



Shaping the Cloud

How We Transformed FINRA With DevOps

A successful story of how FINRA embraced DevOps to transform the organization and revolutionize software delivery.



About Me

Daniel Koo

Senior Director at FINRA managing DevOps Products & Engineering organization. Visionary, leader, influencer, and change agent.

Led the DevOps movement at FINRA since 2015.

Always looking to positively disrupt the enterprise and the industry.

Productivity Engineering

Build custom DevOps products, maintain developer tools

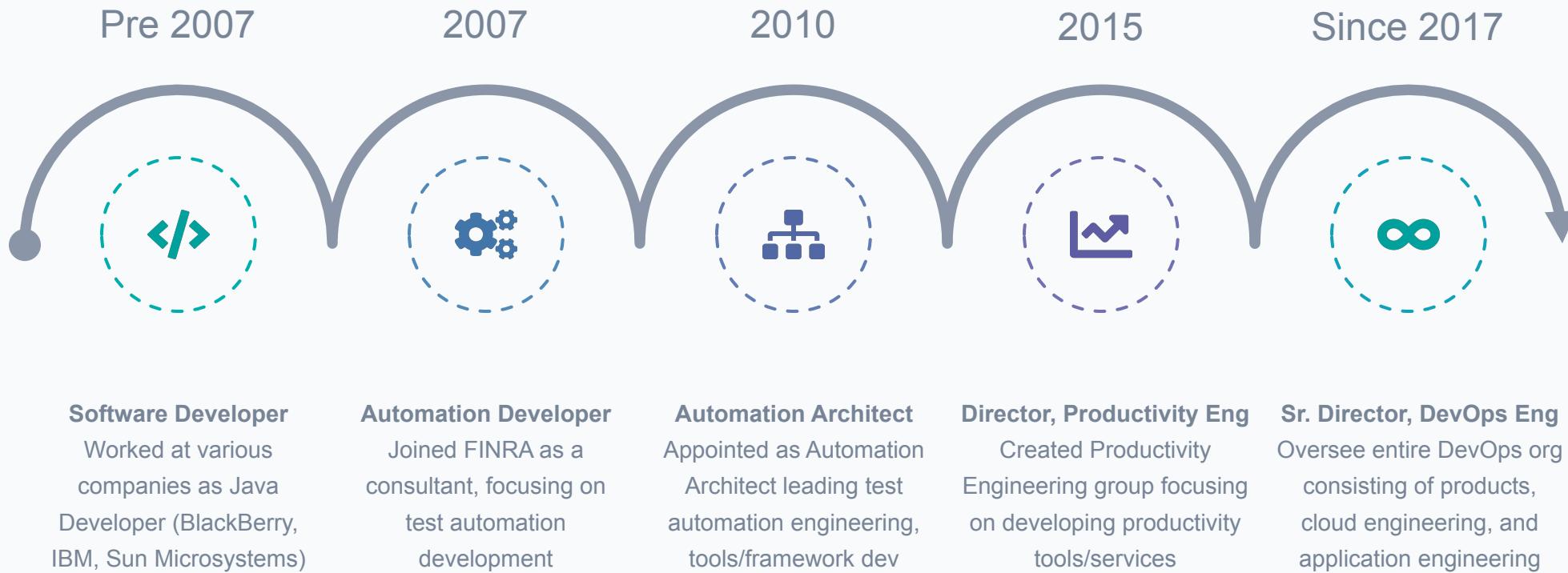
Cloud Engineering

Images, compliance, infrastructure/systems

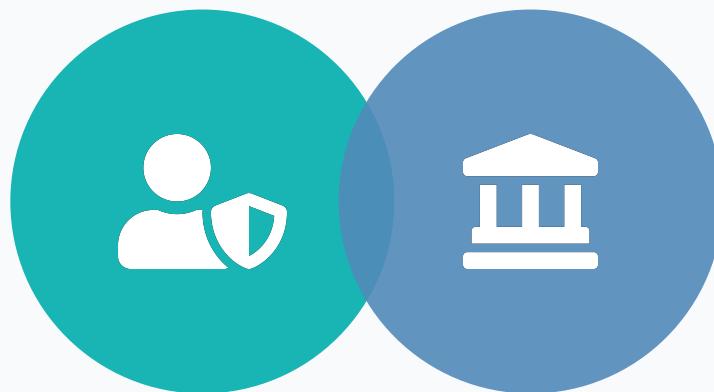
Application Engineering

Support project teams, advocate, train

History



About FINRA



Investor Protection

Market Integrity



Revenue
\$900 mil



Total Employees
~3,600



Tech Org Employees
~1,200



Oversee & Regulate

Brokerage Firms

4,000

Securities Rep

634,000

Markets/Exchanges

12



Foster market transparency

FINRA operates systems that help member firms comply with reporting requirements and facilitate transparency in the applicable markets.



