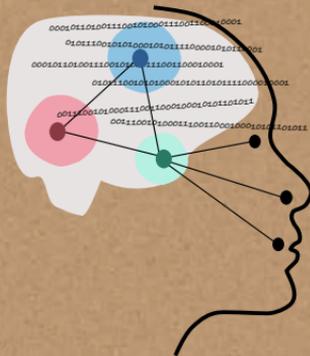


```

// everything is code
// registers methods
// edge type function is a critical path
if (obj instanceof) == "valueType" {
  obj.add(function() {
    res.status(200);
  });
  res.render('error', {
    message: err.message,
    error: err;
  });
}
// configuration as code
// not replicating in the single point of truth
obj.add(function() {
  res.status(200);
  res.render('error', {
    message: err.message,
    error: err;
  });
});
// Compliance, governance, auditing
// @property configurations
obj.add(function() {
  res.status(200);
  res.render('error', {
    message: err.message,
    error: err;
  });
});

```

Engineer



# IBM Cloud DevOps Field Guide



Download the current version of the IBM  
Cloud DevOps Field Guide



<http://ibm.biz/Ibm-cloud-devops-field-guide>

# Deliver faster. Beat the competition.

DevOps is the modern way to deliver digital products. It is an approach where traditionally siloed development and operations teams come together with a product-focused mindset to deliver faster and with higher quality. Over time, other stakeholders, such as the business owner, quality assurance (testing), security, and end users collaborate to continuously deliver software.

## QUICKLY DELIVER TO THE MARKET WITH QUALITY

**Build a startup culture.** Bring business, development, operations, and other stakeholders together.

**Respond to the market faster.** Address organizational inertia, optimize delivery workflow, and leverage cloud technology to respond to consumer demands.

**Reduce development and operational costs.** Automate processes such as code integration, testing, deployment, application monitoring, and issue management.

**Instill trust and confidence.** Engineer transparency, observability, and the appropriate amount of risk mitigation into the delivery pipeline.

---

## What's inside?

This field guide provides a high-level overview of the IBM Cloud DevOps strategy.

### LEARN IT

A summary of the concepts.

### GET STARTED

Tips to start your journey to the cloud.

# DevOps: the DNA of modern delivery

To achieve enterprise agility and responsiveness, use the IBM Garage™ Methodology DevOps practices. These practices combined with Enterprise Design Thinking, agile practices, Lean Startup, and modern architectures enable you to improve your time to market.

## AMP UP YOUR AGILE WITH DEVOPS

**Break down silos.** Don't let heritage organizational boundaries hinder delivery velocity. Collaborate with reckless abandon, work in new ways, and focus on your product.

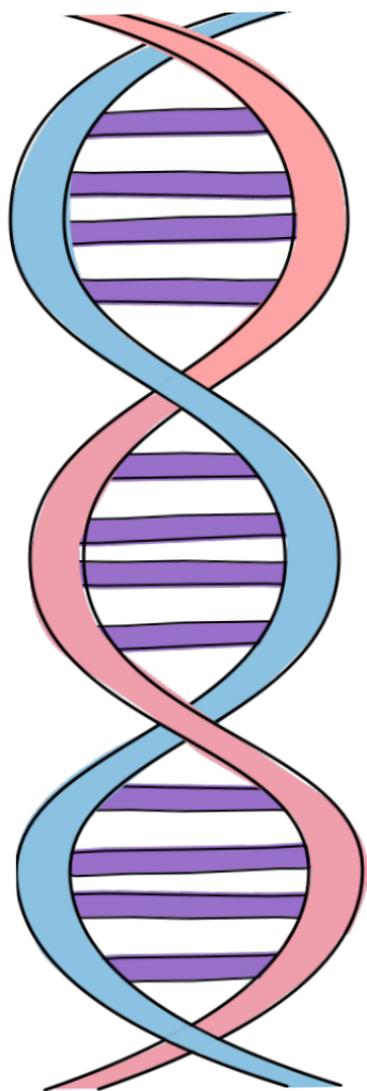
**Establish a continuous delivery pipeline.** Automate the mechanical and mundane, instrument the delivery pipeline for observability, and engineer just enough governance to mitigate the appropriate amount of risk.

**Improve, iteratively and continuously.** Use key performance indicators to gauge your success over time. Is delivery getting faster? Is product quality improving? Are end users happy with the services and experiences being delivered?



Learn more

Explore practices in the IBM Garage Methodology.  
<https://www.ibm.com/garage/method>



# A new reality for hybrid multicloud

DevOps is not new. Or is it? Hybrid and multicloud adoption forces your enterprise to re-examine how people, practices, processes, and platforms are different than they were in the heritage landscape. How are you applying DevOps practices to your integration landscape, data science, and platform engineering?

