



# *DevOps for Mainframes*

# The Sandhata Approach

## Culture

We coach delivery teams to adjust their behaviours and thinking to be lean and agile by demonstrating changes and their impact during a pilot. We encourage cross-skilled integrated teams (feature teams) with shared goals.

## Process

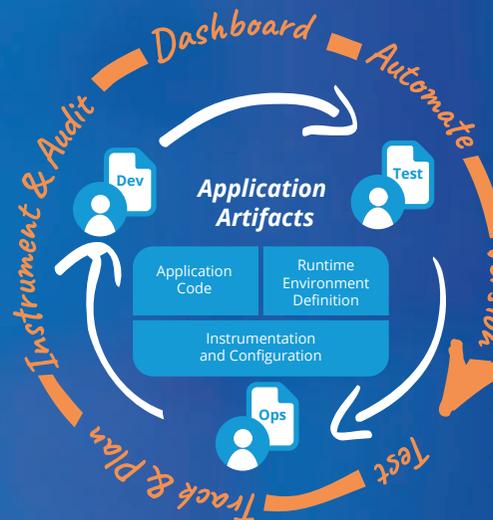
The convoluted process in the mainframe delivery world significantly diminishes the value of any technology modernisation, as such we package the technical framework with the required process changes which makes the solution more effective.

## Technology

The tool chain we recommend is aimed at achieving an optimum level of automation. We integrate key activities involved in the delivery cycle, removing unnecessary dependencies and manual handoffs. The objective is to use the CI/CD framework to reduce limitations imposed by mainframe specialist availability, improve agility, shift left QA while drive most of the activities from distributed platforms.

## Governance

Typically mainframe governance is heavy with many controls in place, which restricts developers and testers. In general, the operations and environments teams have control limits which impacts the scope of end-to-end automation in higher environments. We actively pursue changes to the governance model to bring more autonomy to the delivery teams.



## Key Sandhata Services in the CI/CD Space

### Continuous Delivery

- Build & deployment automation
- Release orchestration modelling
- Automated infrastructure provisioning
- Cloud and containers

### Continuous Testing

- Model based test case design
- Test data management
- Automated testing & SV
- Performance engineering

### Mainframe Services

- Mainframe CI/CD
- Mainframe continuous testing
- Batch system test automation
- Mainframe virtualisation

### Metrics

- Monitoring
- KPI dashboards

# Introduction

*For many organisations mainframe still drives essential back end processes with a plethora of other technology driving what might be termed 'front of organisation' processes and procedures.*

Mainframe is at the heart of many organisations and is essential for ensuring an effective front-end service layer. However, the entire service layer and the batch systems needs to be managed in a more agile way.

Although software on the mainframe has some level of automated promotions and releases, most of the tools work in an autonomous way and are not integrated with each other. This leaves many areas requiring manual processes with the potential of lengthy release process and lengthy and expensive quality assurance processes.

Currently teams are working in a serial conventional way to release software, for example testing focussing on defects rather than quality and process enhancement. The situation is further complicated by a Governance layer that has the effect of making the whole process more cumbersome, slower and inefficient.

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***Mainframes are critical to the enterprise. It is estimated that 70% of the fortune 500 companies use mainframes.** This figure is even higher in Financial Services and Payments. Mainframe systems and software make up the backbone of many of the processes in our digital life and is on a constant increase since mobile has become the dominant go-to channel of many day to day activities.*

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While other platforms, such as mobile cloud and distributed, embraced DevOps to innovate and bring changes to market more quickly, DevOps is still relatively new in the mainframe ecosystem. Traditionally mainframes have limited release cycles, limited automation capabilities, and limits on build and deployment. Organisation are used to a few releases per year and to extract low value from their release cycle. Put simply, enterprises chose mainframe due to its high availability, scalability and security rather than a quick route to market. Bringing agile practices into mainframe can address this and unlock tremendous value to enterprises. The first stage may involve setting targets for monthly releases to gradually introduce DevOps principles to a Mainframe environment.

## Key Business Drivers

- Enabling mainframe to be more responsive to business needs
- Reducing the time to market by removing the bottlenecks in mainframe change delivery
- Reduce cost of changes via process efficiency, automation and driving quality by design

## Key IT Drivers

- Introduce more automation
- Reduce operational costs
- Remove waste from the value stream
- Adopt the process and controls to make releases safer and more efficient

# Key Industry Observations

*Sandhata is well placed to comment on the latest state of mainframe modernisation having recently completed an international survey of the issues involved, as well helping clients with their modernisation projects.*

## Culture / Methodology

- Less lean and mindset is to address demand by more resources
- Division of duties with less emphasis on shared goals
- Isolated Testing and QA functions, mostly outsourced
- Tendency to keep the mainframe SDLC isolated from other applications in the business flow
- Behaviours that project the niche nature of the technology and associated skills
- Expectation and approach is to accept that changes to mainframe will take more time and effort when compared to distributed platforms
- Risk averse culture, encouraging complex and heavy governance to software releases

## Process

- Less Agile and mostly Waterfall
- The process for different functions such as requirement definition & analysis, development, testing, environments management and operations are defined and managed with no integration
- The delivery processes are tightly governed with multiple levels of approvals and significant lead times
- The controls put in place to govern the SDLC are aligned to waterfall and doesn't encourage agile practice
- Most processes are manual with less automation not even covering repetitive tasks such as setting up environments, checking data sets etc.