Educate investors

We provide investors with tools and resources that can help them make wise financial decisions.

Big Data

FINRA maintains

150+

applications running in AWS

FINRA processes and analyzes

trillions

of nodes and edges

FINRA processes up to

135 billion

market events per day

FINRA runs up to

50,000

compute nodes

per days

FINRA manages approximately

30 Petabytes

of storage

Data Volume Growth

37 billion
events on average each day in 2017

58 billion
events on average each day in 2018

100 billion
events on a single day in March 2018

135 billion
events on average each day in 2019

DevOps Journey

DECISION TO MOVE TO THE CLOUD

2014

To meet the demand of growing volumes
of market data at scale



Move to AWS. Infrastructure-as-Code.
Re-establish CI/CD strategy.
Start defining DevOps.



Define backlog with stakeholders -
Enterprise Architecture, Security, Ops,
Development community



PRODUCTIVITY ENGINEERING ESTABLISHED

2015

Centralized team focusing on building products to
support Cloud Migration and DevOps

DEVOPS PRODUCTS DEVELOPMENT

2016

Core DevOps products implemented and adopted across the enterprise



Onboarding, provisioning, network, deploy, integrated security/compliance, integrated ops. Based on architectural patterns.



Establish DevOps experts. Field engineers supporting application development teams. Advocate DevOps.



APPLICATION ENGINEERING CONSOLIDATION

2017

Transform traditional CM engineers to Application Engineers and consolidate within DevOps org

TRAINING & CONTAINERS

2018

Make rest of the technology org DevOps aware/capable. Move to Containers.



DevOps Bootcamp training. Docker development and AWS ECS migration.



Lambda, Fargate, Aurora.
ChatOps, insight, query, dashboards.
Predictions, behaviors/patterns.



SERVERLESS & AI/ML KICKOFF

2019

Move to Serverless where appropriate.
Start defining AI/ML strategy for DevOps.

Vision



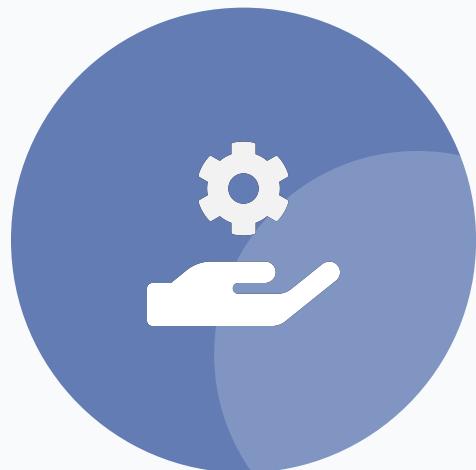
Enable

Teams to **Deliver software faster** and **ensure reliability** at enterprise scale through automation, building products with built-in security/compliance best practices, and continuous monitoring



Advocate

DevOps practices that allow teams to gain **confidence in delivery pipeline** and empower them to **continuously deploy** to production on their own, anytime, anywhere



