IBM Z DIGITAL TRANSFORMATION

Successful digital transformation occurs when you have an all-encompassing yet continuously transformative approach that allows for incremental adoption based on business needs and priorities. This empowers enterprises to swiftly embrace the capabilities of digital transformation and continuously adapt to the changing market and their client's needs. IBM Z® Digital Transformation provides a holistic and incremental approach to digital transformation, with agility and enterprise flexibility as the thread that binds.

Success in the digital era can be defined and measured in many metrics, but when it is boiled down to its fundamental elements, a recurring theme is evolution. In the insurance sector, customer service evolved from face-to-face interactions at a brick-and-mortar location to having the ability to manage multiple policies from the convenience of a mobile device while on the go. That took an errand that consumed hours of a customer's day and transformed it into something they could do in minutes while riding the train in to work. Businesses are constantly having to change and evolve, creating new ways to deliver more to their customers, faster, and everywhere their customers are. The competition is fierce, and transforming your business is essential to survival and continued success for years to come.

With all the disruption going on in technology, the one certainty remains: the mainframe continues to be the heart that beats at the center of business today. From insurance and government to healthcare, most of the world's critical businesses rely on the mainframe. Rapid changes in customer demands and expectations, economic factors, and competitive climates drive innovation at an unprecedented pace. These requirements include but are not limited to:

- Delivering with speed and agility – without sacrificing quality
- Increasing developer productivity to reduce maintenance backlog – for both entry-level and veteran z/OS® developers
- Harvesting data in a context that generates actionable insights to open up new business opportunities
- Embracing open and modern application platforms that allow you to develop and experiment new digital experiences quickly and at low cost
- Identifing key services from monolithic, business critical applications without risk
- Identifying and anticipating bottlenecks before issues arise in these new hybrid cloud applications
- Innovating and rapidly evolving new business capabilities across systems of engagement and systems of record
- Preventing system outages and reducing operational costs.

Businesses can only turn things around as fast as the slowest part of their lifecycle. This part of the lifecycle is typically the one that is held back by outdated development methodologies, tools, and processes around the systems of record, in this case, the mainframe. There have been attempts to address this with the concept of two speed IT, which hypothesizes that businesses can decouple the backend systems of record from customer facing applications. But two speed IT has been proven false, due to fundamental issues in its underlying assumptions. The concept of two speed IT is based on the basic premise that developing for the mainframe can never be as agile as developing for distributed platforms. There is also a general resignation that existing assets that have been built over decades will remain inflexible and immutable, with no chance of evolution. These assumptions cause problems all around.

So how can the cycle be broken? How can the value of mainframe application assets be unleashed? Progress cannot be made by addressing just the obsolescence of tools, or by changing the culture, or changing processes independent of people or culture. Change has to be driven by addressing all the dimensions spanning people, culture, and tools.

The guiding principles behind IBM's approach to facilitating transformation is to focus on all of these dimensions in an incremental fashion, without exposing the business to added risk. It means that digital transformation has to address entrenched culture, by articulating what is the employee value proposition for change. It means that while culture change is the focus, there has to be strong processes to support this culture change so that it becomes pervasive. It also means that the right tools and solutions to support the processes need to be put in place to act as enablers for the culture change. These tools and solutions cannot displace existing IT investments wholesale or create problems for the future by building closed ecosystems that will eventually result in the same situation a few years down the line. Nor can these tools and processes be a patchwork that requires customers to put together solutions from many different open source or commercial providers to merely be viable as a true enabler of end to end digital transformation. The key here is openness, to drive the adoption of agile processes that support a strong culture of flexibility and transformation.

The Solution

IBM offers a holistic solution to help address the growing demands to ensure success regardless of where you are on your digital transformation journey.
The IBM Z Digital Transformation Model (Figure 1) presents three primary transformation levels supported by agile practices, comprehensive tools, and culture change that will enable enterprises to realize the true value of digital transformation. These levels are:

1. Expose
2. Evolve
3. Optimize

This is underpinned by the 'Run & Maintain' level which comprises the latest levels of IBM Z subsystems, compilers, and monitoring tools to provide a healthy baseline and foundation for accelerating Digital Transformation. Gaining efficiencies in this foundational level is key in ensuring enterprises can free up resources for embracing the capabilities at the Expose, Evolve, and Optimize levels of the IBM Z Digital Transformation Model. Each of these levels has a set of associated, loosely coupled capabilities that can be incrementally adopted and mapped to key personas in an organization, as shown below. These capabilities allow enterprises to unlock the value of their enterprise application assets while adopting agile best practices along the way, with strong and open solutions supporting the journey. The remainder of this paper goes through each of these capabilities in more detail.