## Technology

- Typically mainframe tool-chain involves the areas covering requirements management, impact analysis, code generation, build, unit testing, code analysis, promotion, functional and non-functional testing and data management. The main gaps in most organisations are lack of integration and lack of automation
- One of the key challenges we see in the market is unavailability of off the shelf solutions in the CI/CD space. Hence it is slower to implement the key capabilities
- Mainframe change activities are driven from the green screen, mostly manual and there are restrictions / resistance for automation and process streamlining

## SDLC processes and separation of duties

It's no surprise that the mainframe mindset is not agile. Mainframe was built for high availability and traditionally the SDLC process was designed for that. This means long processes, rigid control management (that in most cases is manual) and strong segregation of duties.

Given that mainframe is the heart of the organisation a common approach is to provide more resources to deal with higher demand, rather than to integrate different parts of the SDLC.

Software delivery can involve manual processes that can take a considerable amount of time.

A tough compliance and regulatory environment can also add to the complexity. This is especially the case for the heavily regulated sectors such as, banking, insurance and healthcare. This can result in a division of duties and a separation of key processes to help reduce error and fraud risk.

When applications cut through multiple architectural layers, spanning mobile devices, web apps, Windows, Linux/Unix, and z/OS, having multiple SDLC process may look like a good practice. But the reality is that in many cases it significantly increases the likelihood of version and control conflicts, for example incompatible components being packaged together, or rollback package issues etc.

Many organisations choose to keep the SDLC process on the mainframe completely separate from other SDLC processes in the organisation. Often there is no technical reason for this.

*In practice all types of 'source' in a generic sense should be managed together. This should include:*

- Source Code & Application Configuration Files
- System-related configuration settings (e.g., batch job scheduler settings, preconfigured CICS CSD files, etc.)
- Database Artefacts (e.g., DDL, stored procedures, DML for metadata etc.)
- Automated Checks/Tests at all levels of abstraction
- Documentation (for all audiences)
- Scripts for configuring/provisioning servers
- JCL and scripts (VSAM, CICS, Administration, Operations etc.)

## Top Challenges Bringing DevOps to Mainframe

- Testing and QA is too slow and ineffective with lack of automation, more emphasis on catching issues when compared to preventing quality issues
- SDLC process are unnecessarily serialised and mostly manual and with wastage between handoffs, (little or no 'shift left' practice)
- Culture in mainframe teams is aligned to waterfall with lack of joint ownership, shared goals and generally not integrated with rest of the organisation
- Nature of the technology and current governance model makes it difficult to introduce changes, improvements and lean/agile processes
- Mainframe environments and data are often the bottleneck for business agility. Lack of automation and convoluted processes are the key reasons
- Hybrid Specialists with both mainframe and DevOps skills are scarce and often become a bottleneck to deliver the improvements and transformation objectives

# How Can Sandhata Help Mainframe Become More Agile?



## Strategy

Our strategy team/consultants work in an advisory capacity, proactively bringing industry insights to ensure that the supplier eco-system, delivery model, strategies and approaches are in line with the target operating model.

## Release & Deploy

- Release Modelling
- Deployment Orchestration

## Environment

- Automated Environment
- Upgrades
- Mainframe Virtualisation

## Delivery

Our mainframe DevOps experts deliver solutions in CI, release pipeline automation, test process automation and performance engineering for mainframe. Our consultants add value from day one with their strong Agile and DevOps skills.

## Development

- Automated Impact Analysis
- Enhanced Code Generation (IDEs)
- Automated Unit testing, Code Analysis

## Testing

- Test Automation – Func. & Non-Func.
- Continuous testing pipeline
- Robotic Process Automation
- Automated Test Data Management

# Mainframe Accelerated Development and Continuous Integration

With many millions of lines of vital code written in languages such as COBOL, Assembler, and PL/1, database schema etc., releases to the mainframe appear only quarterly while developers deploy on a monthly, weekly or even daily basis. It's not unusual for developers to keep code 'checked out' for long periods of time until they are ready to hand over work to testers and QA teams.

The gap needs to be closed. In contemporary agile software development, teams tend to work using short feedback cycles. Yet on the mainframe, some development tools encourage delays in the developers' cycle. Identifying dependencies can be time consuming, test data preparation can be laborious and application building can be longer than in digital environments.