## MODERNIZE HERITAGE DEVOPS FOR THE CLOUD

**Make way for new roles, stakeholders, and beneficiaries.** The Site Reliability Engineer (SRE) role speaks to the resurgence of service quality (availability, scalability, maintainability) in delivery; throw some love at IT Security, early....like real early, for the sake of your digital reputation.

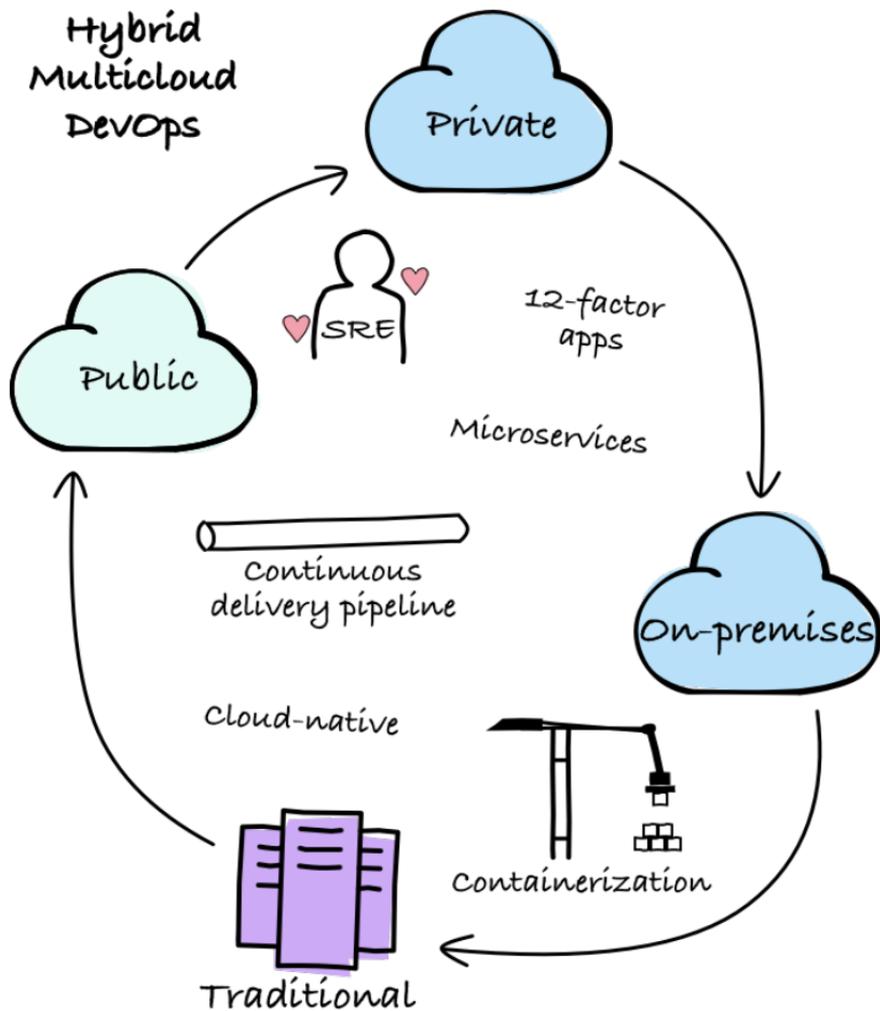
**Leverage new platforms and tools.** Cloud's commoditization of network, infrastructure, and middleware has opened an opportunity to move value up the stack. As you adopt cloud architecture and platforms the tools in your continuous delivery pipeline should change.

**Deliver differently.** Consider 12 factor apps, containerization, and microservices. Modern cloud-native apps are built, tested, and delivered differently than their heritage counterparts and they land on different platforms. The mechanics of build, test, and deploy are not the same.



Read the Modern DevOps Manifesto.

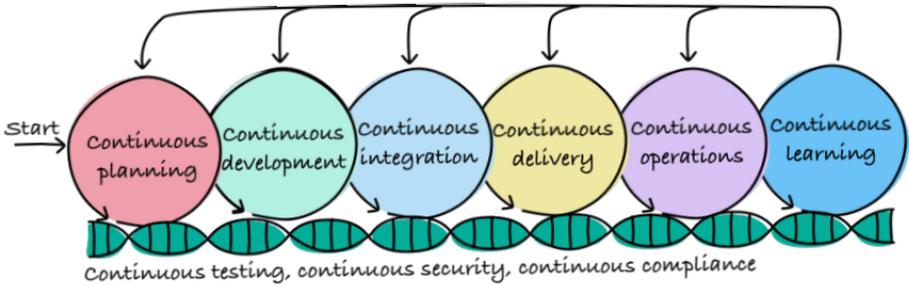
<https://medium.com/ibm-garage/the-modern-devops-manifesto-f06c82964722>



# DevOps Reference Architecture

People, process, tools and technology are critical to DevOps. When compared to people, tools and technology are the easy part of modern delivery. People are your greatest asset. Create an agile culture and give your people the tools they need to be successful.