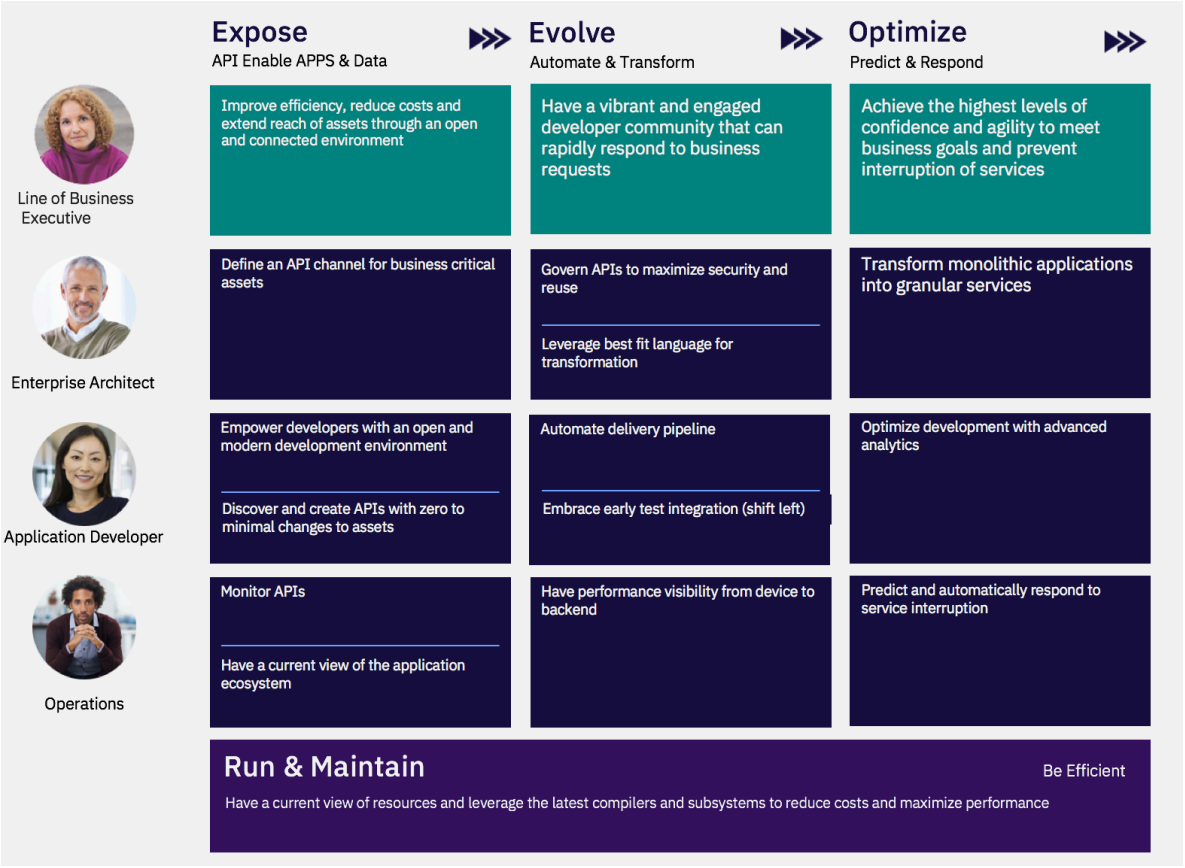

Figure 1: IBM Z Digital Transformation Model

Run & Maintain

Be Efficient to reduce costs and maximize performance

Have a current view of resources and leverage the latest compilers and subsystems to reduce costs and maximize performance.

Organizations are continuously challenged to lower costs and to do more with less. Recent releases of IBM Z subsystem products and compilers offer optimizations and platform exploitation that can help reduce costs and support increased workloads, while tools enhancements help customers to understand and measure their workloads.

As enterprise extend the reach of their enterprise assets to support mobile, web and social, their workload will increase dramatically. To reduce operating costs, companies need to make sure these applications are performing optimally on the platform.

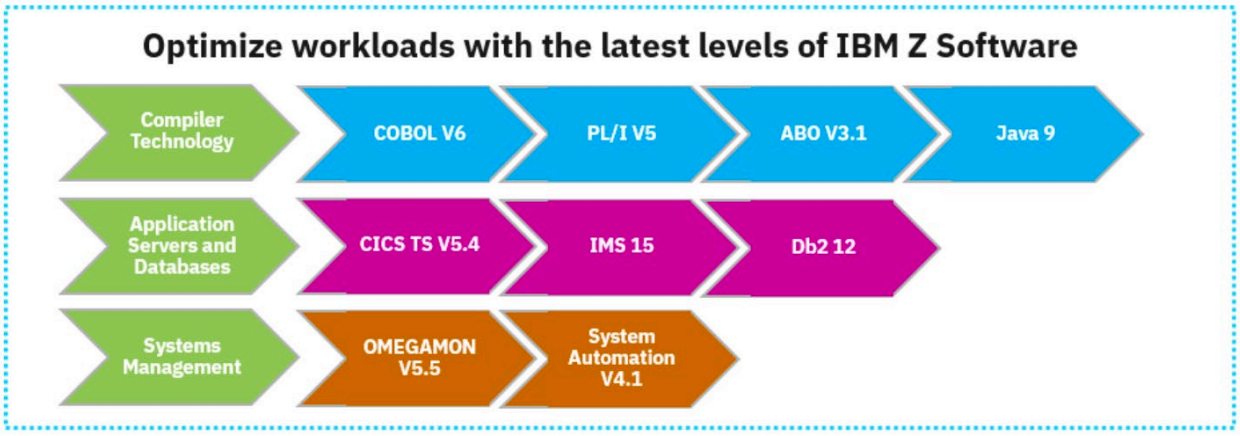

Figure 2: Optimize workloads with the latest levels of IBM Z Software

With decades of application assets working as planned, enterprises cannot afford to make wholesale changes, and in many instances, it is not only unviable but also unnecessary. The right application mix must be chosen for any digital transformation initiative, but that does not mean that enterprises cannot take advantage of the latest hardware and compiler advancements to get the best out of their entire application landscape. The latest level of compilers offers the ability to get better performance through recompiling, by taking advantage of the latest hardware instructions and reducing the path length. For instance, COBOL v6.2 reduces CPU usage of Decimal intensive & Floating Point Intensive Applications by up to 94% over COBOL v4.2 (67% over COBOL v5.2 in a controlled environment).

If you have load modules that have no source files, or do not want to recompile to take advantage of hardware improvements, Automatic Binary Optimizer (ABO) can provide 80% of the gain with minimal test effort and therefore lower risk. Furthermore, ABO complements the latest COBOL compilers by allowing customers to improve performance without requiring that their entire application be recompiled and tested, thereby saving time and money.

IBM Z customers are very focused on reducing CPU and operating cost. The latest releases of subsystems such as CICS® and IMS™ and zTPF look to offer optimizations that will help to achieve this. Staying current is the best way to take advantage of these enhancements. Moving to newer Z mainframe hardware, such as the IBM z14™, also offers performance benefits, and the greatest benefit will be achieved by recompiling COBOL and PL/I applications using the latest releases of the compilers. This can be done incrementally by recompiling the most performance sensitive applications first.

Expose

API Enable existing application and data to improve efficiency, reduce costs and extend reach of assets through an open and connected environment

Define an API channel for business critical assets

More than 80% of the world's structured enterprise data resides on the mainframe[1], over 220 Billion lines of COBOL code captures core business processes[2] and more than 55% of all enterprise application transactions run on the mainframe[3]. A key part of digital transformation hence needs to focus on opening up the mainframe to applications outside the mainframe, including as a full-fledged participant of the API Economy.

For example, a global bank slashed its account opening time from days to milliseconds by surfacing their core banking services as APIs. They significantly improved their customers' experience and satisfaction, resulting in hundreds of millions of USD in new account deposits in just days.

In addition, using IBM cloud API solutions, a US financial services company used IBM z/OS Connect Enterprise Edition to provide support for Apple Pay and other third party payment options. This project went from nothing to full working prototype in five days—and the full production launch was achieved in record time for the organization. Finally, a US health insurance company can now build and deploy an API from existing COBOL code in as little as 30 minutes.

Those are just a few examples of revenue-generating, cost and risk reducing innovations in technology made through the use of IBM products in the real world.

Deploying these services can drive new use and revenue from third parties, external developers, vendors, and partners as they license and incorporate these APIs into their

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[1] *http://www.share.org/p/bl/et/blogid=2&blogaid=234*

[2] *http://cobolpros.com/the-need-for-cobol/*

[3] *http://www.datacenterdynamics.com/focus/archive/2013/12/research-reveals-mobiles-mainframe-impact*

solutions. But exposing these services must be simple and intuitive. Otherwise, development teams can struggle to unleash this hidden value and the new venture can fail before it begins.