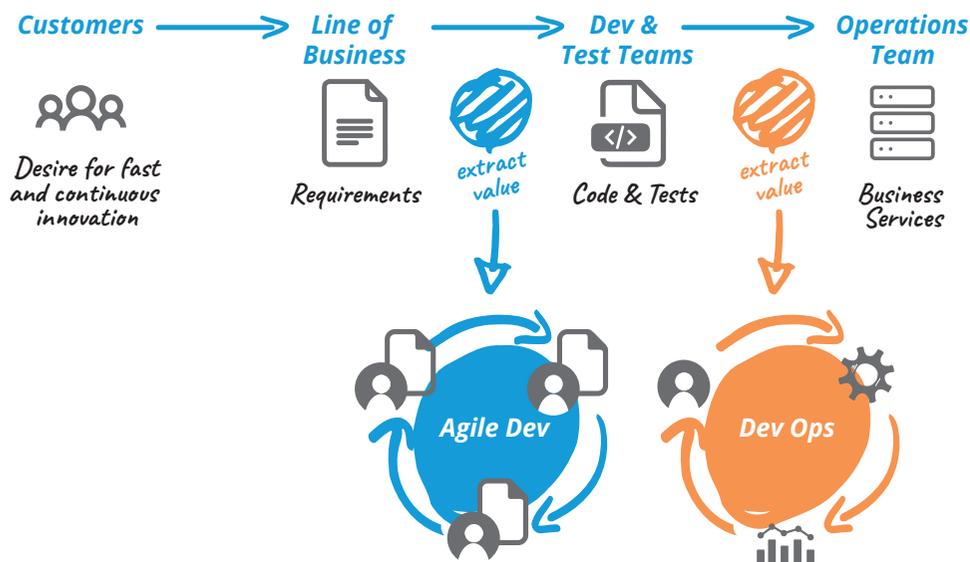
DevOps typically involves test automation and frequent small-scale testing. This naturally requires tooling that enables smaller scale testing, and in some instances executable test cases to be written prior to production code. This is at odds culturally with mainframe where unit test cases are still done manually.

Adopting CI/CD practices can assuredly accelerate change whilst minimising risk, error, and cost. CI can break down silos that separate and multiply development efforts, streamlining the development process. Development and testing tools, automation, metrics, reporting, and documentation to support CI are within reach today.

Using integrated development environment (IDE) tools for DevOps can accelerate the automation of CI and CD and to achieve true

automation on the mainframe IDE tools alongside tools such as SonarQube , Topaz Total Test, SonarLint, Strobe, Jenkins etc. are designed to deliver high-quality code, early defect detection, enforcing automated code review rules, automated unit testing, code coverage testing, continuous integration, and automated deployment.

Some of the main inefficiencies in mainframe development are in performing impact analysis, unit testing, the promotion process, data management and version control of batch processes, mainly due to inadequate automation and inadequate agile practice. The batch systems and IBM DB2 changes are harder to version control and to integrate continuously.





## *How we add value*

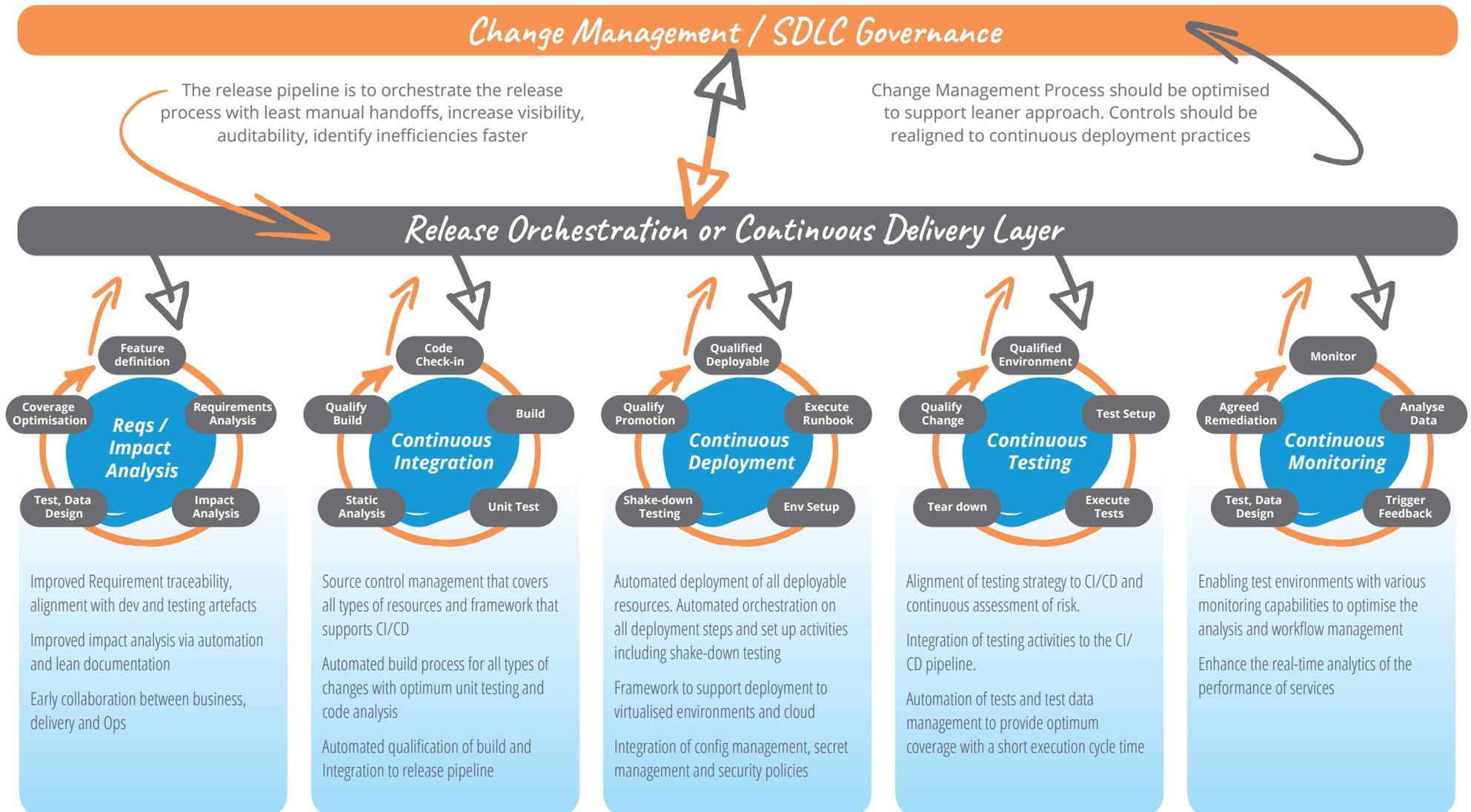
We bring our project-based experience and knowledge from our partner community to our clients, proactively addressing the challenges and assure smoother transition.

