# DevOps @ Amazon:

## Microservices, 2 Pizza Teams, & 50 Million Deploys a Year

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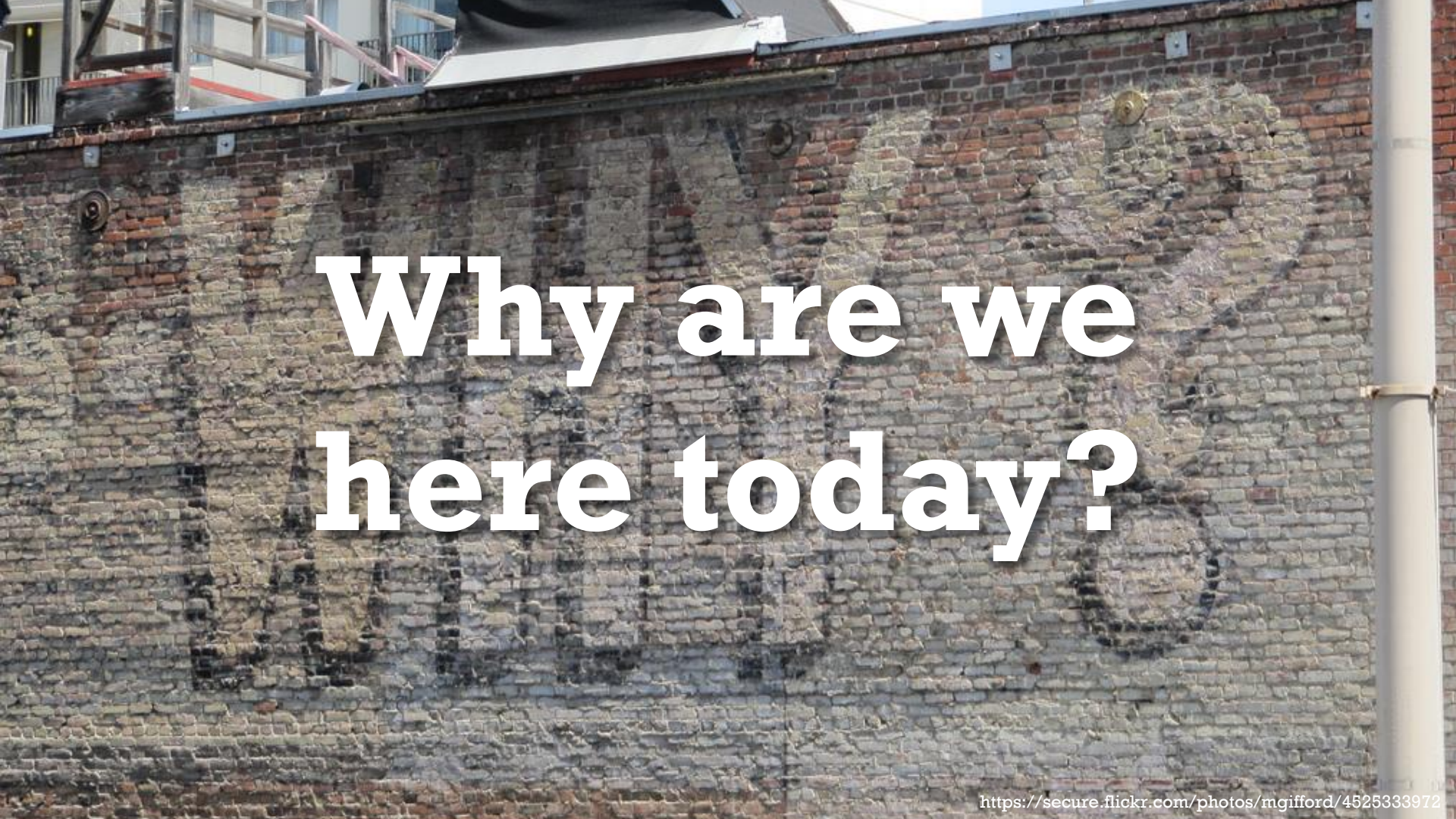
TriNimbus
Cloud Management Solutions

