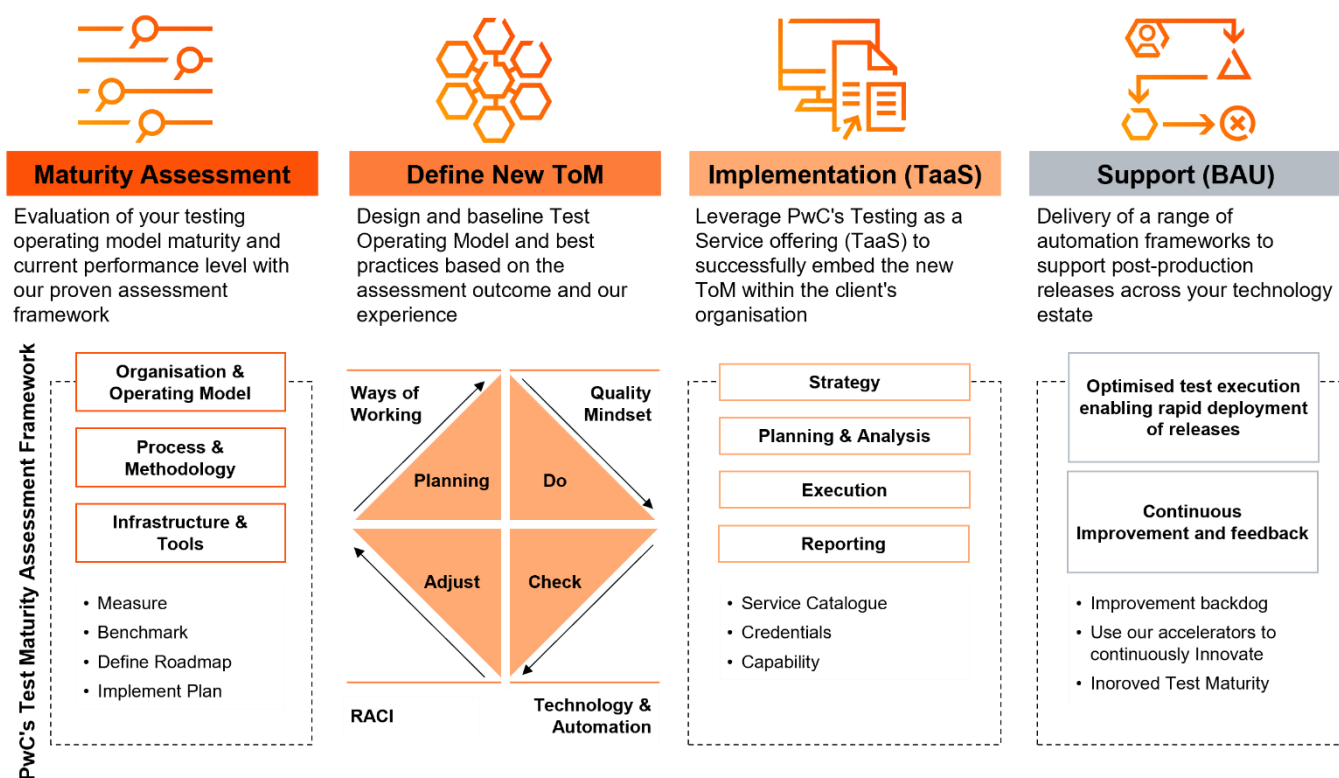
Our maturity assessment framework is designed to support clients in their transformation journey where they can gain a comprehensive understanding of their QA function's strengths and weaknesses. This helps them to make informed decisions and develop a roadmap for QA transformation, ultimately enhancing their overall testing capabilities and driving improved business outcomes.

Transforming test function through our Test Maturity Assessment framework



The framework is built upon the principles of Test Maturity Model Integration (TMMi), a globally recognised standard for assessing test maturity. However, our framework goes beyond by incorporating weightage-based scoring, additional insights and expertise from our testing TMMi certified specialists. It includes industry-specific best practices and emerging trends, helping organisations stay relevant and up-to-date. It can also be tailored to fit the specific needs of each client, considering their unique challenges and objectives.

Our approach is designed based on four distinct phases which serve as the basis of assessing current capability levels. We can transform a client's testing operating model into a fast paced, agile and innovative test function providing the ability to deliver 'quality at speed'. When working with you we will adopt a one team approach, engaging regularly to seek feedback prior to roll out providing a seamless handover back to the client after successful implementation.



Phases of the Maturity Assessment

Phase 1 – Assessment: We will initially perform a test maturity assessment to review the current client's Testing Operating Model and deliver a report outlining recommendations. We will build a business case for approval to implement our recommendations to optimise test delivery

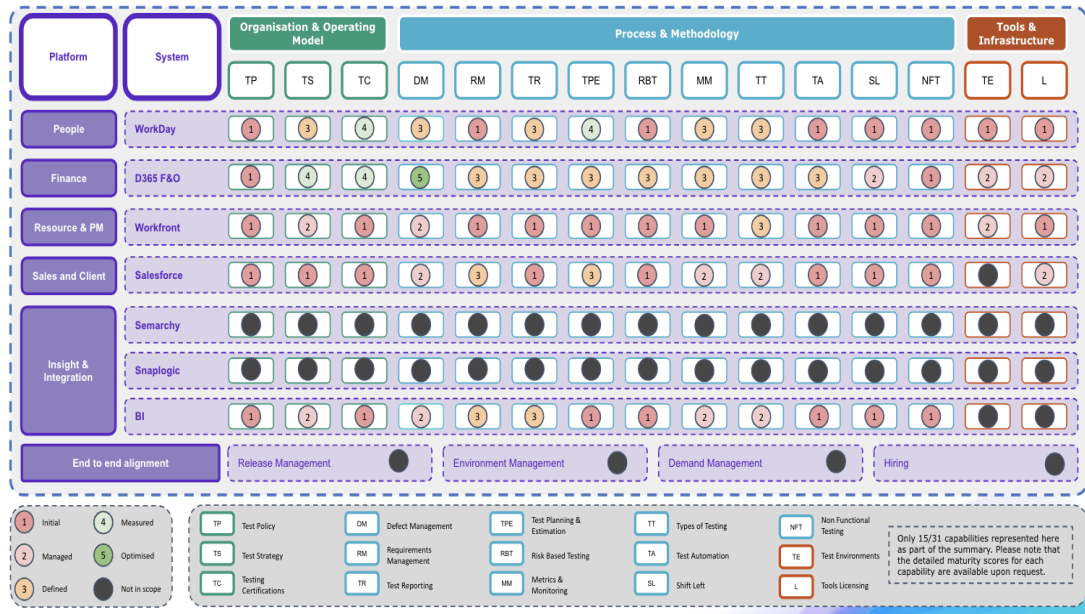
Phase 2 – Design Test Operating Model: Definition, design, creation and communication of the to-be Test Operating Model to address the recommendations identified in Phase 1

Phase 3 – Implementation: Provide support to embed the new Test Operating Model created in Phase 2 and drive its adoption. Handover of the Testing Operating Model to client's stakeholders

Phase 4 – BAU: We help deliver a range of automation frameworks and industry best practices for BAU releases to support post-production releases across client's technology estate.

Intuitive Reporting

The framework benefits from an intuitive report that highlights the identified gaps and provides recommendations in a clear and concise manner. The report presents the recommendations in a quick hits, interim, and steady state view, allowing clients to easily understand and prioritise which recommendations to implement first. This feature provides clients with a roadmap for action, enabling them to make informed decisions and efficiently drive their QA transformation efforts.





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