We are experts in enabling clients with new technology and solutions in the mainframe space. Our mainframe specialists are trained to champion Agile and DevOps practices helping your teams to adopt to new process and tooling quickly.

## *A Typical Solution Summary*

- A value stream analysis to stream line the process, to remove wastage and to identify the automatable steps is critical
- Introducing mainframe IDE to drive development and management dev and data resources from distributed technology improves productivity
- Introducing Impact analysis solution with improved automation and documentation save significant time
- Automated unit testing and code analysers with custom coding standards helps to shift left testing and improve visibility of code quality
- The batch systems and IBM DB2 changes (Schemas) imposes unique challenges and development solution covering analysis, unit testing and data management improves efficiency

## Continuous Integration, Continuous Delivery Target State



# Mainframe Continuous Testing

**Automation is key to reducing development lifecycles and ensuring a better-quality outcome. Although there are multiple z/OS test environments shared across application development teams, in most enterprises there has been very little automated testing of applications and development projects and the majority of the release process stages are performed manually. In order to shorten the length of the process, many organisations are increasing the amount of resource at each stage, which makes the process more expensive and less nimble.**

A good testing strategy with automation enables shift-left testing, helping developers to better filter out and fix the bugs during the development process. Testers can then achieve optimum coverage faster and earlier in the lifecycle

If testing is slow, resource intense and inefficient, it can take weeks to test even small changes making it near impossible to release changes in less than 4 weeks.

Typical issues are: a lack of automation, test environments taking weeks to set up, test data consumes days to generate, testers operate with lots of dependencies resulting in significant waiting times and most of the testing is not integrated with development and release processes.

## **Test automation isn't just enough to meet the goals of DevOps or CI/CD.**

Organisations need Continuous Testing which focuses on eliminating business risks by enabling quick and effective feedback mechanisms, which is one of the key aspects of DevOps. Continuous Testing is a key differentiator in the overall DevOps success rate and have therefore invested proactively in solutions, skills and methodologies that help our clients.

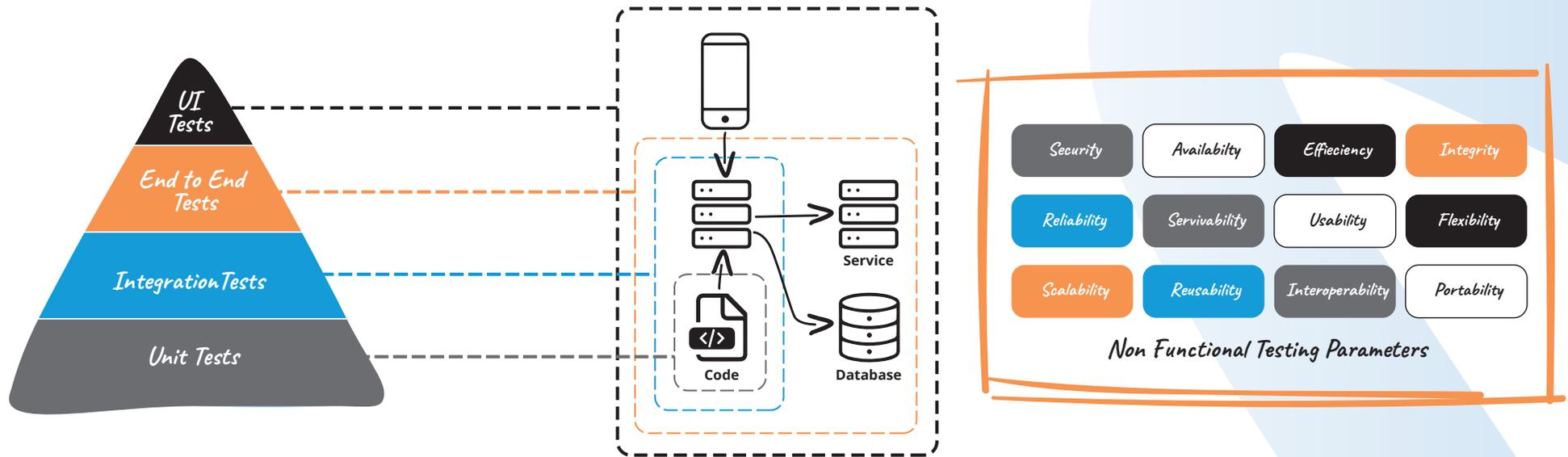
## **Testing readiness to CI/CD is currently poor across the industry.**

From our experience, although organisations are mostly focused on enabling the CI/CD capabilities from the build and deployment automation, cloud and containers angles, there are still huge gaps in testing and QA. Many application areas having the ability to build and deploy within hours do not have the confidence to assure the quality of the software changes, leaving testing as the bottle neck to release into production.