## SUPPORT CONTINUOUS “EVERYTHING”



Learn more

Check out IBM Cloud Architectures.

<https://www.ibm.com/cloud/architecture/architectures/devOpsArchitecture/reference-architecture>

**Continuous planning.** A healthy rank-ordered backlog includes new features, technical debt, defect remediation, and end user feedback. Along with the squad, the product owner prioritizes, estimates and clarifies user stories.

**Continuous development.** Curated application stacks, pipelines, and integrated toolchains liberate developers so they can do what they do best...code! Developers need to onboard quickly with a simple, easy, and consistent experience that minimizes workstation variance.

**Continuous integration.** Merging features quickly and frequently into the pipeline promotes early detection of defects. Build trust and confidence by using automation for build, test, static analysis, compliance/governance, and packaging.

**Continuous delivery.** Automate deployment so that when it is time to deploy to production, it's almost a "non-event."

**Continuous operations.** If "Day 1" is "all that development stuff", "Day 2" is "all that operations stuff". Monitor granular services and healthcheck end points, connect operations tools with chatbots, and instrument applications with the hooks needed to manage them in their runtime environments.

**Continuous learning.** Observe the delivery pipeline and make improvements that infuse more quality into the product. Cloud-native applications make it easier to respond to user feedback via roll out and rollback deployments, which make A/B testing, and canary and zero downtime deployments possible.

**Continuous testing.** Weave image scanning, vetting library dependencies for license compliance, and testing cluster and namespace policies into the pipeline in addition to unit, contract, and penetration testing.

# DevOps trends

Look at DevOps through a new lens to cope with modern client challenges. DevOps is not just for applications anymore, nor is it just about development and operations. Here are some trending ways in which DevOps is being applied. Some are new and some are perennial favorites.

## DUST OFF YOUR DEVOPS AND EXPAND YOUR HORIZONS

```

1101011LOCKED110010100011001100010101
01011PROTECTED010010101110000PRIVATE10001
10101110011010111000010001
0011SEALED100110100010101101011
110011001010101010101101111
00010101011001011SECURE10010100011100101
  
```



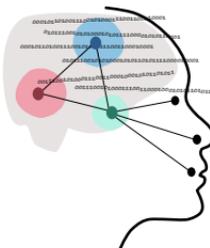
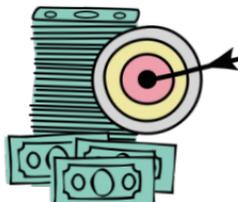
```

// everything is safe
// engineer are safe
// only from engineer is a critical asset
if (engineerStatus) {
  app.use(function(req,res,next){
    res.status(200);
    message: err.message,
    error: err,
  });
}

// configuration is safe
// the message is the single point of failure
app.use(function(req,res,next){
  res.status(200);
  message: err.message,
  error: err,
});

// compliance, governance, auditing
// everything is configuration
app.use(function(req,res,next){
  res.status(200);
  message: err.message,
  error: err,
});
  
```

Engineer



Learn more

Read the blog on DevOps trends:

<https://medium.com/ibm-garage/2019-devops-trends-4f8f9b476ac7>

**DevSecOps.** Look at DevOps with a focus on secure design, development and delivery. Note how security is architected into cloud-native applications and platform constructs like clusters, namespaces, deployment configurations, SDN, roles, and pipelines.

**AIOps (AI for IT Operations).** Apply deep and machine learning (ML) to model behavioral patterns in operations using the data that cloud native applications generate to arrive at predictions. When applied to IT operations, AIOps provides insight about a system and can give rise to predictive alerts, reduction in mean time to repair (MTTR), and outage avoidance.

**ModelOps.** About those ML models...they're not just for AIOps. Part of infusing AI into the enterprise is building a rich set of ML models that can differentiate you from your competition. ML model lifecycles are highly iterative, involve code, deployments, and publishing for consumption. The constructs are different, but the pipeline activity, like application code, can be automated in a toolchain.

**BizDevOps.** Focus on leading product management practices and tools, while grooming strong, agile product owners. Avoid failure by investing and emphasizing the importance of agile product management practices.

**GitOps.** Adopt an approach in which operations benefit from managing platforms and services on “Day 2” similar to the way developers manage their code on “Day 1.” GitOps is an evolutionary step in infrastructure-as-code. Source repositories are the source of truth for operational, infrastructure, and platform assets that define the desired state of environments.