Canadian Executive
Cloud & DevOps Summit

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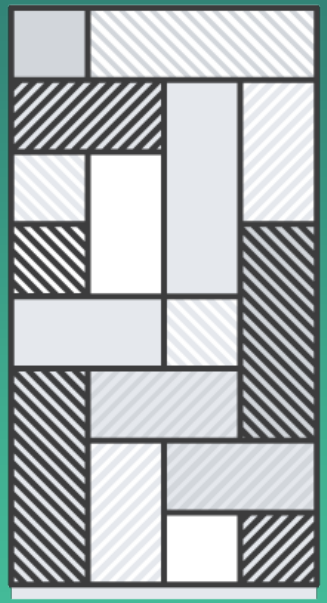

monolithic application

+

monolithic teams

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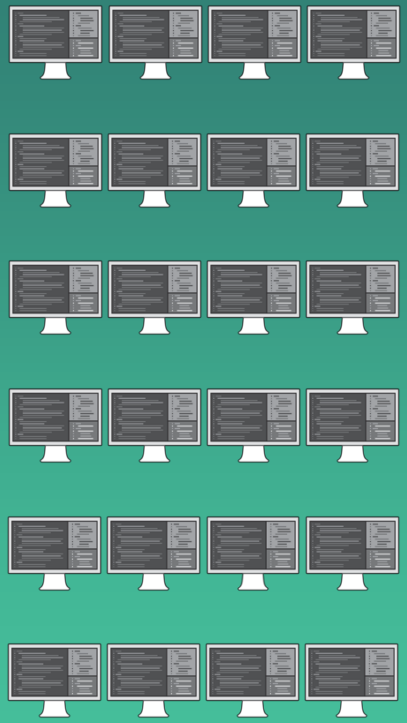
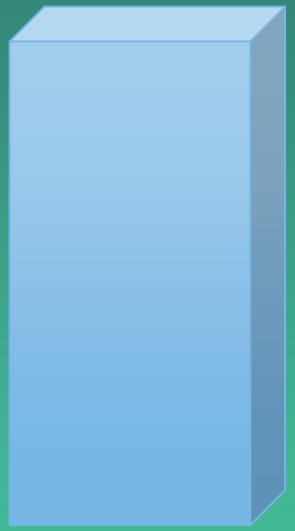
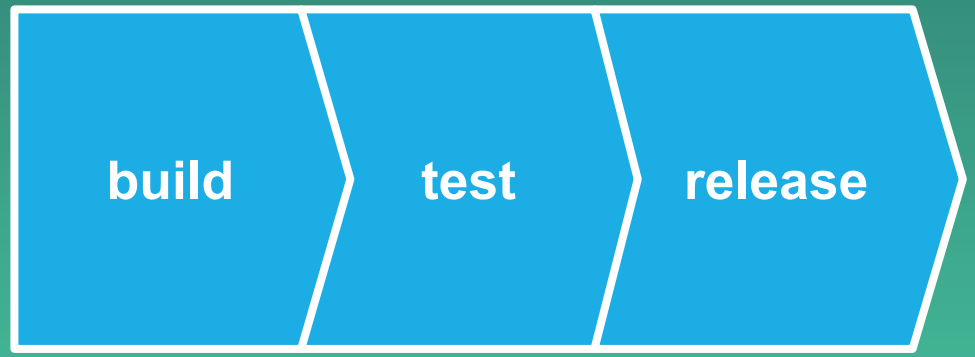
# Monolith development lifecycle








developers

app

delivery pipeline

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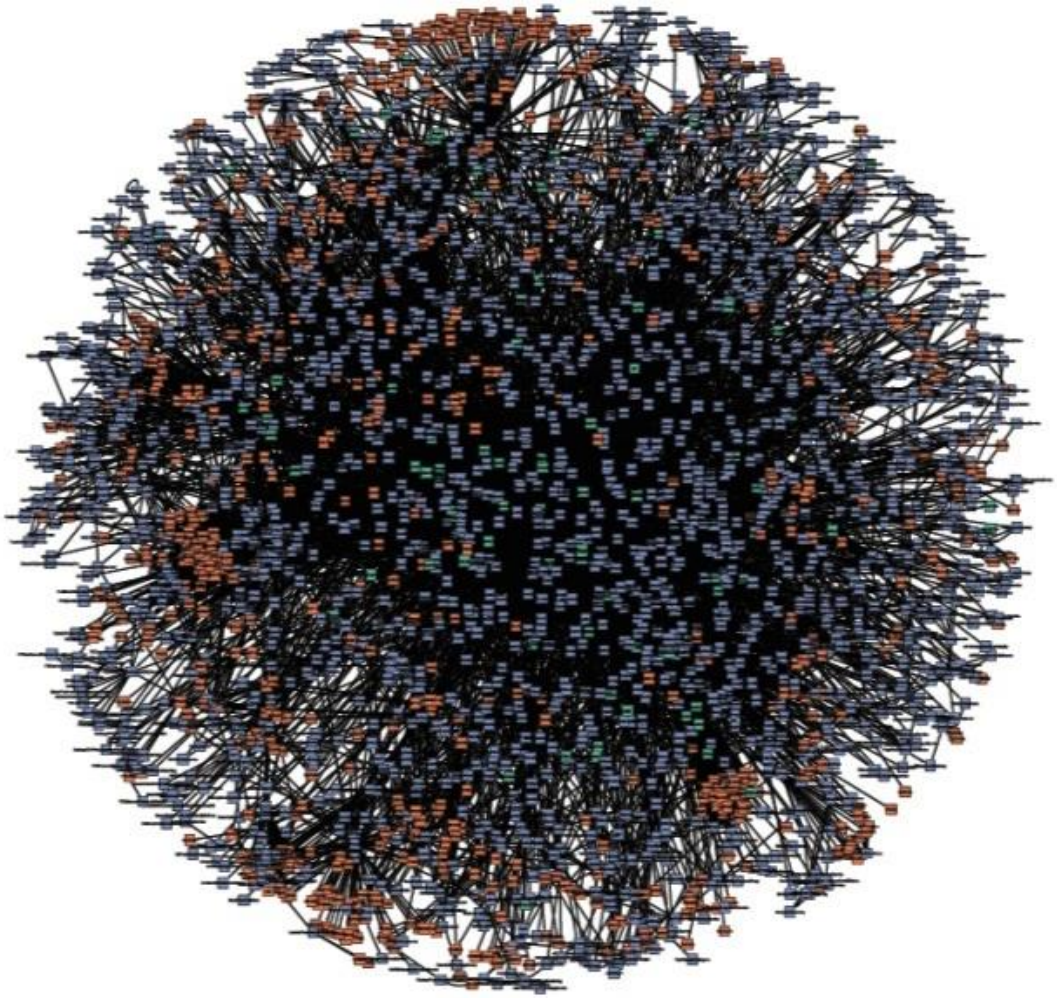