## *Our Key Observations in Summary*

- Test automation is mature but exists in pockets in within an organisation
- There is lack of connected testing strategy from left to right
- Testing is disconnected from business and operations
- Organisational setup, isolated / outsourced testing functions, old school approach to test applications developed by third party's is common
- Performance testing is mature but performance engineering is still evolving





## How we add value

We have proven experience in building ground breaking testing solutions in legacy technologies and are leading the testing space in mainframe DevOps, delivering continuous testing solutions by bringing the right tools together and by optimising the process framework. Furthermore, we have invested in partnerships, research labs and expert skills to continuously improve the solutions for our clients.

## A Typical Solution Summary

- Automation is key, all testing levels should be automated with no manual interventions including reporting and notifications. The solution should be fit for all test environments, easy to use and allow developers and testers to drive testing autonomously
- Test case design and scripting activities are accelerated by automating the analysis and building a reusable test framework which allows faster generation of test scripts
- Test data management solution is targeted to enable developers and testers to provision both reference data and test driver data in an automated way, on demand, with no dependencies. The solution is also targeted to avoid frequent production snapshots and improves data protection
- Test orchestration and robotic process automation is aimed at automating all activities that are performed in a testing cycle. This includes testing online, batch and IBM DB2 changes
- Improving the collaboration between business, development and testing from the requirements definition stage

The main objective is to optimise mainframe testing to continuously assess the business risks throughout the value stream.

The key objectives are to automate the testing process and integrate to the release process.

- ✓ End to End Test process Automation
- ✓ Test Design to qualify changes early and continuously in SDLC
- ✓ Solution which is seamlessly integrated to CI/CD pipeline
- ✓ Bespoke solution for the complex technologies - Batch, CICS, DB2

## Preparation

### Areas we can help

- Smart Impact Analysis
- Test Data Management
- Test Coverage Optimisation
- Accelerated Test Design

## Execution

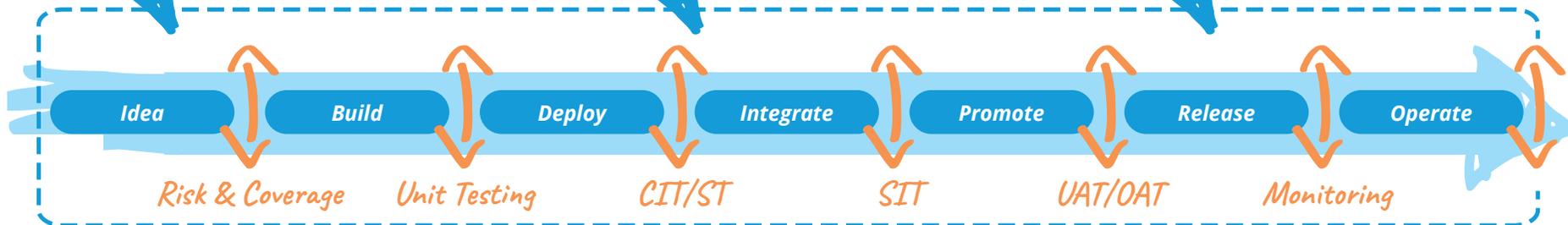
### Areas we can help

- Test Automation
- Service Virtualisation
- Testing Process Orchestration
- Performance Engineering

## Operation

### Areas we can help

- Continuous Monitoring
- All enabled Analysis
- Automated Feedback
- Accelerated Remediation



# Release and Deploy Transformation for Mainframe

A common problem is that unlike the distributed systems, in mainframe the code promotion happens via the SCM tool. There are a significant number of manual activities or scripts performed by different teams to prepare an environment for change. For example, CICS Configs, IBM DB2, and batch schedules are promoted individually organised as per the runbook. This process as it stands is not automatically repeatable in all environments and is hence prone to errors and high resource/time conception.