# DevSecOps

DevSecOps is DevOps with a lens for security: secure design and development of code, secure delivery through the pipeline, and secure operations on Day 2. The challenges introduced with decentralized workloads on the cloud, developers empowered with self-service, and unprecedented accountability requires careful re-examination of separation of duties, policy implementation, and how that translates to modern cloud platform constructs.

## SECURE DELIVERY INSTILLS TRUST & CONFIDENCE

**Everyone is accountable.** The IT security organization, developers, architects, operations, and engineers are accountable for protecting the enterprise. It is essential to include ITSec, AppSec, and NetSec as crucial stakeholders in the evolution of your delivery governance, pipeline activities, and operational readiness.

**Mitigate the right amount of risk.** Boldly question every pipeline task that hinders velocity. Be sure it addresses a liability or mitigates an unacceptable risk to the enterprise's digital reputation. What risk is taken if a pipeline task is not done?

**Implement continuous compliance.** Cloud adoption includes policies and tools that provide a new granularity of control to images, pipeline governance, application stacks, cluster environments, and identity and access management that can extend the cloud platform.



Check out the IBM Cloud Security Architecture.

<https://www.ibm.com/cloud/architecture/architectures/securityArchitecture>

11010111 LOCKED 1100101000111001100010101  
010111 PROTECTED 0100010101 110000 PRIVATE 10001  
1010111001 0101 11000010001  
0011 SEALED 100 100 0010101101011  
11001110010 010101101111  
000101010111001011 SECURE 100101000111001101

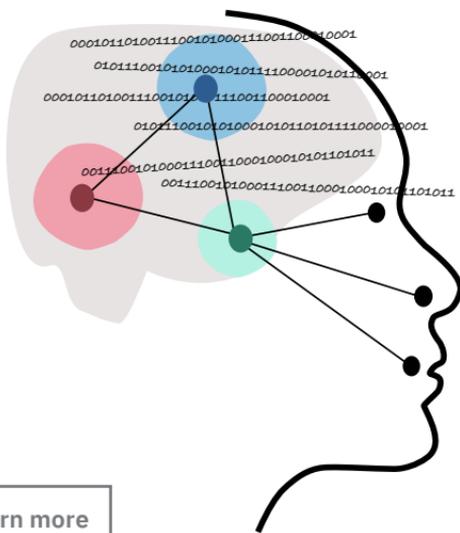
Declarative approaches to platform compliance leave the control flow logistics to the platform to achieve the “desired state”, making continuous compliance achievable.

# AIOps

Traditional monitoring is changing. Teams can no longer rely on administrators to define a set of monitors and associated thresholds that might or might not detect an issue as it occurs. This lack of insight into a system means that significant events can occur with almost no foresight or warning.

“AI for IT Operations takes data from tickets, metrics, and log sources, and uses deep learning and AI to gain insights from the data. This data is then infused into processes to provide expert guidance for the operations teams.” –Richard Wilkins, IBM Distinguished Engineer

## SOLVE IT OPERATIONS PROBLEMS BY USING AI



Read about AIOps.

<https://www.ibm.com/cloud/architecture/architectures/sm-aiops/overview>

**Collect relevant data.** Monitoring products collect large amounts of data that is streamed into a common centralized data lake, which enables AI models to create a system performance baseline. Relevant data must be defined collaboratively by application and system stakeholders.

**Organize and curate data.** Understanding the data and ensuring that it is curated, accurate, organized, and up to date is important. A data science team that understands the origin of the data, company policies and rules, and the different data types can make or break the accuracy of your AI predictions. Use big data tools and concepts to organize the data into logical groups, or data sets, that drive AI models.

**Analyze by using data models.** It is key to select the right AI models to get the most accurate results from a data set. Data scientists select and train the AI models that best suit the available data. Models are fed data through supervised and then unsupervised learning to establish a baseline of predictions that yield high confidence. Models continuously learn with reinforcement learning to correct biases and follow changes in application behavior.

**Infuse processes with insight.** The true value of AIOps is realized when the insight gained from AI models is infused into operational processes and procedures. Use collaboration tools that surface and publish the results from AI models. These tools bring people together so they can interact while using the insights provided by AI.

# ModelOps

ML models must be trained (tested) and iteratively refined to achieve the predictions needed to bring greater insight to a problem. ML models consist of code, an analogous build to package and publish a binary artifact, which is the runtime deployment of the model, and an endpoint in which the model is consumed.

## MACHINE LEARNING MODELS + DEVOPS = MODEL OPS

**Consider the lifecycle of model data.** ML models are fed with data from the collect and organize rungs of the IBM AI Ladder. Raw data is collected from a variety of sources and pre-processed to prepare it for consumption by an ML model.

**Manage and govern your ML models in a pipeline.** ML model code is stored and version controlled in a repository. The source code must be packaged and deployed (usually as an API endpoint), married with its pre-processed data, trained, and evaluated to generate predictions.