Discover and create APIs with zero to minimal changes to assets

The ability to expose assets selectively to systems of interaction, through standard REST APIs with minimal to no code changes, is a key next step to opening up the application landscape and embarking on the digital transformation journey.

This can be done by leveraging Application Discovery and Delivery Intelligence (ADDI) and IBM z/OS Connect Enterprise Edition.

- Identify key services to expose and then quickly and confidently develop those services by understanding your existing assets with ADDI. Knowing what assets you have in your Z enterprise, and knowing the relationships between those assets, is a key enabler to identifying the right business entities to expose as APIs.

- Easily provide consumable, industry-standard RESTful APIs to these assets with IBM z/OS Connect Enterprise Edition. These technologies enable APIs to be created in half the time and for a fraction of the cost that it used to require for integration.[4] . z/OS Connect uses industry standard Swagger definitions to express these REST APIs in keeping with IBM's philosophy of embracing open technologies.

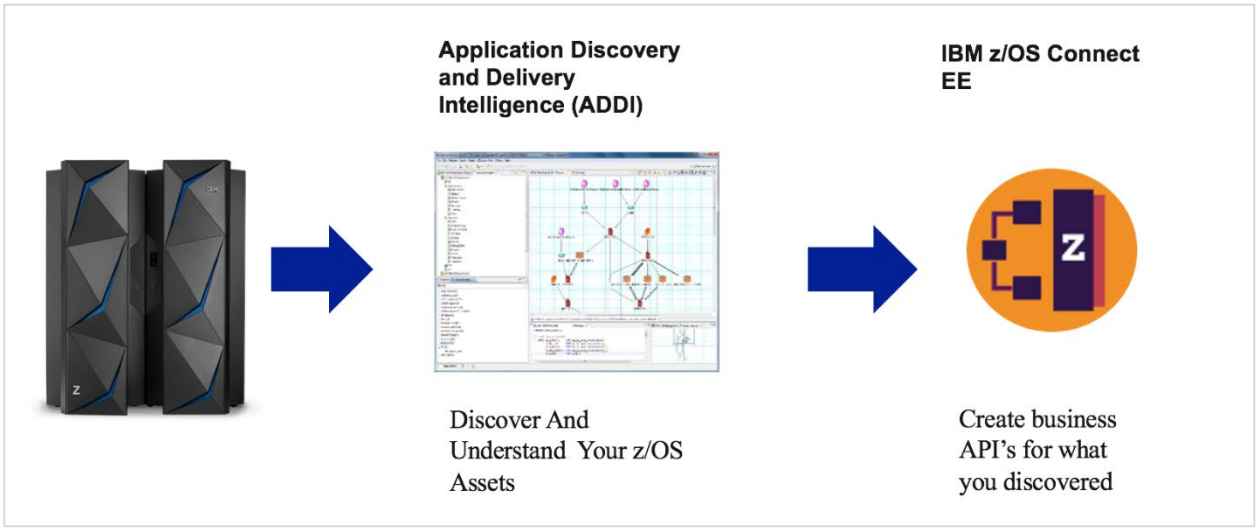

Figure 3: Discover and create API's

[4] https://www.itnews.com.au/news/core-banking-overhaul-still-off-the-agenda-at-anz-bank-429979

Exposing these assets requires modern and user friendly tools such as Application Delivery Foundation for z Systems (ADFz) to create and work with the APIs as well as the backend applications and subsystems. Modern tools need to provide the ability to work with existing software configuration management systems, while providing productivity and flexibility as described in the next capability.

The combination of ADDI, ADFz, and z/OS Connect EE therefore allows enterprises to develop, connect, and extend the reach of Z application assets to additional markets/consumers without added risk. This is an important first step in the digital transformation journey.

Empower developers with an open and modern development environment

Many enterprises are risk averse and reluctant to modify their aging monolithic applications. Making strategic changes to long-standing, keystone application source code carries a fair amount of risk, often requiring the assistance of subject matter experts to ensure that changes are made safely with minimal peripheral impact. These experienced developers are now retiring and enterprises are losing the skills and knowledge they have which is why it's critical that we can replenish the expertise with a new generation of developers through the use of open and modern tools and practices.

The first step in unlocking the value of your application assets is to getting an understanding of those assets. Application Discovery and Delivery Intelligence (ADDI) uses static analysis to provide this by presenting graphical views and reports about your applications, the JCL, integrations with schedulers and correlating that information from data feeds from your DevOps process, including code changes, testing, and operations.

This functionality is key in easing the onboarding process for newer developers providing them a much quicker way to understand the code that they will be responsible for maintaining or enhancing. ADDI also provides an efficient way to do impact analysis by identifying all the areas that would be impacted by a code change, eliminating human error and therefore reducing risk.

Forrester interviewed an organization that provides development management and technology services faster and better with ADDI and concluded that ADDI delivers significant benefits including a 145% ROI and a payback period of less than seven months. This is important because organizations are constantly required to justify their technology investments and show the improvement in business results associated with the investments.

Modern tools need to be attractive to the next generation of developers and provide the ability to work with existing software configuration management systems, while providing productivity and flexibility. Application Delivery Foundation for z Systems (ADFz) does exactly this, through a comprehensive set of capabilities spanning editing, compiling, debugging, code coverage, and delivery of COBOL, PL1, Assembler, and Java code. ADFz provides advanced capabilities such as visual debugging, code coverage, and unit testing with zUnit, program/data flow, and built in code review capabilities with software analyzer and SonarQube integration. ADFz also provides application fault and performance analysis capabilities and integrates with all major legacy software configuration management systems to deliver on average a 15-25% improvement in productivity and provide an easy entry point to modern tools.