- Single-purpose
- Connect only through APIs
- Connect over HTTPS
- Largely “black boxes” to each other
- “Microservices”

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# Monolithic vs. SOA vs. Microservices

**Monolithic**
Single Unit

**SOA**
Coarse-grained

**Microservices**
Fine-grained

# Microservices vs. SOA

## Microservices:

- Many very small components
- Business logic lives inside of single service domain
- Simple wire protocols(HTTP with XML/JSON)
- API driven with SDKs/Clients

## SOA:

- Fewer more sophisticated components
- Business logic can live across domains
- Enterprise Service Bus like layers between services
- Middleware

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- Two-pizza teams
- Full ownership
- Full accountability
- Aligned incentives
- “DevOps”

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# How do Two Pizza Teams work?

We call them "Service teams"

- Own the "primitives" they build:
  - Product planning (roadmap)
  - Development work
  - Operational/Client support work
- "You build it, you run it"
- Part of a larger concentrated org (Amazon.com, AWS, Prime, etc)

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# Who Does QA?


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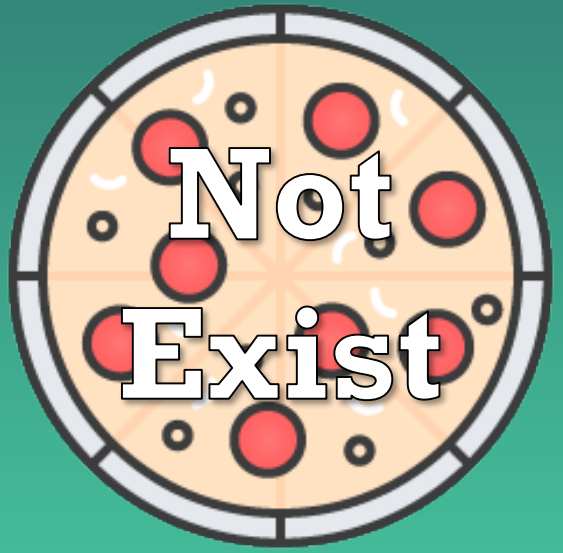
# Who Does On Call?

Image By: Chris Munns - cmunns@amazon.com

# What does Ops Do?



# What about Ops/QA/Etc?

Everyone exists on a "service team" focused on their primitive(s):

- SDE's focused on developing
- PM's focused on product direction
- TPM's help drive development
- SE's focused on infra/tooling
- SDET's focused on test excellence throughout the organization

} Most "2 pizza" teams are just these 2 roles

Some folks are shared across the org, some on individual teams

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# Boy, that sounds like a lot of freedom?