## How we add value

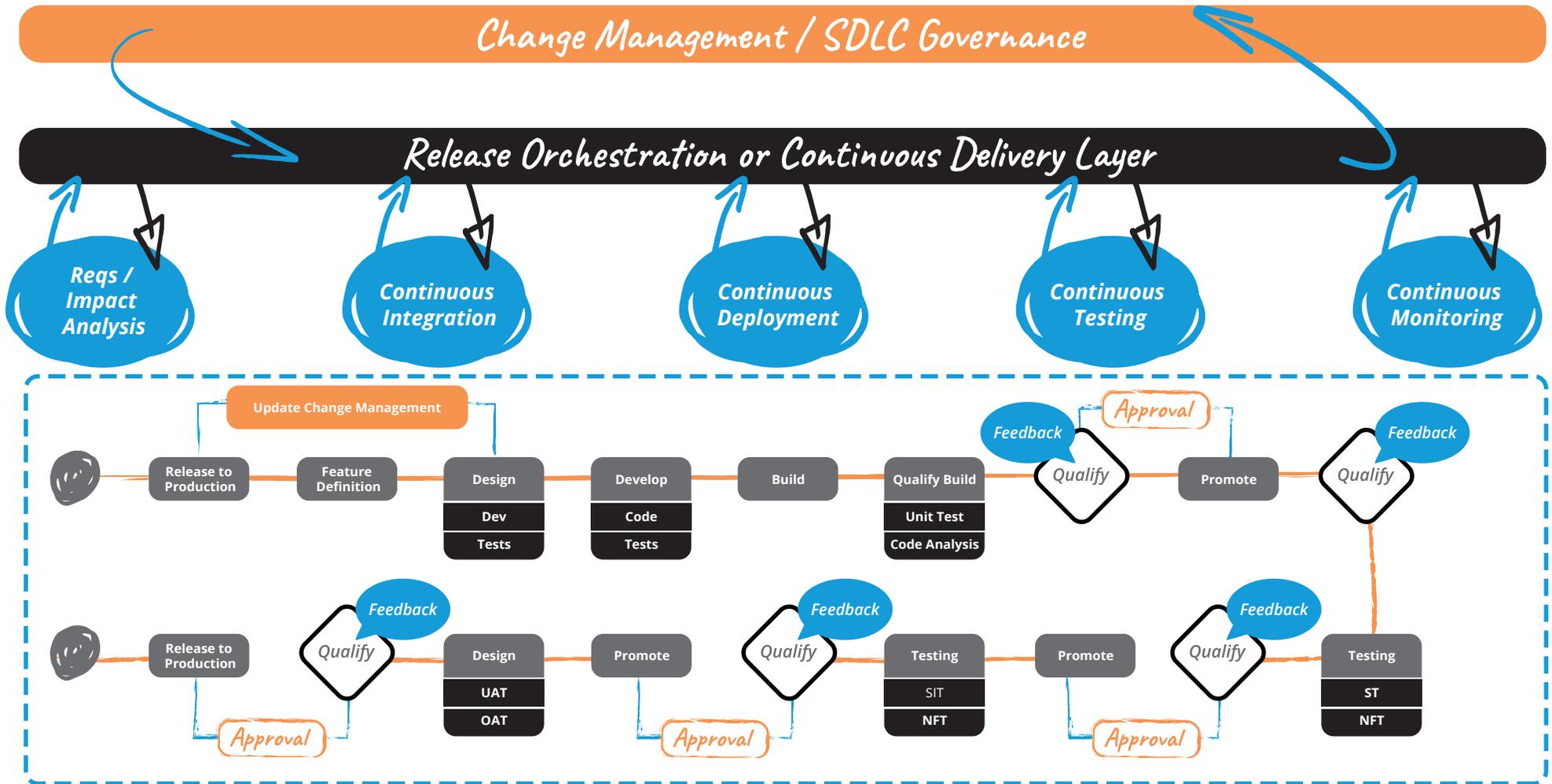
Sandhata has substantial experience of delivering cutting edge orchestration pipelines in mainframe cross-platform environments. Additionally we are experts in modelling release pipelines tailored for our clients' current setup, dependencies and automation maturity. Finally, we also help organisations to leverage the release orchestration solution to generate meaningful data giving better insights on the performance of the SDLC activities.



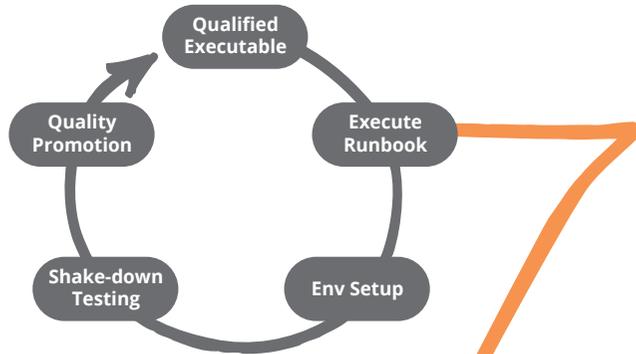
## A Typical Solution

- The key aspect of the deployment automation/orchestration solution is to automate and integrate all activities involved in promoting a change to an environment and dependencies such as RACF
- The release automation/orchestration focuses on the integration of CI, deployment automation, testing and change management process while applying the required controls and governance
- The main objective is to deliver mainframe changes securely with complete traceability, auditability with no manual interventions. In order to achieve this we also assist in required process streamlining
- The fully automated, robust deployment solutions for CICS, IBM DB2 and Batch components need additional analysis and solutions to handle technical hurdles
- With increasing use of a virtualised mainframe environment, the solutions should consider maximum reusability and quicker turn-around times
- Automation of post promotion activities such as populating ref data and shake-down testing will be part of the e-2-e solution

## Mainframe Release Process Automation



## Mainframe Deployment Automation



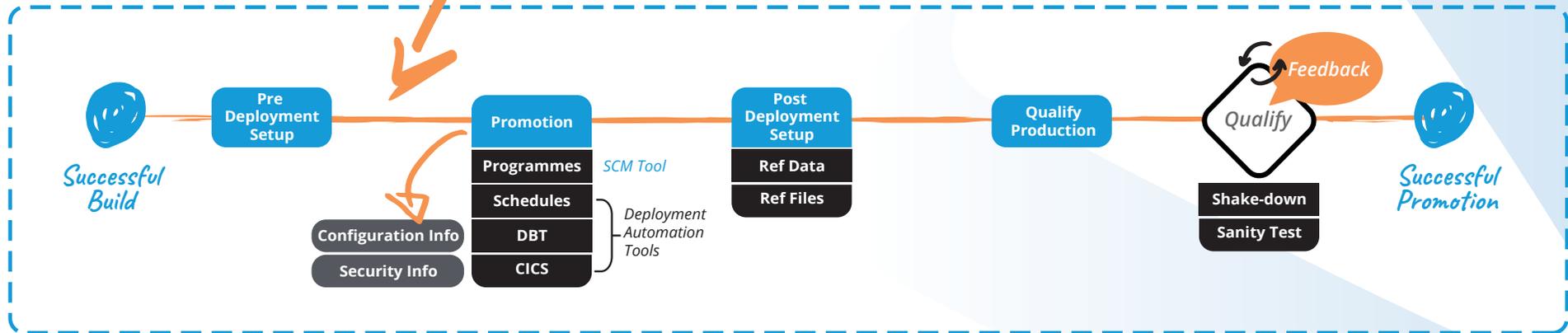
### Objective

The key goal is to achieve one click promotion of mainframe changes.