Provide

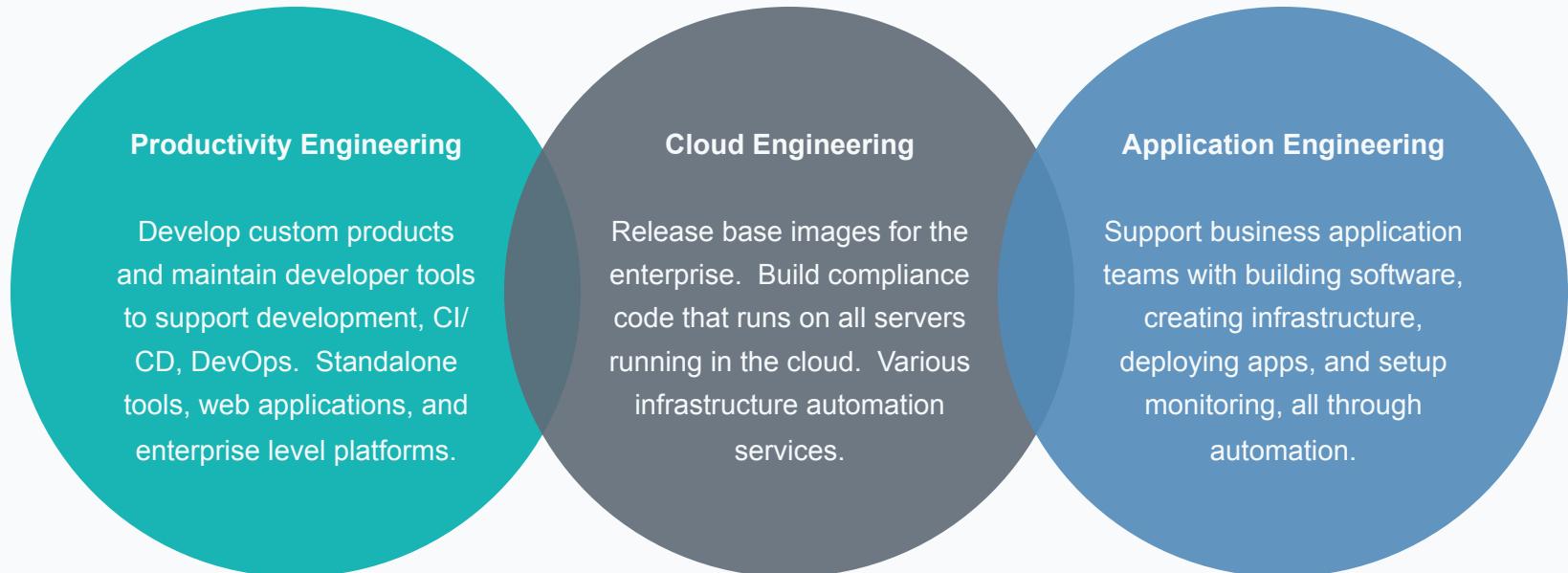
Feedback mechanism to teams by **continuously collecting data** and making them **accessible** via meaningful interfaces



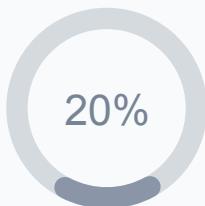
Promote

Collaboration and innovation by **shaping the DevOps culture** within the technology community to revolutionize the delivery experience

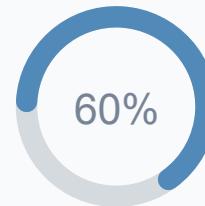
Organizational Structure



Full Stack Development
Software Developers with both frontend, backend development skills. DevOps & Test capable.



Infrastructure / Systems
System Engineers with automation focus. OS, scripting, troubleshooting, and support.



CI/CD / DevOps / SRE
Embedded within application development projects. DevOps experts and automation guru.

Tools & Products



Inception



Onboard



Portus

Standardization

Compliance

Kickstart



Provision



App Config



Jenkins / F3



docker



FINRA Images

Dev/Test



Provision



App Config



Jenkins / F3



Fidelius



docker



Portus



FINRA Images



CloudPass

Architecture Pattern

Integrated Ops

Released



Aphelion



Shaping The Cloud

Open Source

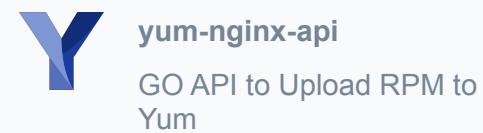
<http://technology.finra.org/opensource.html>

AVAILABLE



Gatekeeper

Temporary access to EC2/
RDS



yum-nginx-api

GO API to Upload RPM to
Yum



Aphelion

Monitor AWS service limits



Fidelius

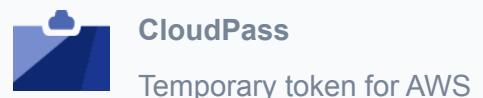
Secrets management in AWS

COMING SOON



Provision

Create resources in AWS



CloudPass

Temporary token for AWS



Portus

Security group manager

Best Practices



Automate Everything

Infrastructure-as-Code. Configuration-as-Code. API integration. CI/CD pipeline. Orchestration. Rollback. Automated tests.