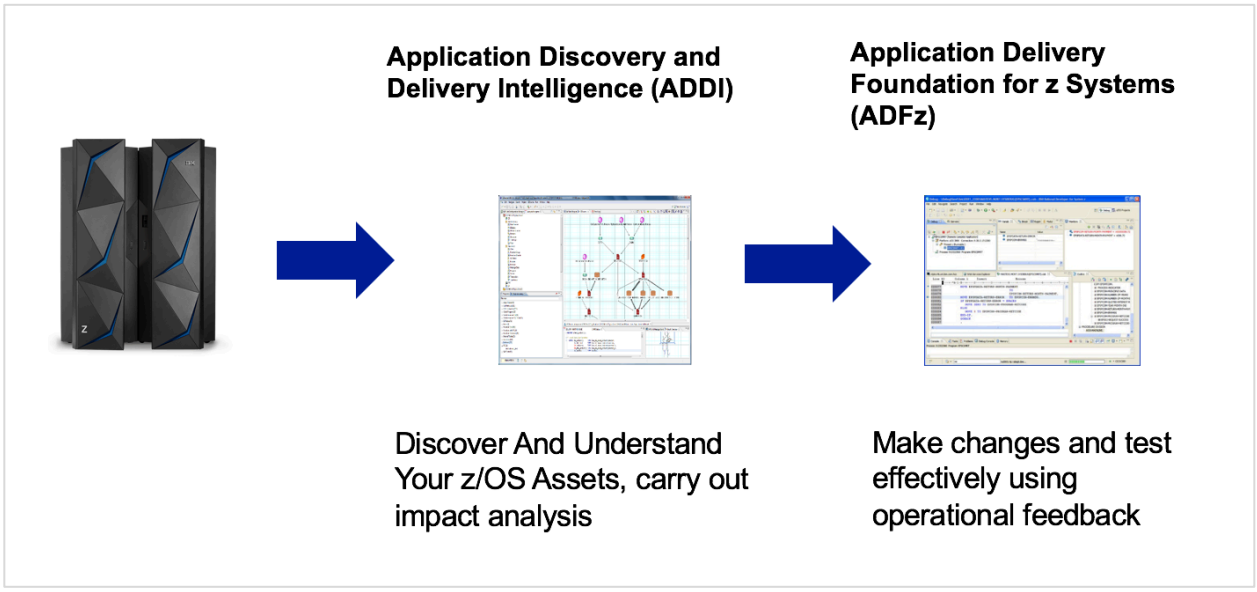

Figure 4: Make changes faster with an open and modern development environment

IBM recommends customers to work in an agile way and have adopted it across the IBM company. One example of this is IBM Explorer for z/OS Aqua. It is a platform on which 20 tools integrate. We provide monthly releases across all of these tools, providing one simple download and install experience, similar to an App Store for Android or IOS. We build, deploy and test these releases using our own and open source tools. An end user can select any one or more of the 20 tools needed in their install package. This is a very powerful delivery channel consists of a compelling user experience and deep integration on an open platform. It's a one stop shop all the products with an easy install experience.

ADFz is built on the Aqua platform, and its integration with ADDI unlocks a whole host of differentiated capabilities that substantially accelerate the ability to reduce the risk of working with application assets, including the fundamental ability to understand the impact of change, which can greatly speed up development while ensuring that quality is not compromised.

Organizations that have empowered their developers with IBM's open and modern development solution have seen a reduction in development and testing efforts by up to 30% and improvement in code quality by up to 50%.

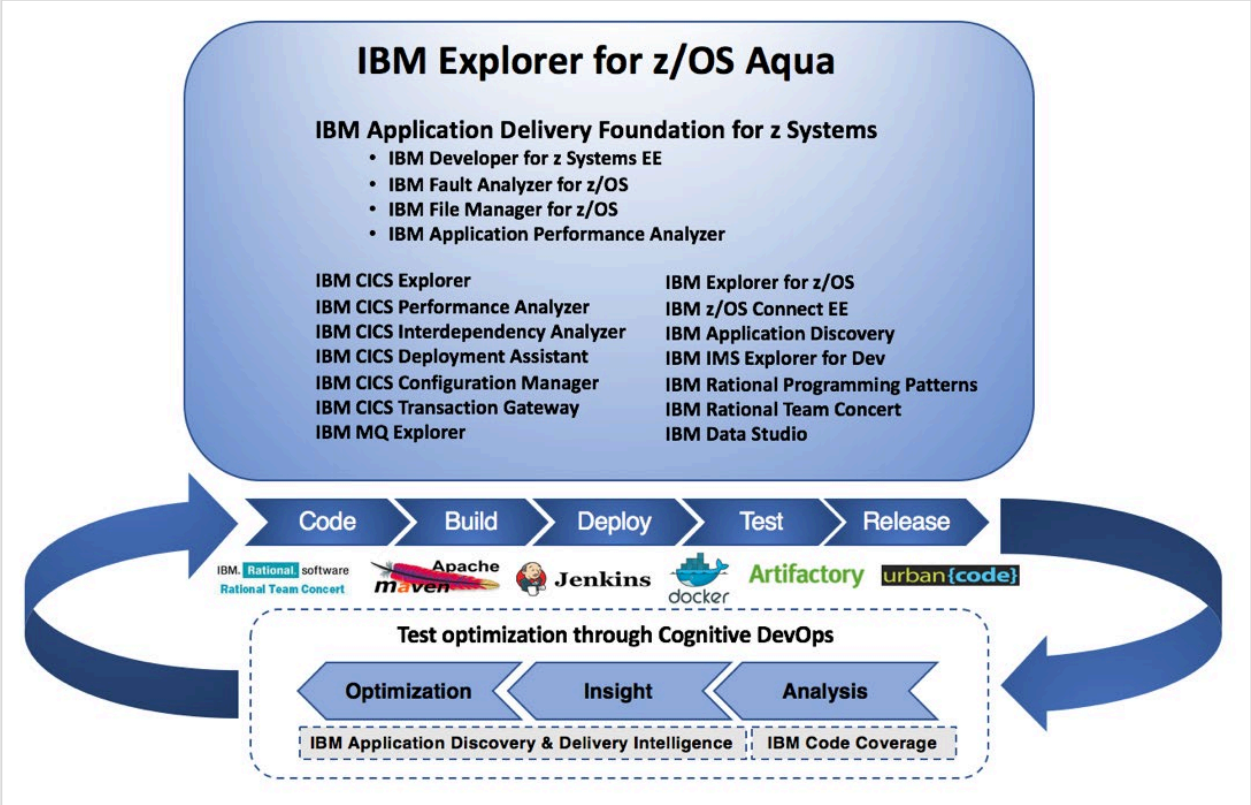

Figure 5: IBM Explorer for z/OS Aqua

Monitor APIs

Clients are leveraging APIs to improve agility and by bringing services to consumers faster they will hope to leverage the assets contained in the back-end (systems of record) SORs and drive workloads that increase business value. The challenge for the API provider is that the services must perform to standards that deliver data and responses to consumers in a timely fashion, while also not impacting traditional workloads and SLAs. Failure to provide a service that meets the consumers' requirements - which may ultimately include end-users on a mobile app far-removed from the mainframe - may result in loss of business, lack of adoption, and an inability to compete in a rapidly changing marketplace.

To address these challenges, the operations teams can use OMEGAMON® for JVM and API Connect to proactively monitor response time and data throughput and understand if the infrastructure is balanced / able to handle the current workload.

Monitoring through OMEGAMON for JVM addresses key concerns because the impact on response times of APIs can be seen and proactively monitored. When issues are identified, corrective action can be taken by alerting the operations team (increasing capacity on the system, for example) before the problem becomes a major impact to business performance. Without this visibility, a complete understanding of the changes impacted by exposing assets as APIs is missing. IBM provides an exceptional customer experience through end-to-end monitoring.