### Benefits:

- Remove Deployment Errors
- Remove Manual Dependencies
- Reduce promotion time and effort by at least 60%

- ✓ No Manual Interventions
- ✓ Integrated with Release or CI/CD Pipeline
- ✓ Automated qualifications of updated test environment
- ✓ Solution includes COBOL, CICS and DB2 changes
- ✓ Batch Schedules and configurations are automatically promoted



# Mainframe Continuous Testing Solution for Batch Systems

**The mainframe is the workhorse of many digital projects and it enables them. For example, in most banks the mainframe is the backbone for internet banking, cashpoints (ATM's) and other payment services. The consumption of digital services via channels such as mobile or web is enabled through middleware of service APIs and the mainframe batch system. Put simply, the mainframe is the server, the clients are mobile and web and the glue in the middle is a layer of service APIs.**

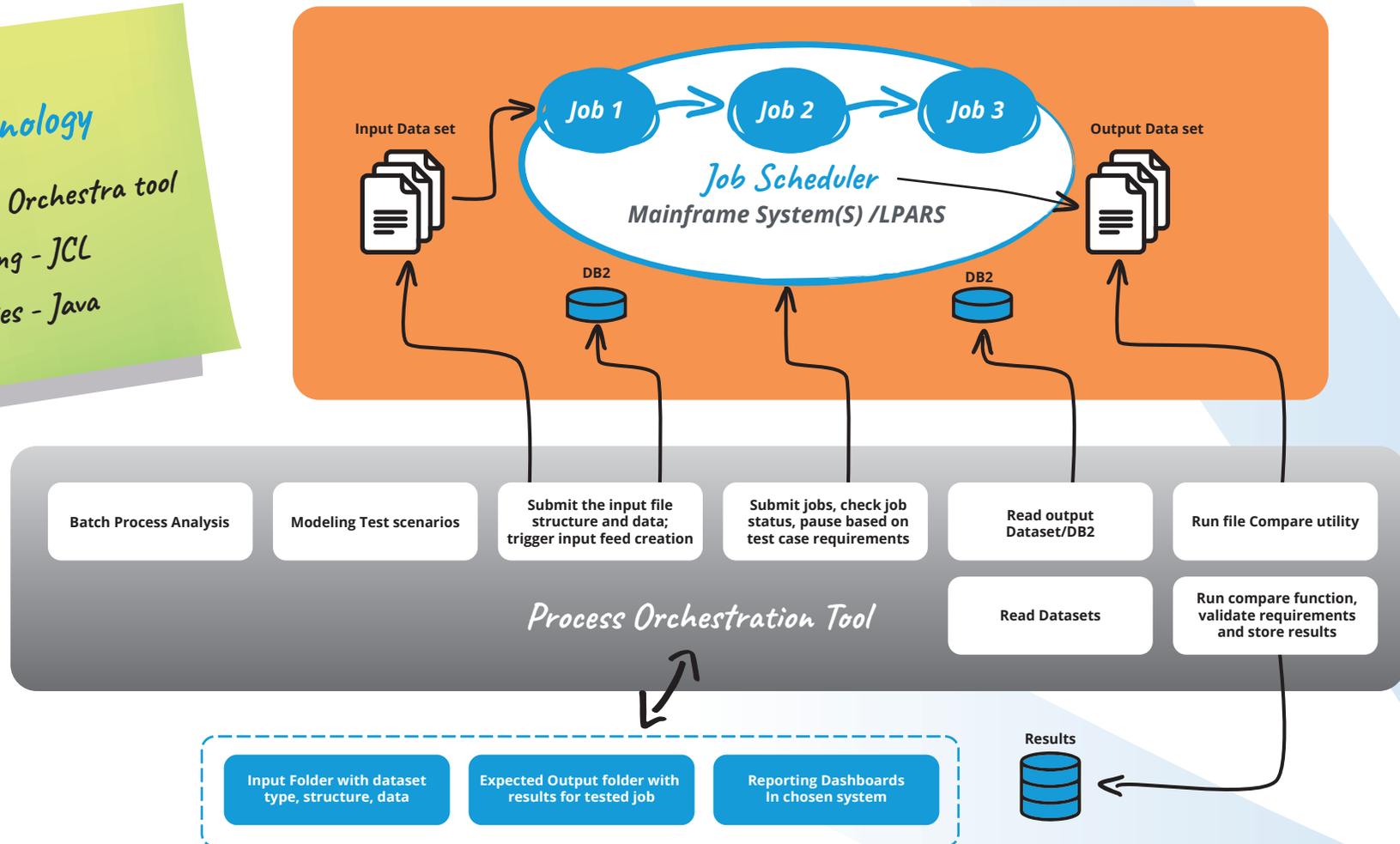
Most of mainframe workloads fall into a batch processing category. The operating system defines a job as a predefined sequence of commands, programs and data as a single unit. Once submitted, the operating system keeps a number of jobs in memory and executes them without manual interventions. Jobs are processed in the order of submission, in a first come first served fashion, their output is directed to files or DBMS systems.