It is! Teams are empowered and also held to high standards:

- Thorough onboarding/training
- Patterns/practices defined at scale and with 20+ years of organizational knowledge
- Regular technical and business metric reviews
- Regular sharing of new tools, services, technologies, etc, by internal subject matter experts
- Public sharing of COEs; "Correction of Errors" our post-mortem process/tool

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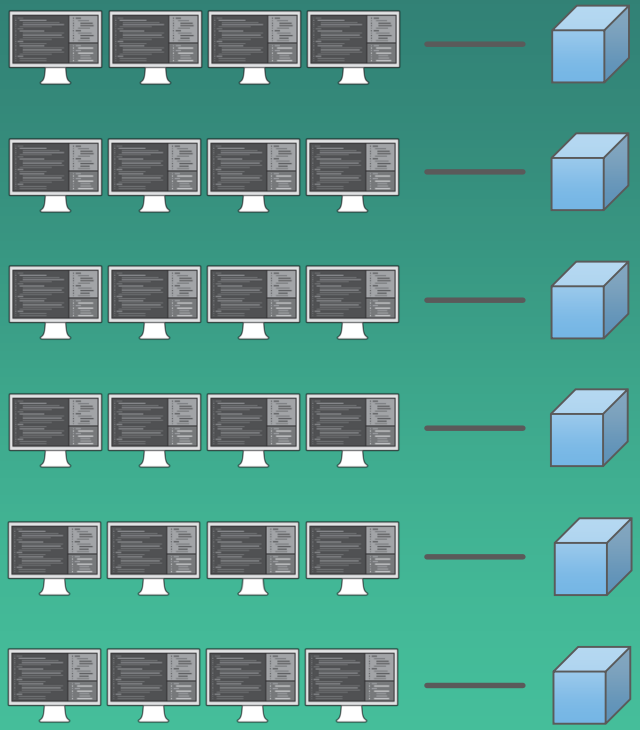
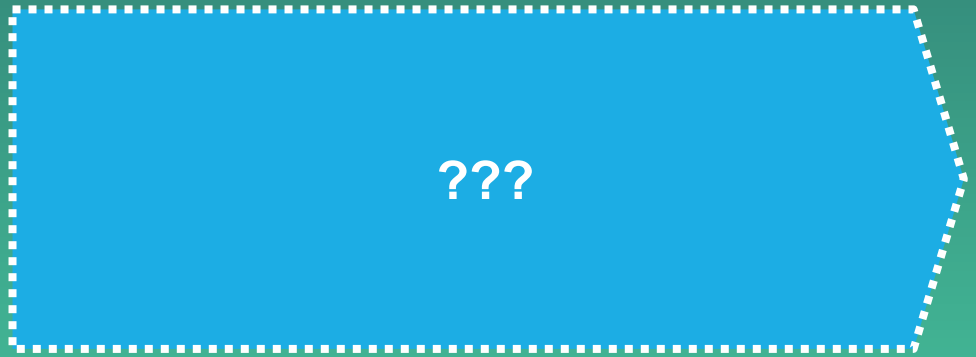
# Missing tools



developers

services




delivery pipeline

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- Self-service
- Technology-agnostic
- Encourage best practices
- Single-purpose services

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- Deployment service
- No downtime deployments
- Health checking
- Versioned artifacts and rollbacks

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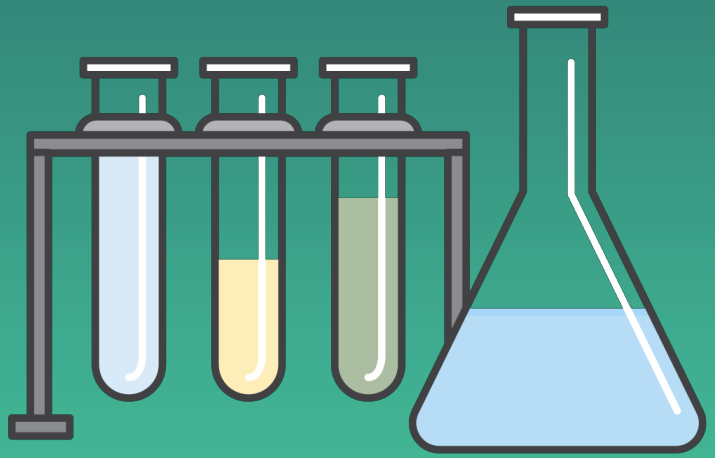
Things went much better under this model and teams were developing features faster than ever, but we felt that we could still improve.