Have a current view of the application ecosystem

There is a need to reduce operational risks in the data center by ensuring that the right monitoring and management solutions are in place to manage existing and new applications – solutions that allow for proactive analytics to prevent outages as well as solutions that help resolve issues quickly when they occur.

There is a need to ensure that IT managers and administrators have the tools and utilities that they need to most efficiently manage mainframe service levels.

The increasing need to bring new z/OS staff into specific domain expertise areas requires specialty tools to assist with and mask platform-specific complexity. This is achieved by providing familiar user experiences, integrated analytics, and automated procedures. These enable prevention, identification and correction of problems in key infrastructure hardware and software subsystems. In addition, they help with optimizing the performance of those subsystems.

The IBM Service Management Solution on Z (SMSz) provides visibility, control, and automation to ensure business continuity of an integrated set of applications. This provides a holistic solution to automate and monitor your IBM Z, networks, applications, subsystems, and processors.

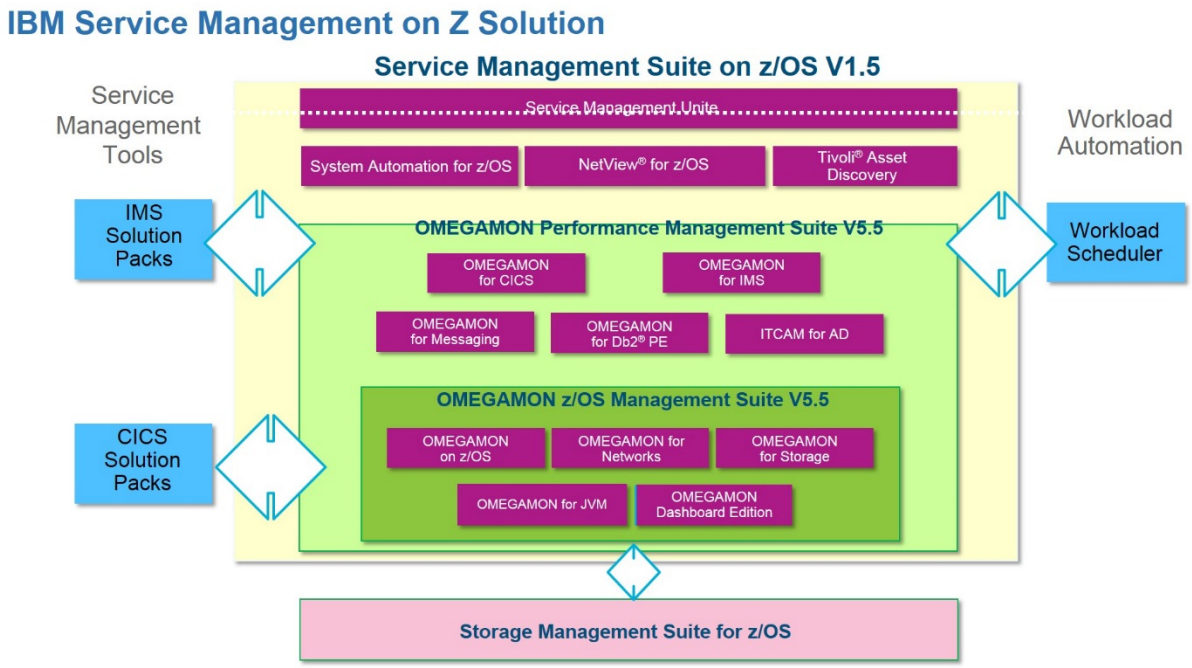

Figure 6: IBM Service Management on Z solution

Evolve

Automate and transform to have a vibrant, engaged developer community that can rapidly respond to business requests

Once enterprises set out on the digital transformation journey, with a simple entry point such as ADFz for a modern development experience, it also forms the basis for the adoption of more sophisticated and agile practices.

Govern APIs to maximize security and reuse

REST APIs provides a universal language for how applications can communicate with each other, making them the digital glue that links services, applications and systems. You do not need to care whether the service is delivered by a mainframe or not, nor what subsystem of a mainframe. Effective API governance solutions, such as IBM API Connect help orchestrate, govern and consume APIs by managing them with business-level controls by setting varying levels of security, visibility, and rate limits while sharing APIs with application developers, making it easy for developers to find APIs using a community based approach.

There has never been a better—or easier—time to expose and exploit those reliable, scalable and responsive core services as representational state transfer (RESTful) APIs. And the IBM Z platform offers you unprecedented levels of performance and security so you confidently open your APIs

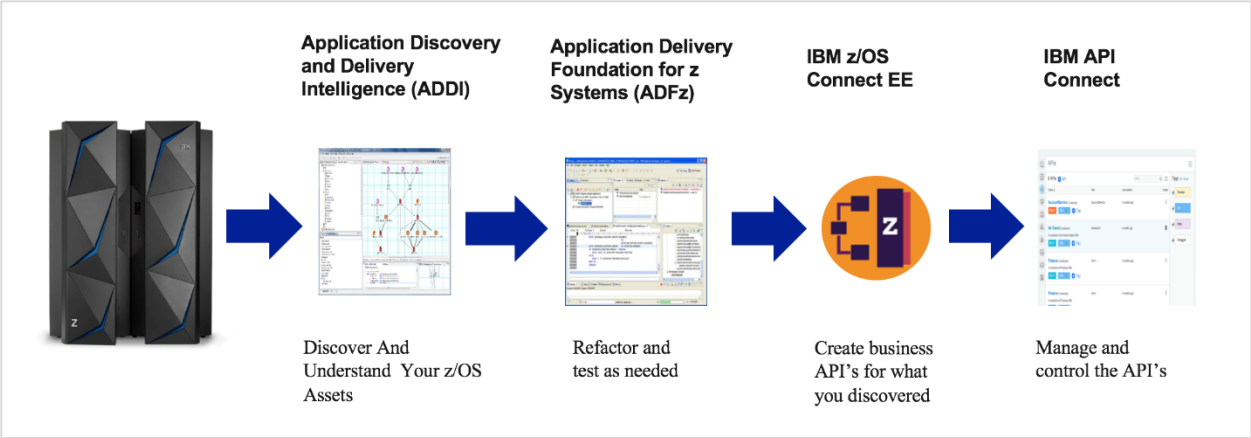

Figure 7: Accelerate API Enablement

Leverage best fit language for transformation

Java is the most popular language in the world with a developer population of over 14M. It is a proven enterprise language on IBM Z and is deeply integrated with the Z ecosystem. Business logic written in Java works seamlessly with IBM Middleware, (CICS, IMS, Db2® and WebSphere®) for both batch and online applications. IBM Java fully exploits Z architecture and has shown outstanding release-to-release improvements in performance, and capability since it was first introduced in 2005. In July 2017, Java introduced a number of innovations on z14 including pause-less garbage collection and exploitation of new features in crypto co-processors.