**”Day 2” for ML models.** Models and their predictions are only as good as the data they ingest. Data changes over time, ML models “decay,” which signals an opportunity to iterate on the model and examine the data it consumes to make its predictions. Continuous learning is key for the life cycle of ModelOps, which may result in a model being updated or retired.



See IBM’s AI and Analytics architecture.

<https://www.ibm.com/cloud/architecture/architectures/aiAnalyticsArchitecture>



AI is built on the strength of the machine learning (ML) models that provide good actionable predications.

# BizDevOps

The fast pace of cloud adoption and change leads successful agile organizations to place a much greater emphasis on the quality and business effectiveness of new digital capabilities. After adopting DevOps practices and technology to streamline your IT team, removing blockers, and building a pipeline, you continuously deliver faster than ever before. However, you must ensure you are delivering what the market demands.

## THE RIGHT OUTCOMES AT THE SPEED THE MARKET DEMANDS

**Clearly define the business and user problem.** Enterprise Design Thinking is a proven way to clarify the definition of your desired business outcomes. Technology enables you to deliver the solution.

**Focus on business outcomes, not the work.** Set Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) goals for your product owners. Effective and empowered product ownership sets clear strategic goals so that delivery teams can autonomously achieve those goals.

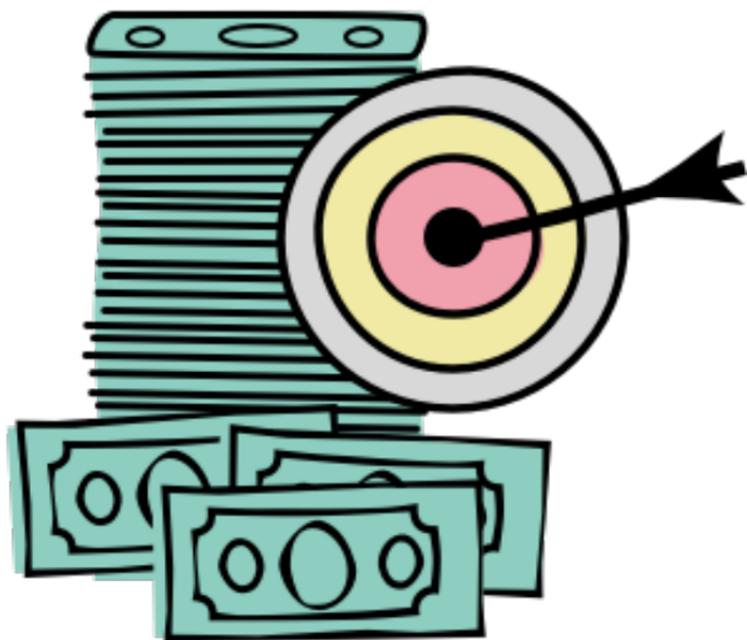
**Empower product owners.** Product owners are the organizational glue between leaders and agile teams. As CEO of their product, good product owners help teams do less starting and more finishing.

**Measure value outcomes, not work.** When it comes to delivering value, busy does not mean productive. SMART goals matter to the business, and measuring and achieving those goals defines true success.



Learn how to empower your product owners.

<https://www.ibm.com/garage/method/practices/culture/empower-product-owners/>



Ensure you deliver what the market demands!

# GitOps

Infrastructure, platform, and operations engineers are essential roles in a modern enterprise. With the adoption of cloud platforms, configurations for applications, clusters, policies, roles, monitors, chatbots, and operators are version controlled coded assets with their own pipeline and lifecycle. Git is a well-known version control system for coded assets. Use it or your favorite version control system to enable GitOps.

## THE NEXT EVOLUTIONARY STEP OF CONFIGURATION-AS-CODE

**System engineers are coders.** System operators are engineers who code. Their code is a valuable asset to the enterprise and must be treated as a “first class citizen,” just like application code. Ensure your engineers have the tools they need to maintain and curate their assets.

**Everything is code.** Source repositories are the source of truth for operational, infrastructure, and platform assets that define the desired state of environments. Repositories serve as the single point of management for environment configurations and can be used to separate concerns, duties, and access.

**Compliance, governance, agility...oh my!** Configuration-as-code can make IT Sec and auditors super happy with the audit trail, access and version control capabilities that come with repositories, because all changes are observable and verifiable. Deploy configs through pipelines and trigger config deployments, just like application code. That’s pretty hands off!



Read about the DevOps architectures.