In 2009, we ran a study to find out where inefficiencies might still exist

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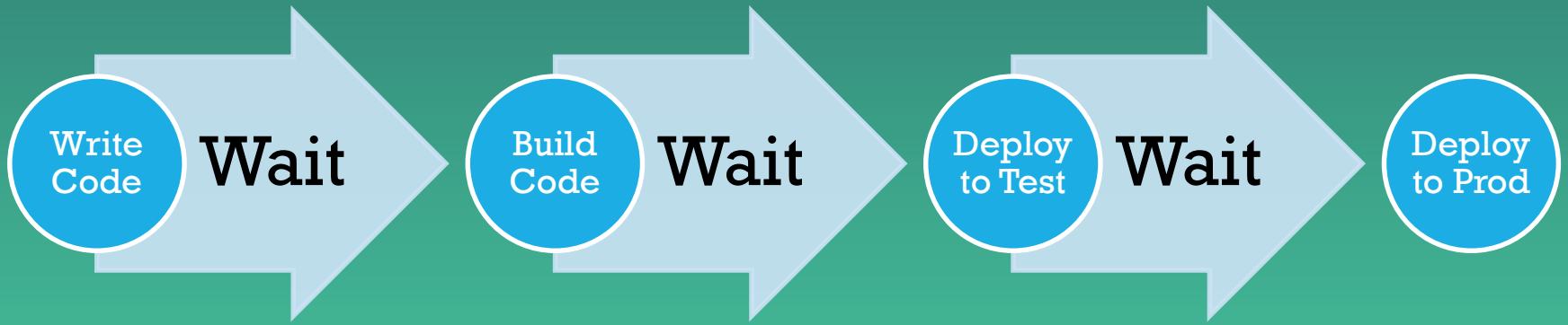
# We were just waiting.

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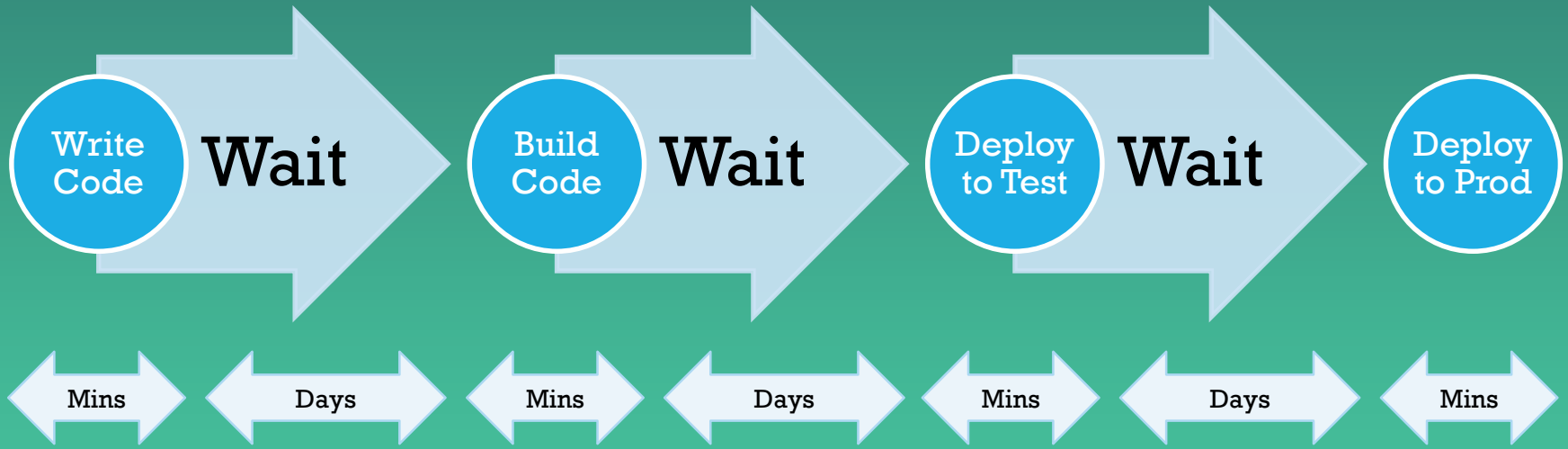