In the past few years, Node.js has emerged as a favorable choice within enterprises. It has a developer population of over 11.5 million worldwide. Developers can also take advantage of an ecosystem of over 500,000 Node.js npm (node package manager) modules that can be used in applications. In addition, by using a common programming language (i.e., JavaScript) across the entire application stack, the same team of Node.js programmers can work on applications on both client and server side. This helps remove organizational roadblocks, increase application development efficiency and shorten delivery time.

On the same day that Apple made Swift open source, IBM introduced the IBM Swift Sandbox, and started the journey of bringing Swift to the server platform. They have already ported Swift to Linux® on Z and now working in bringing Swift to z/OS. Swift is widely used by mobile developers and is gaining momentum in the application development community. Supporting Swift on z/OS opens the platform for millions of Swift developers, making it easier for enterprises to share the same pool of skills between front-end (mobile development) and the back-end (server development). Having Swift on z will bring it closer to the system-of-records, offering performance advantage for Swift application back-end running on z/OS.

Embrace early test integration (shift left)

Early test integration or shift left testing is a fundamental requirement for driving agility and improving quality across the development lifecycle. Shift left testing means testing earlier in the life cycle. It stresses integrating development and testing activities to ensure quality is built-in as early in the life cycle as possible.

There is very clear rationale for shifting left, cost savings, given enterprises simply save more by catching defects earlier in the lifecycle rather than after putting their applications into production. This approach has other benefits including higher customer satisfaction due to better software quality, and quicker time to market due to the test cycle being an integral part of development, rather than as a stand-alone QA phase which is typical in the waterfall approach. However, solutions available or being touted by vendors focus on automating only parts of the testing lifecycle, rather than holistically on automating everything from the standing up of test environment to driving automated testing as part of the continuous integration/continuous deployment (CI/CD) pipeline. This is where IBM solutions provide enhanced value that make them far superior to other solutions/approaches in the market.

With a simple entry point such as ADFz for a modern development experience, it lays the foundation for the adoption of more sophisticated and agile practices such as shift left testing. Within ADFz, you have unit testing capabilities for batch and COBOL CICS programs. A recent tech preview within IDz enables developers to record CICS runtime data, import that data into a test case, and then run a CICS unit test case and user interface changes.

IBM z Systems Development and Test Environment (zD&T) is the industry's only Intel-based environment that runs current, genuine z/OS software and middleware. With the advent of zD&T, mainframe shops have had the ability to rapidly spin up and take down z/OS test environments on demand both on premise and in the cloud. It empowers development teams with autonomy to have their own test environment avoiding the issues of contending for resources or even contenting for capacity.
This ability is substantially bolstered by the addition of provisioning tools that allow for the transfer of PDS, data, and other assets from conventional test LPARs to the zD&T environment. The integration of ADDI application asset understanding with zD&T facilitates targeted provisioning of the test environment "intelligently". This capability is truly differentiated from solutions that address just parts of the problem. This one of a kind approach is a game changer for enterprises that need to be more agile with testing on the mainframe.

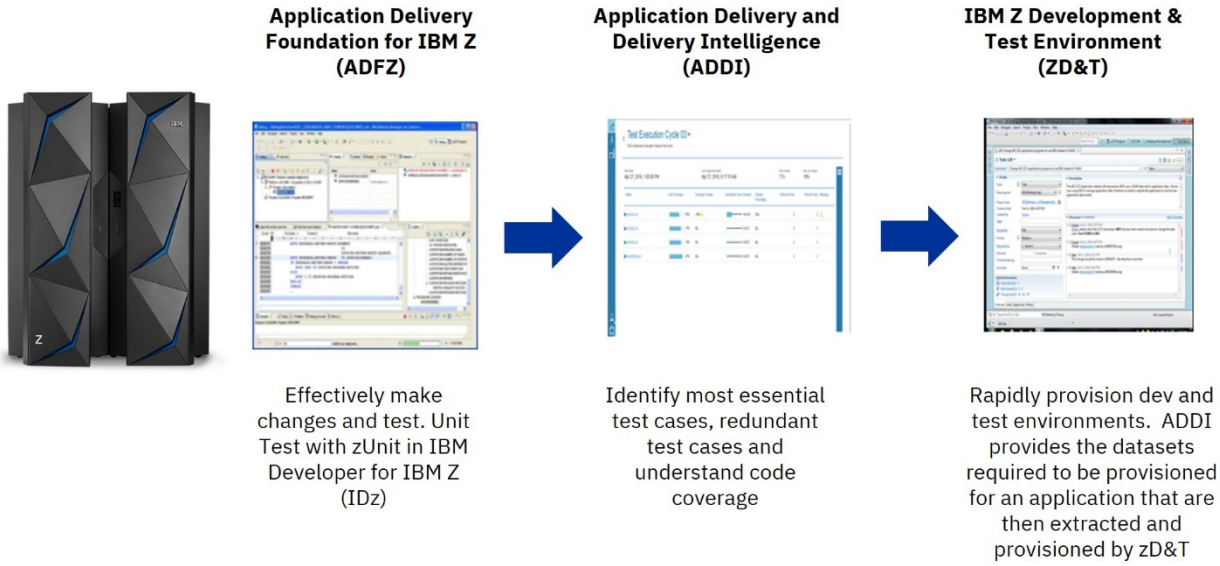

Figure 8: Shift Left Testing

When zD&T is combined with the service virtualization capabilities of Rational® Test Virtualization Server (RTVS) and Rational Test Workbench (RTW), bottlenecks that prevent agile testing are comprehensively addressed. RTW and RTVS provide the ability to effectively virtualize intra and inter mainframe interactions. A key differentiator being the focus on intra mainframe virtualization capabilities such as Db2 on z/OS call, and CICS transaction call virtualization, which are unique to the IBM tools, and not provided by the more distributed service virtualization solutions available in the market that also claim to support the mainframe.

Automate delivery pipeline

An automated delivery pipeline integrates all activities from ideation to build and deployment in an automated fashion. This capability is a key part of a Digital Transformation journey to create systems that are more responsive to the market. It helps customers create a collaborative IT environment across technologies and break down traditional silos separating technologies, operations and development - thus enabling them to respond faster to market needs.

Agile lifecycle management capabilities cannot be found in last century's SCMs that other vendors offer. Trying to retrofit last century's non-agile SCM, a strategy adopted by several vendors, and selling it as cutting edge is less than optimal and does not provide strategic value to customers. Only IBM's Rational Team Concert® can deliver the integrated Agile planning, SCM, Build and Collaborative Platform that teams need to run cross-platform DevOps and to accelerate digital transformation. It is the industry's most open integrated SCM, build and collaborative environment. This includes integration with the Industry's leading modern development platform (ADFz), open source integrations such as with JIRA or GIT as well as UrbanCode™ Deploy, the industry's most powerful cross-platform deployment platform.