<https://www.ibm.com/cloud/architecture/architectures/devOpsArchitecture>

```
// everything is code

// engineers are coders
// code from engineers is a critical asset
if (engineercodes) === 'realdevelopment' {
  app.use(function(firstclasscitizen) {
    res.status(err.status || 500);
    res.render('error', {
      message: err.message,
      error: err,
    });
  });
}

// configuration as code
// the repository is the single point of truth
app.use(function(concerns, duties, access) {
  res.status(err.status || 500);
  res.render('error', {
    message: err.message,
    error: {},
  });
});

// Compliance, governance, agility
// deployable configurations
app.use(function(audits, deployment, pipeline) {
  res.status(err.status || 500);
  res.render('error', {
    message: err.message,
    error: {},
  });
});
```

Engineer

# One facet in the enterprise modernization diamond

The modern enterprise is all about delivering modern applications on modern platforms with modern teams. DevOps in combination with application, integration, platform, and operations modernization becomes a multiplier to achieving the success enterprises strive for.

## DEVOPS...IT GOES SO GOOD WITH *FILL IN THE BLANK*

**Application modernization.** You invested in cloud adoption and moving parts of your application portfolio to the cloud. Pipelines and toolchains must evolve with your apps and the platforms.

**Integration modernization.** Whether it's exposing functions deep in your core systems, connecting microservices to APIs, or managing configurations, use DevOps automation as an enabler to bridge custom application development and integration capabilities.

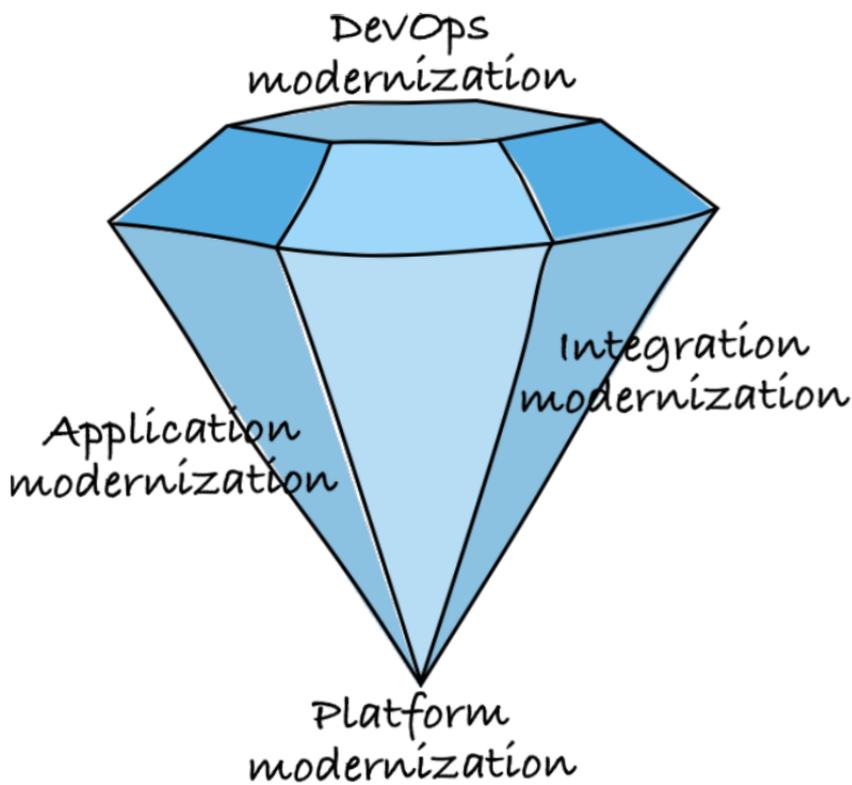
**Platform modernization.** As workloads move to container based platforms, infrastructure engineering implements GitOps to create and manage platform assets. Policies, configurations, and resources require governance and benefit from pipeline automation as they are iteratively developed and managed.

**Operations Modernization.** Modernize operations for the cloud and adopt SRE practices.



Read about modern architectures.

<https://www.ibm.com/cloud/architecture/architectures>



If DevOps is the only facet of your transformation, you're doing it wrong.

# DevOps on IBM Cloud

IBM Cloud has DevOps capabilities for your cloud native apps no matter where your hybrid cloud workloads land. Create and customize an open toolchain from a template or roll your own. Powered by open source technologies, like Tekton, IBM Cloud Continuous Delivery service provides the framework to take your source code to a running container in the cloud.

## CLOUD PROUD, DEVOPS STRONG

**Like open source pipeline tech? We do too!** IBM Cloud provides Kubernetes CI/CD capability using open source Tekton. Of course, we git code, and hope you do too!

**Leverage existing tool investments? Check!** The toolchain templates enable you to start quickly, easily integrate your existing tools with your toolchain, and create custom stages for your continuous delivery pipeline.