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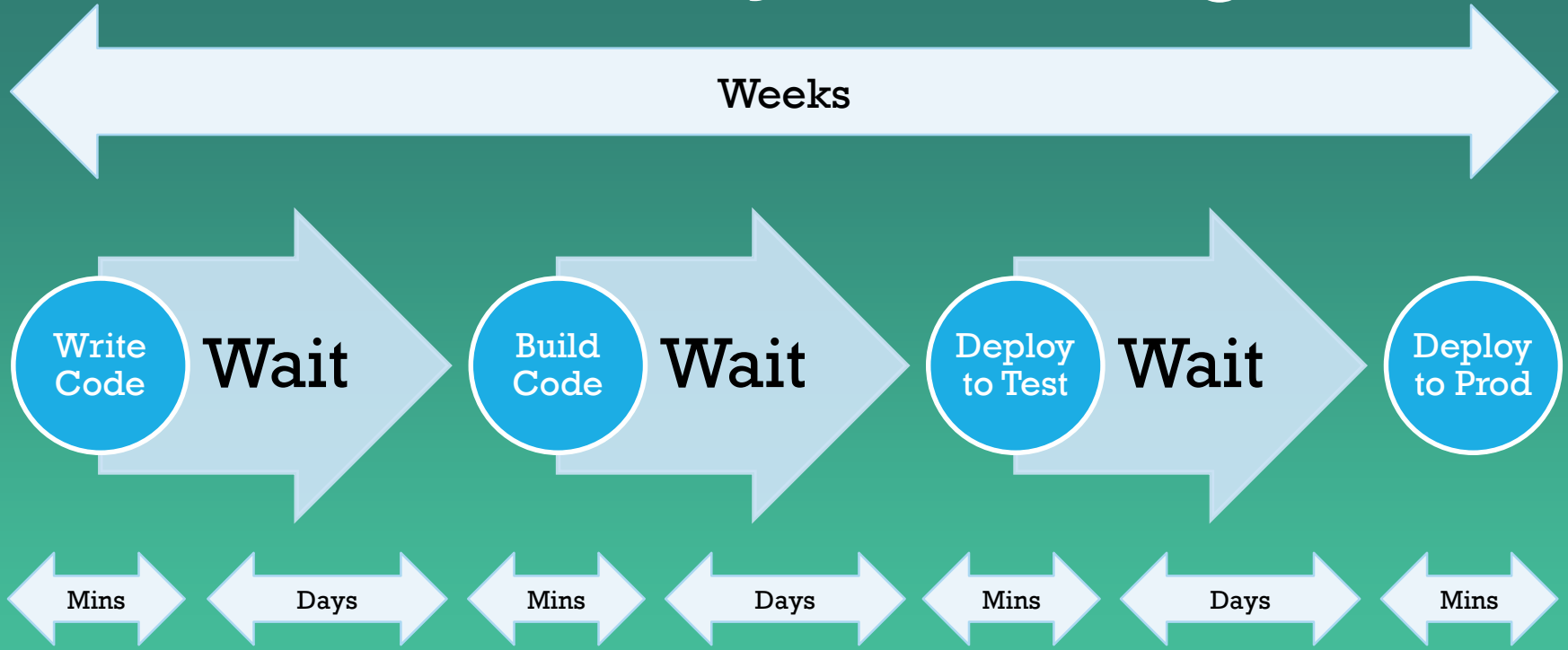

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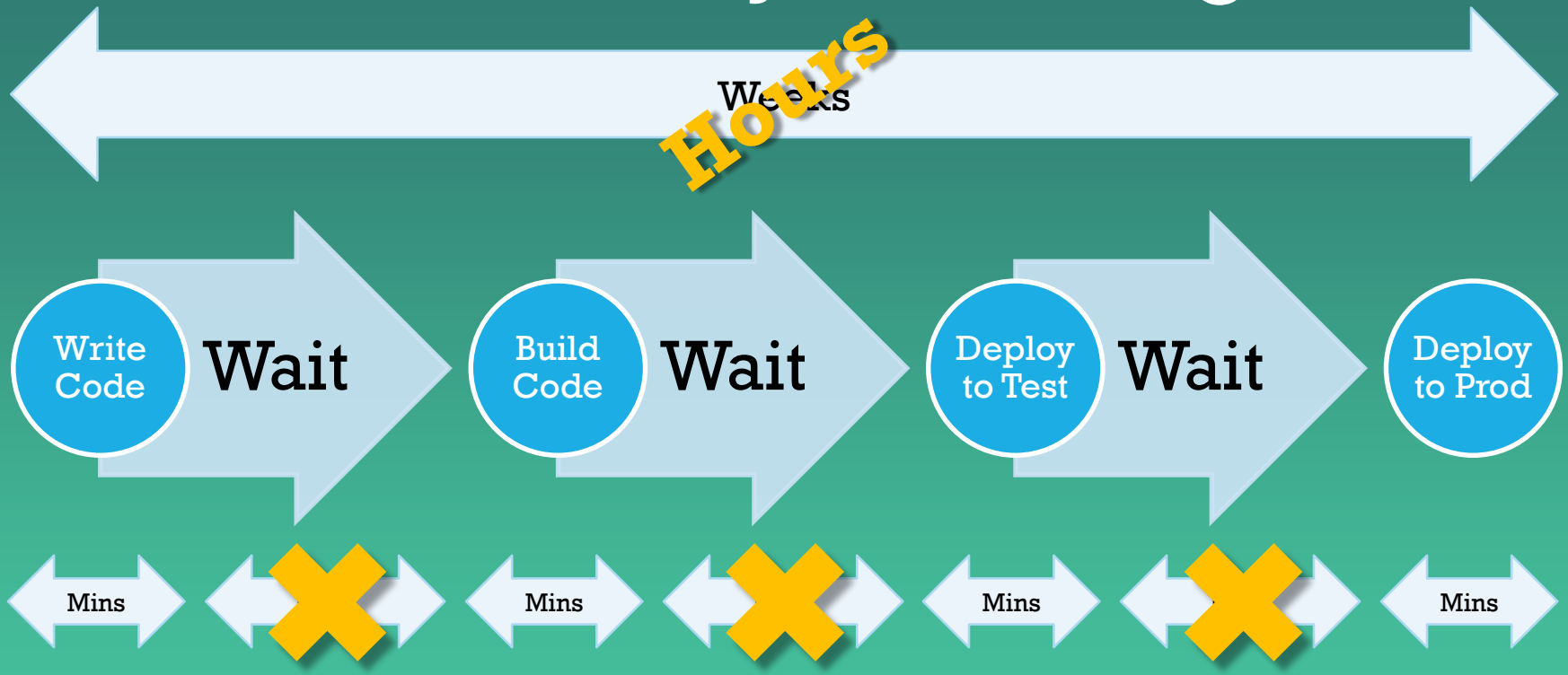