IBM UrbanCode Deploy is a tool for automating application deployments through your environments. It is designed to facilitate rapid feedback and continuous delivery in agile development while providing the audit trails, versioning and approvals needed in production.

It is now possible to tie the automated deployment capabilities of UrbanCode Deploy, and Jenkins, in conjunction with leveraging z/OS MF workflows to drive completely automated provisioning, deployment, testing, and promotion as part of a CI/CD pipeline that spans both mainframe and distributed platforms. UrbanCode Deploy has true Z support with server agents on Z and distributed that facilitate orchestration of multiplatform deployment. Other solutions in the market are glorified workflow engines that can only interact with the mainframe through script based execution for artifact deployment. UrbanCode Deploy also provides the ability to version, commit and rollback on quality check failures, therefore enhancing the ability to truly adopt CI/CD for the mainframe.

IBM's end to end cross-platform delivery pipeline solution integrates with a variety of open source and third party tools allowing you to balance between open source and enterprise tooling to choose a pipeline that is right for your organization based on business needs.

Some of the integrations that are offered include:

- Jira for Task Management - Jira is a popular tool for task management largely for two reasons - ease of use and its low cost. Jira integrates well with UrbanCode Deploy as well as ADFz
- GIT as an SCM - GIT is an open source SCM slowly capturing the market place across technologies. If GIT is the enterprise standard SCM in your organization, there is no reason why it can't also be used for z/OS. IBM has a Dependency Based Build for GIT currently in Beta. In addition, GIT integrates with ADFz.
- Jenkins as a Pipeline Orchestrator - Jenkins is an open source tool capable of automating builds and orchestration of the Delivery pipeline with plugins that can be used to connect different third party tools used across an IT application. Jenkins can be used to trigger GIT builds and also integrates well with RTC and UrbanCode Deploy
- SonarQube is a popular enterprise wide quality inspection tool which handles a wide range of technologies. ADFz integrates seamlessly with Sonar for on-the-go quality checks.

Having an integrated open source pipeline is a critical transformation to allow organizations to move at the speed required by the business. This brings teams together, breaking down the silos and breaking down the barriers between the different teams and the different parts of the organization.

IBM is the only company that provides a complete end to end cross-platform DevOps solution. The IBM philosophy is to allow clean integration with open source, third party, and legacy tools, so that best of breed tools can be mixed and matched, and existing customer investments are protected during a transformation journey.

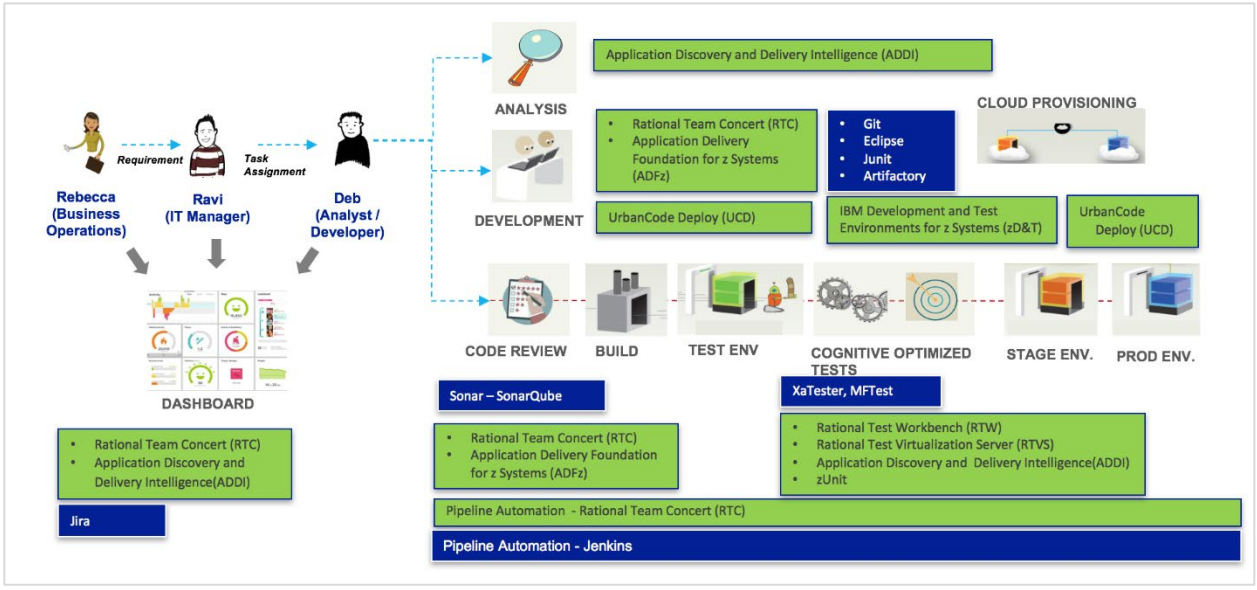

Figure 9: Automated Delivery Pipeline

Have performance visibility from device to backend

Today's digital businesses rely upon a large amount of software systems built throughout the history of the organization. Much of the recent focus in IT has been on systems of engagement such as mobile and web applications, but there are countless systems underneath these newer modern applications. For many of the largest enterprises in the world, IBM Z is running core systems of record application that are critical to new enterprise applications.

The increasing complexity of this technical stack and resulted in many different operations teams using different tools and view to monitor their particularly platform or set of platforms. The problem, is that no one has the full end to end view and when problems arise, it often requires pulling in multiple teams to work in a war room, everyone working the problem in parallel and trying to provide it's not 'their' application component that is at fault.

Application Performance Management (APM) software provides an end to end view of the entire application - from mobile to mainframe. This enables rapid problem isolation and significantly reduces the time to resolution. But today, very few leading APM vendors have support for IBM Z.

With IBM Z APM Connect, mainframe application components are now visible in both IBM Cloud APM v8 and also the AppDynamics APM offering. This enables enterprises with system

of record application running on IBM Z to at long last get visibility of these application components in their APM software. By supporting multiple APM vendors, clients have choice and flexibility of to select their APM vendor of choice, safe in the knowledge that their critical Z applications components will be visible in their APM dashboards.

Optimize

Predict and respond to achieve the highest levels of confidence and agility to meet business goals and prevent interruption of services.