Resiliency & Reliability

Design for resiliency through automation and tools. Auto-recovery. Reliability at every level of the lifecycle.



Compliance & Security

Bake in compliance and security into tools. No opting out. Encryption-at-rest & in-transit. AuthN/Z every traffic. Build-time & run-time scans.



Delivery Insights

Collect relevant data for every aspect of delivery. Make data available for analytics. Query and visualize. Informed decisions.



Standardization & Architectural Patterns

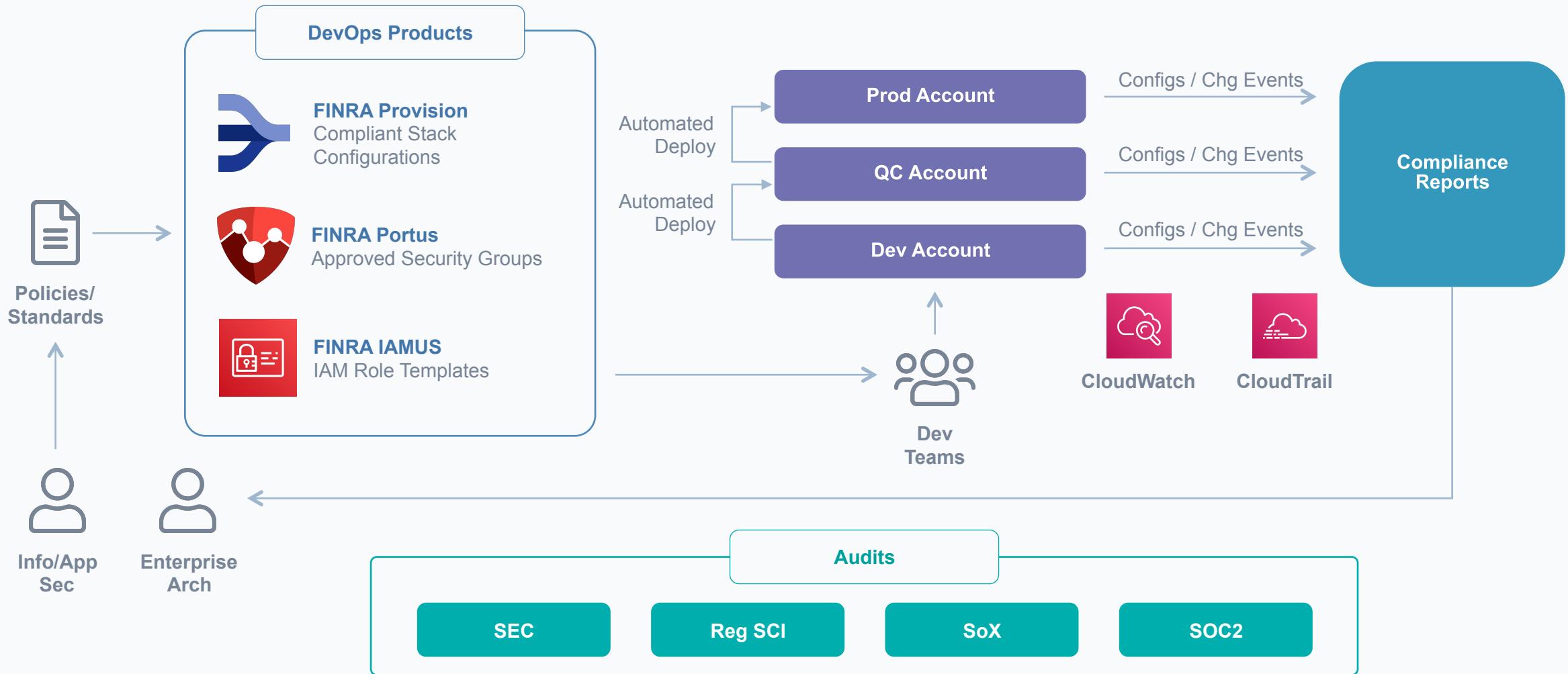
Define stack types. Make it easy for people. Convenient. Easy to troubleshoot. No re-inventing the wheel. Push desired architecture.