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Automated actions and transitions; from check-in to production

Development benefits:

- Faster
- Safer
- Consistent & Standardized
- Visualization of the process

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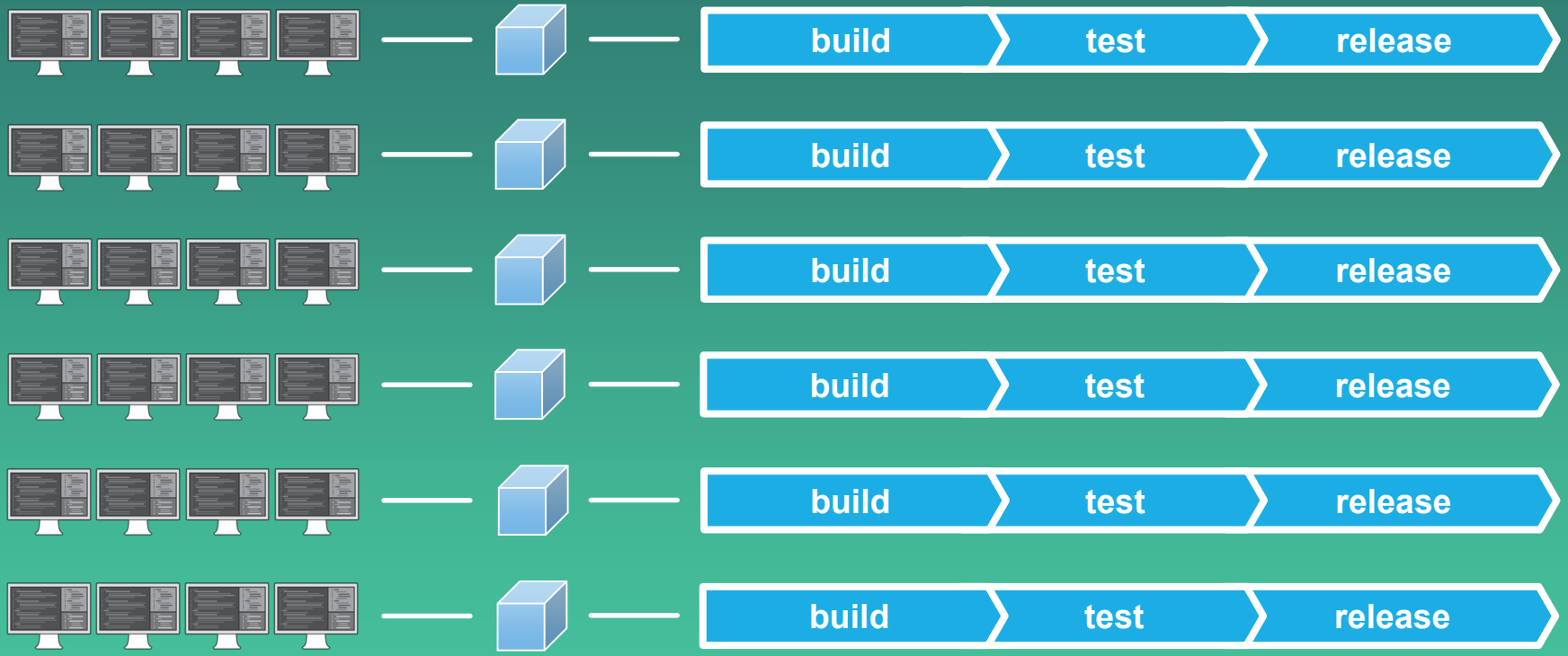
# Microservice development lifecycle




developers services delivery pipelines

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# This has continued to work out really well:

- Every year at Amazon, we perform a survey of all our software developers. The 2014 results found only one development tool/service could be correlated statistically with happier developers:

- Our pipelines service!