Optimize development with advanced analytics

Throughout the DevOps lifecycle, a huge amount of data is produced including code, designs, test cases, test execution records and operational information about applications. Advanced analytics can be used to analyze this information to work more effectively. For example, it can expose difficult to identify interdependencies and issues in code that provide powerful insights. ADDI's analytics capabilities will allow users to analyze the correlated runtime performance data, with static code quality data, as well as the testing details over time. It will pro-actively alert users on early problem detection so resources can be shifted to the areas that need attention.

One of the pain points for enterprises is the struggle with collecting and understanding application development data and how it impacts IT operations. With ADDI, automation and intelligence assist in collecting data from millions of lines of code, operational logs, code metrics, and code coverage, which can then be used to identify the data that matters, make sense of this data, and then communicate the insights from it visually for further investigation with confidence. It is based on taking a very proactive approach (as opposed to a reactive approach) to dealing with issues, thereby reducing risk. So ADDI becomes that smart, trusted advisor that intelligently connects key pieces of information from a sea of data to improve the development process, and anticipate issues. For example, if your operational data in OMEGAMON reports that an application's response time has increased, correlating this data with Application Discovery data regarding recent changes, one can quickly pinpoint the likely reason for the performance degradation. Furthermore, using complexity and maintainability information, it can alert the client to the level of risk associated with fixing the performance issue.

Testing is an area where there are abundant opportunities for transformation. When dealing with a large code base, and a lot of tests to run, resources need to be spent efficiently to run tests optimally, especially when those tests are run manually. ADDI uses code coverage data as well as data on code changes to optimize time and resources needed to quickly decide which tests to run. For example - What is the minimum set of tests with the biggest coverage impact based on your changes? If 1000 test cases are available and 5 lines of code have been changed, only 10 test cases that touch those 5 line of code might need to be run instead of all 1000 test cases resulting in a savings of 99% of manual testing effort. Furthermore, visibility into whether there is sufficient coverage for the new code that has been added to the

application compared to past test runs with the old code are required. Does the new code just added to the application in the last build have sufficient coverage compared to previous builds? Are the tests keeping up with the changes to the application? ADDI stores and analyzes all the code coverage and code change data for all builds to provide such powerful insights. It can reveal which parts of the code gets executed most, gets changed the most, experiences the most problems to empower test teams with insights that reduce risk and improve productivity.

ADDI brings the integrated intelligent DevOps experience that accelerates efficient application development and deployment.

Transform monolithic applications into granular services

True business agility requires a loosely coupled and granular architecture. Evolving exisiting architecture as well process go hand in hand to achieve the highest levels of speed and agility. If monolithic applications are impacting business agility, ADDI and ADFz can be used together to intelligently refactor those applications. Business initiatives such as API enablement for participation in the API economy, business rule extraction to enable business rule updates without programming, or movement to a microservices architecture, all can end in a need to restructure your existing programs. Refactoring requires an Enterprise View which ADDI can provide. It also provides capabilities such as program call graphs, data flow analysis, code complexity metrics, and code coverage monitoring can be used to identify refactoring candidates and govern refactoring activities. ADFz can be used to perform the restructuring with deeper program visualization, refactoring wizards, visual debugging, and code coverage collection. Refactoring empowers enterprises with applications that become easier to maintain as well as provide the ability to expose business critical logic to partners or other in house projects. Once the end-to-end pipeline is in place and automated testing is set up as part of the transformation effort, rerunning tests to check viability of refactoring is much easier, ensuring code quality after refactoring.

IBM is the only vendor that provides tools that enables rapid refactoring of your application architecture within an end-to-end cross-platform DevOps solution

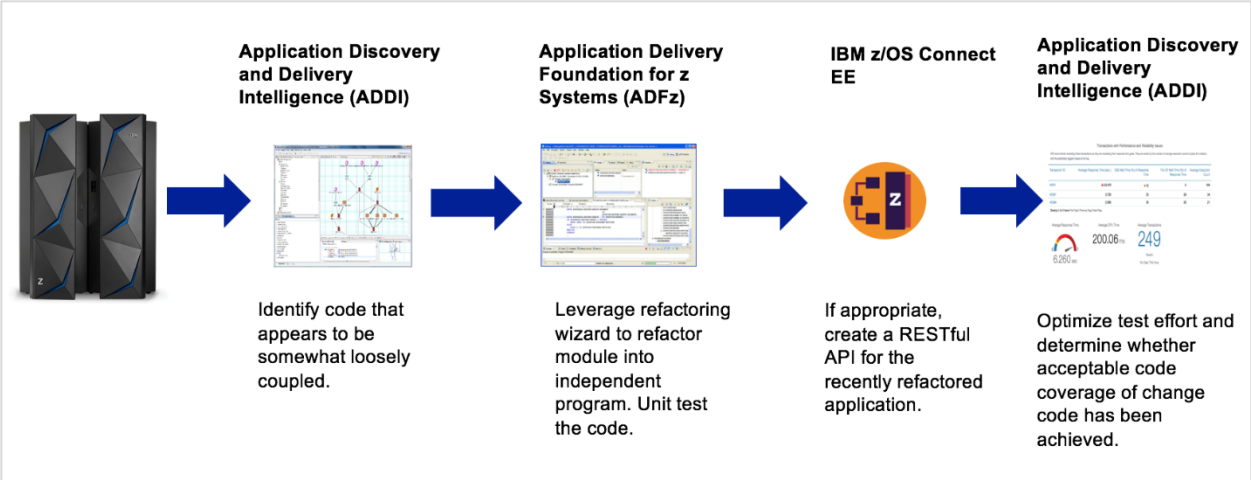

Figure 10: Refactor monolithic applications

Predict and automatically respond to service interruption

Demands for 24x7 high performance operations continue to rise. This is coupled with service windows that shrink and are much less frequent while IT budgets are squeezed. Enterprises need to manage applications and infrastructure seamlessly across a wide variety of hybrid environments—including public cloud, distributed infrastructure and IBM Z.
IBM Operations Analytics for z Systems (IOAz) and IBM Common Data Provider for z Systems (CDPz) ensure your IBM Z servers operate at peak performance by providing near real-time access to the vast amounts of operational data in your Z server so you can build your analytics ecosystem and quickly analyze data in-place. Clients who have deployed this IBM solution have reduced the time required to do root cause analysis up to 60 percent — and even learned of potential problems before they occur.

IOAz allows customers to ingest, search, and visualize disparate sets of IBM Z log and SMF data to quickly get to the root cause of issues. Its includes problem insights, dashboards, recommended actions, and quick searches to save operations teams time when problems arise. The zAware component of IOAz alerts customers to potential issues by detecting anomalies in Z log data which can prevent issues.

CDPz collects a wide range of IT Operational data (140+ data sources are available) once and streams the data to multiple destinations in near real time. It integrates with the market leading analytics engines (Splunk, Elastic, IBM). IBM has partnered with Splunk to empower clients with the ability to quickly take information and turn it into powerful insights.

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