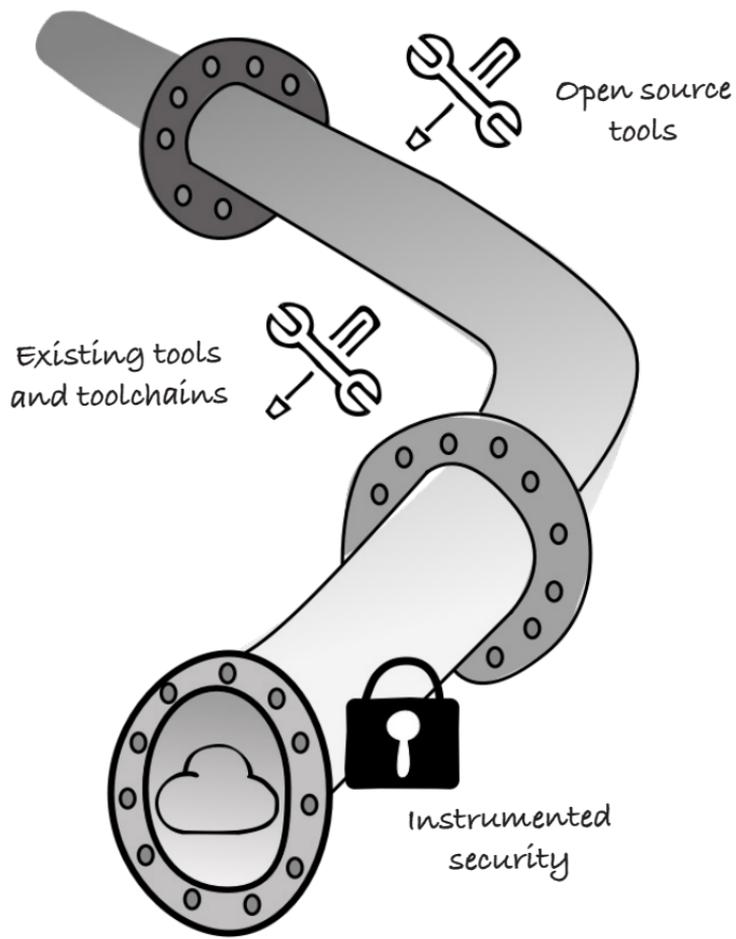
**Instrument with IBM Cloud innovation? Yes, please!** You can instrument innovative security and compliance services in your CI/CD pipeline using the IBM Cloud Code Risk Analyzer and IBM Cloud Security and Compliance Center. Shift left security and compliance are integrated with your pipeline without changing your code and by leveraging predefined industry compliance goals.



Check out IBM Cloud Pak®.

<https://www.ibm.com/cloud/cloud-pak-for-applications>





Want to send build alerts to your Slack team?

# Hybrid DevOps with Red Hat OpenShift

Hybrid cloud holds the promise of extending the enterprise estate beyond on-premises data centers to include the public cloud multiverse. How do you design, develop, deploy, and manage your cloud native workloads?

## COEXISTENCE IS KEY, CONSISTENCY IS CRUCIAL

**“Hey, Java! Those containers look good on you!”** Modernize your WAS estate to Java running in Liberty containers on the Red Hat OpenShift Container Platform. Migrate heritage WAS workloads using tools to analyze and automate. Match your containerized Java by modernizing your k8s native CI/CD pipelines with Tekton.

**Deploy workloads to Red Hat OpenShift in your “frankencloud”.** Build once, deploy anywhere. Red Hat OpenShift Container Platform is the industrialized version of Kubernetes in your hybrid, multi, open, “frankencloud”. Deploy containers with open source k8s native CI/CD to land anywhere in your hybrid cloud.

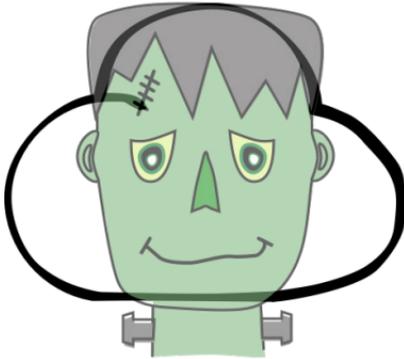
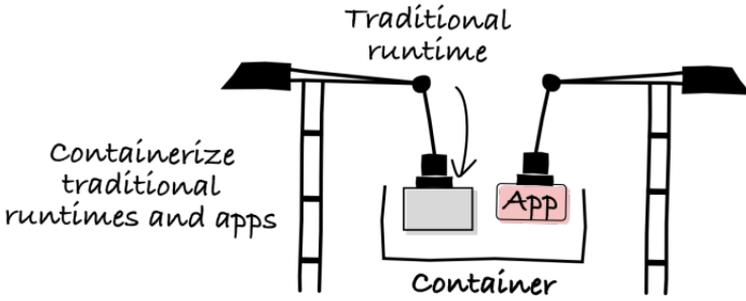
**Respecting the “classics” (mainframe DevOps).** In many enterprises mainframes run your essential core processes. Accelerate the modernization of your mission-critical apps. IBM Z® offers a standard lifecycle toolchain and automation.