Monitoring & Governance

Pre-configured monitoring. Understand health, state. Alert before issue happens. Page quickly. Maximum transparency. Audit friendly/ready.

Compliance, Consistency, Transparency



Adoption



Goal is to enable teams to adopt DevOps and provide oversight

Make it easy for teams to do the right thing. Understand the patterns and focus on enterprise use solutions. Help with adoption, oversee and establish feedback loop.



Focused Product Team

Dedicate a team focusing on building the right products, research new tools/concepts, rapidly make changes.

Embedded Application Engineers

DevOps is owned by projects. Application Engineers help teams to practice. Feedback channel.

Frequent Releases / Feedback

Quick turnaround. Incremental changes. Encourage collaboration/contribution.

Training

Self-paced training with hands-on labs. Keep updating content with new tools/concepts.

Bootcamp Training

The screenshot shows a web browser window with the URL devopsbootcamp.finra.org. The page title is "CREATE ECS CLUSTER". On the left, there is a sidebar menu for the "DevOps Bootcamp" with sections like "1. Introduction", "2. Tools & Products", "3. Containers", "3.1. ECS Overview", "3.2. Example Microservice Architecture", "3.3. Provisioning Exercise Overview", "3.3.1. Create ECS Cluster" (which is selected), "3.3.2. Create ALB", "3.4. Local Development", "3.4.1. Docker Compose", "3.4.2. Build App Image", "3.4.3. Deploy Locally", "3.5. Deployment Exercise Overview", "3.5.1. Push App Image to ECR", and "3.5.2. Deploy Application to AWS ECS". Below the sidebar, there is a "Note" section: "Make sure you have installed all the [tools & software's](#) required before starting with the exercises." Under the "3.3.1. Create ECS Cluster" section, there is a list of steps: "1. Get temporary credentials from CloudPass". The steps are: "Visit <https://cloudpass.finra.org/cloudpass>", "Pick the right priv role", "Enter your network credentials", and "Copy the credentials in your buffer and paste them carefully in your favorite CLI program(be sure to review the tabs) - cmd.exe, mac shell, cygwin - whatever you wish to use to run provision". Below this, there is a screenshot of a "CloudPass" web application showing a login form with fields for "Username", "Password", "Role Provider", "Role To Assume ARN", and "MFA".

Self-paced bootcamp designed to teach DevOps concepts, tools, and best practices. It focuses on standard approaches and architectural patterns that we want to see across the portfolio. It is mainly lab-based exercises with real examples. Teams are expected to pick up on DevOps responsibilities at the end of the training.

DevOps Tools / Practices

Containers / Serverless

RDS / DB Deployments

Security / Operations

Measuring Maturity

Automation Level

Approved CI/CD, no manual steps, no down-time, adequate test coverage, health check



Tool Adoption

Approved solutions/products, standards, use right versions



CI/CD Metrics

Source code mgmt., infrastructure provisioning, build/deploy metrics



Scorecard

Compliance, quality assurance, security, operations



Deployment

Blue/green, automated rollback, zero-down time, orchestrated, dependency check



Reliability & Availability

Outages, auto-scaling, resiliency, alerts, multi-az, performance

Future Problems



WHAT'S NEXT? SHAPING THE FUTURE

We are not done yet. We continue to look at how we can positively disrupt the enterprise and bring the best delivery experience to our development community. Using cutting-edge technologies and innovative thinking, we continue to shape the cloud for the future.



Continuous Deployment

Readiness check. Dry-run. Auto-upgrade. Blue/Green, Zero-down time. Feature flag. Automated tests.



DevOps Insight

Ingest meaningful data at every point. Manage data. Transform. Analyze. Query. Visualize.



ChatOps

Less humans, more bots. Help integrate. Promote collaboration. Bring transparency.



AI / ML

Predict failure, anomaly. Detect behaviors, patterns. Informed decisions. Better automation.



Shaping The Cloud
Thank You!

Thanks for listening! Please feel free to reach out to me below. I would love to discuss further on DevOps or any other topics related to technology.

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 <http://technology.finra.org/>

 <https://github.com/finraos>