Testing services that activate batch systems on the mainframe are largely manual because of the job submission and the review of the test results. Significant value in terms of time and cost can be extracted by automating such test scenarios. Sandhata has developed an automated framework to allow testing of the mainframe batch jobs and API calls without manual intervention.

- This solution enables the team to be more self-sufficient in refreshing test environments with a pre-defined baseline and sanity test without or, with least dependency, on the environments team
- This framework is an integral to mainframe virtualisation strategy as it enables faster testing with better coverage within the ZD&T & ZVM environments
- It enables the team to start regression testing much earlier in the development cycle by removing the dependencies on the upstream systems
- This solution is critical to CI/CD capability within mainframe as it removes all manual process and handoffs
- This framework provides better visibility and auditability which removes the necessity for the testers / developers to manually evidence using screenshots
- This solution is key to enable agile practices within mainframe as it supports a lean approach, enhanced automation and collaboration between dev and test
- This solution supports multiple testing phases, i.e. Unit Test, ST, SIT, CIT, NFT and UAT with maximum

## Technology

- Process Orchestra tool
- Scripting - JCL
- Utilities - Java



# Sandhata Wins Best Overall Testing Project Finance for UK Largest Bank

Sandhata won this award jointly with the engineering team at the UK's largest bank. The team worked together with the aim of accelerating mainframe change. The test engineers were empowered to drive mainframe testing with reduced dependency on central teams with a resulting 90% saving in execution time and effort.

Sandhata enabled the mainframe platforms to perform continuous testing despite a limited selection of off the shelf tools, a limited resource pool and complex technology. The project required close working with engineers and operations to assist in the realignment of process, controls and governance.

Sandhata has proven that it is able to work with its clients on projects of the highest levels of complexity and strategic importance in order to achieve positive change. This is something that was recognised by the judges in the award scheme.



*“This was one of the most challenging testing projects we have delivered in recent times,”*

Said Gary Thornhill, CEO Sandhata Technologies.

*“This is because we dealt with complex technology and a significant shift in the mindset of the operations teams, liberating mainframe testing. Furthermore, the engineers were fully accountable for the quality of the changes they delivered.”*

*Our Key Target Outcome was to Accelerate Mainframe Testing & QA*



*Our Target KPIs were*

- Testing Cycle Time
- Testing Cost (time & effort)
- Automated Testing Coverage



*Our Target Culture was*

- Autonomy for testers to drive testing
- Automate everything that's repeatable
- Reduce or eliminate dependencies



## Environment Setup Utilities

Saved in excess of 82% of effort in average over manual setup in a major programme. The financial savings is FTE £130 per day reduction to £26 per day

## Batch Test Automation

Resulted in benefits in excess of 90% effort savings in average and Test Cycle Time from few weeks to days

## Test Execution Support Utilities

The support utilities such as DB2, logging, reporting and Mainframe plugins produced benefits of 95% effort savings in average and savings of approximate £242k within three months

## Test Process Orchestration

The average effort saving proven is in excess of 90% in conjunction with test automation. Although the financial savings is expected to be greater than 60% of the current text execution cost by the end of this year

*Effort saving is calculated by the average reduction in the Effort spent during testing cycles including test execution, environment support, data setup and sanity tests.*



## Who we are

*Sandhata is a global niche consultancy that develops innovative, enterprise-wide, DevOps-centric service propositions, in response to business and technical challenges faced by the biggest and most complex organisations. We have a reputation for tackling the most complex issues and can optimise IT delivery across the enterprise.*

Sandhata has many years of proven experience in accelerating software delivery in complex legacy systems.

We deliver ground-breaking solutions to our customers, transforming their mainframes enabling them to become lean and responsive.

We understand the unique challenges posed by mainframes, which make it difficult to adopt DevOps or CI/CD as well as the common challenges experienced with the distributed IT systems.

We bring the knowledge, experience and expertise to accelerate mainframe transformation, bringing them up to pace with rest of the technology shops.

## Core Services

We can provide high quality services which include:

- IT Transformation
- DevOps
- Mainframe DevOps
- DataOps
- System Integration
- Banking Domain expertise

## Our core values

We promote equality, diversity and integrity. We are committed to the pursuit of excellence for our clients. We actively support and finance humanitarian causes.

## Where we operate

We are a global company and have offices in the following locations:

- UK – London and Reading
- US – New York
- India – Chennai and Hyderabad  
Gurgaon and Pune (2019)

Our customers include:





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## *Areas of DevOps mainframe competence*

- Release CI/CD pipeline
- Continuous Testing (Testing Process Orchestration, Continuous Business Risk Assessment, Monitoring)
- AI enabled monitoring, KPIs and analysis (zAdvisor, IBM UrbanCode Velocity)
- Continuous testing of batch systems on mainframes
- Mainframe Virtualisation and Data Virtualisation
- Mainframe Source Control Migration (ISPW)
- Deployment Automation for z Systems (IBM DB2, IBM UrbanCode for z Systems, Batch Schedules)
- Test Data Management and Data provisioning