Check out IBM CCloud Pak.

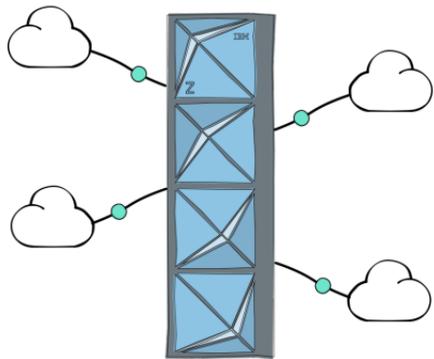
<https://www.ibm.com/cloud/cloud-pak-for-management>





Deploy workloads in your frankencloud

Modernization and the mainframe



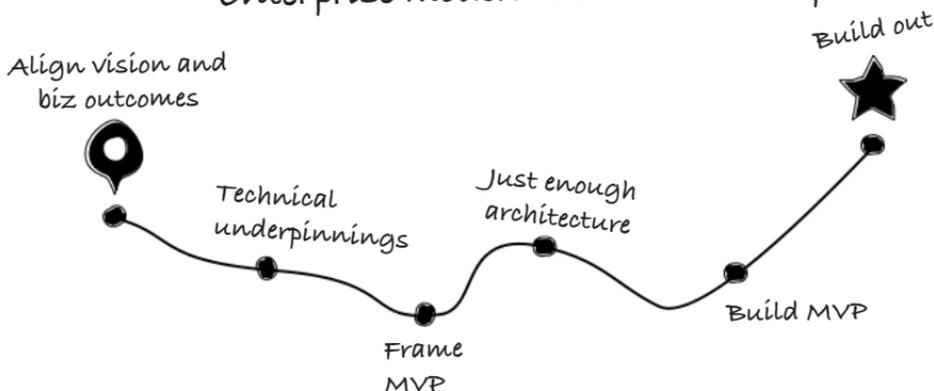
# IBM Garage can help you with DevOps

DevOps is at the core of IBM Garage and enterprise modernization. The IBM Garage is ready to help enterprises transform people, process, and tools to achieve the business results you need to stay competitive and differentiate your business in the market. IBM Garage is your trusted partner to co-create, co-execute, and co-operate in ways that matter to your enterprise.

LET'S BUILD SOMETHING TOGETHER

Partner with the IBM Garage!

Enterprise modernization roadmap



Learn more

Check out the IBM Garage.

<https://www.ibm.com/garage>

**Align on vision and desired business outcome.** Whether it's strengthening your enterprise's position in the market with innovative products for consumers, or being responsive to market conditions, DevOps must be placed in proper context to bring value to the business. This results in defining your "diamond", which includes more than DevOps.

**Discover technical underpinnings.** Explore technical areas of interest. Are there applications that are of interest? Are there emerging technologies or capabilities that align with enterprise strategies? Define the non-functional and qualities of service you strive for.

**Frame your MVP.** Use Enterprise Design Thinking to align business and IT with an end user experience and roadmap that meets the desired business outcome. Identify, define, and scope your MVP experiment in the context of a roadmap. Be sure to identify risks and assumptions.

**Define just enough architecture.** Define a secure minimum viable architecture that mitigates risk. Architect and create an implementation roadmap for a hybrid, multicloud platform and DevOps adoptions.

**Build an MVP.** With new ways of working, modernize, deploy, and test the application with a DevOps pipeline. Test hypotheses against the stated business outcome.

**Build out.** Iterate across multiple MVPs to refine your solution until you achieve the stated business outcome. Then, scale your production environment and applications.

**IBM Garage is a trusted partner, providing technology and prescriptive guidance to deliver immediate business value.**

## Notes:

Get Technical with the IBM Cloud  
DevOps Architecture

<https://www.ibm.com/cloud/architecture/architectures/devOpsArchitecture>

Try these DevOps code assests!!

<https://github.com/ibm-cloud-architecture/gse-devops>

Learn more about Red  
Hat OpenShift

<https://www.openshift.com/>

Learn more about IBM Cloud Paks

<https://www.ibm.com/cloud/paks/>

Check out these cool DevOps videos!

<https://www.youtube.com/playlist?list=P-LOspHqNVtKAAMidmyjIRgWMMwIU-Bo0wZVj>

Visit an IBM Garage

<https://www.ibm.com/garage>



Explore the Garage  
Methodology and get a  
badge!!!

[ibm.biz/explore-method-course](https://ibm.biz/explore-method-course)

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# IBM CLOUD DEVOPSS STRATEGY