**continuous delivery == happier developers!**

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Thousands of teams

× Microservice architecture

× Continuous delivery

× Multiple environments

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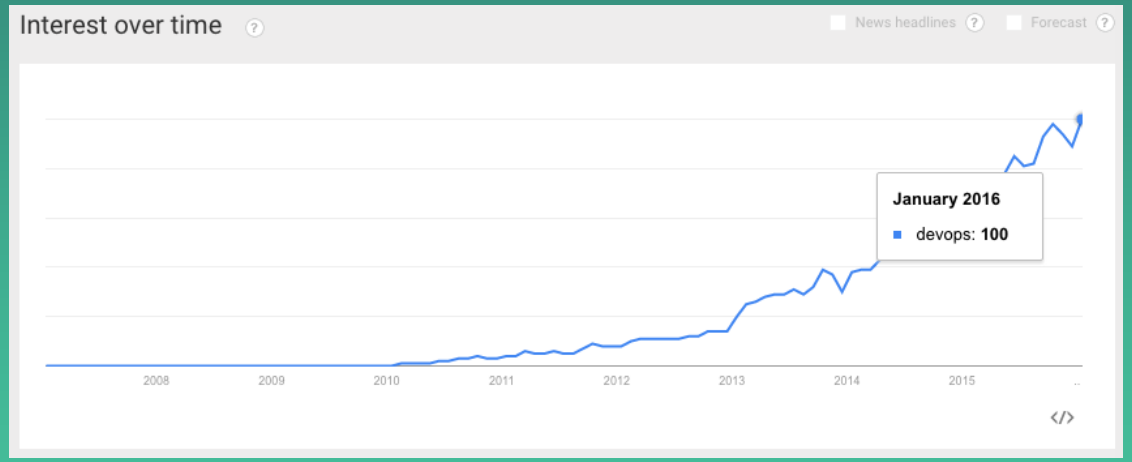
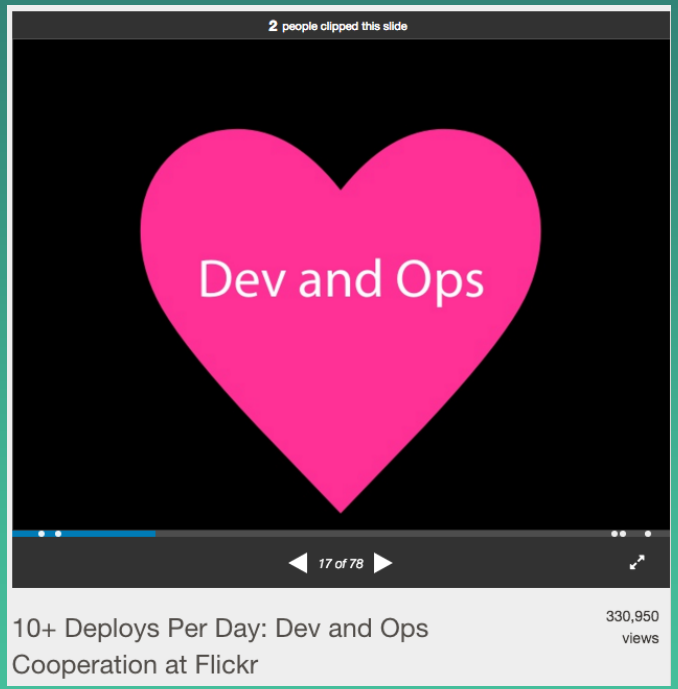
= 50 million deployments a year*

*2014 number

# Quick aside on DevOps

In 2009 (same year as our study) the term "DevOps" first started to appear:




Source: Google Trends & http://www.slideshare.net/jallspaw/10-deploys-per-day-dev-and-ops-cooperation-at-flickr/

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# What is DevOps?

Cultural Philosophy + Practices + Tools

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# What is DevOps?

Cultural Philosophy

Practices

Tools

# What is DevOps?

## Cultural Philosophy

## Practices

## Tools

- Tearing down barriers
  - Between teams
  - Mid-process
- Enable the smart people you are spending time and money hiring to make smart decisions
- Assigning ownership, accountability, responsibility to the people doing the work, aka “you build it, you run it”
- Reducing responsibility to the most directly involved individuals
- Increase visibility to the big picture and the results of work being done

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# What is DevOps?

Cultural Philosophy

Practices

Tools

- Continuous Integration
  - Application testing/QA work applied throughout the development
- Continuous Delivery
  - Automated deployment capabilities of code across environments
- Infrastructure as Code
  - No hand carved infrastructure
- Self-service environments
  - Remove procurement blockers for basic needs
- Microservices
  - Break down complicated monolithic applications in to smaller ones

# What is DevOps?

Cultural Philosophy

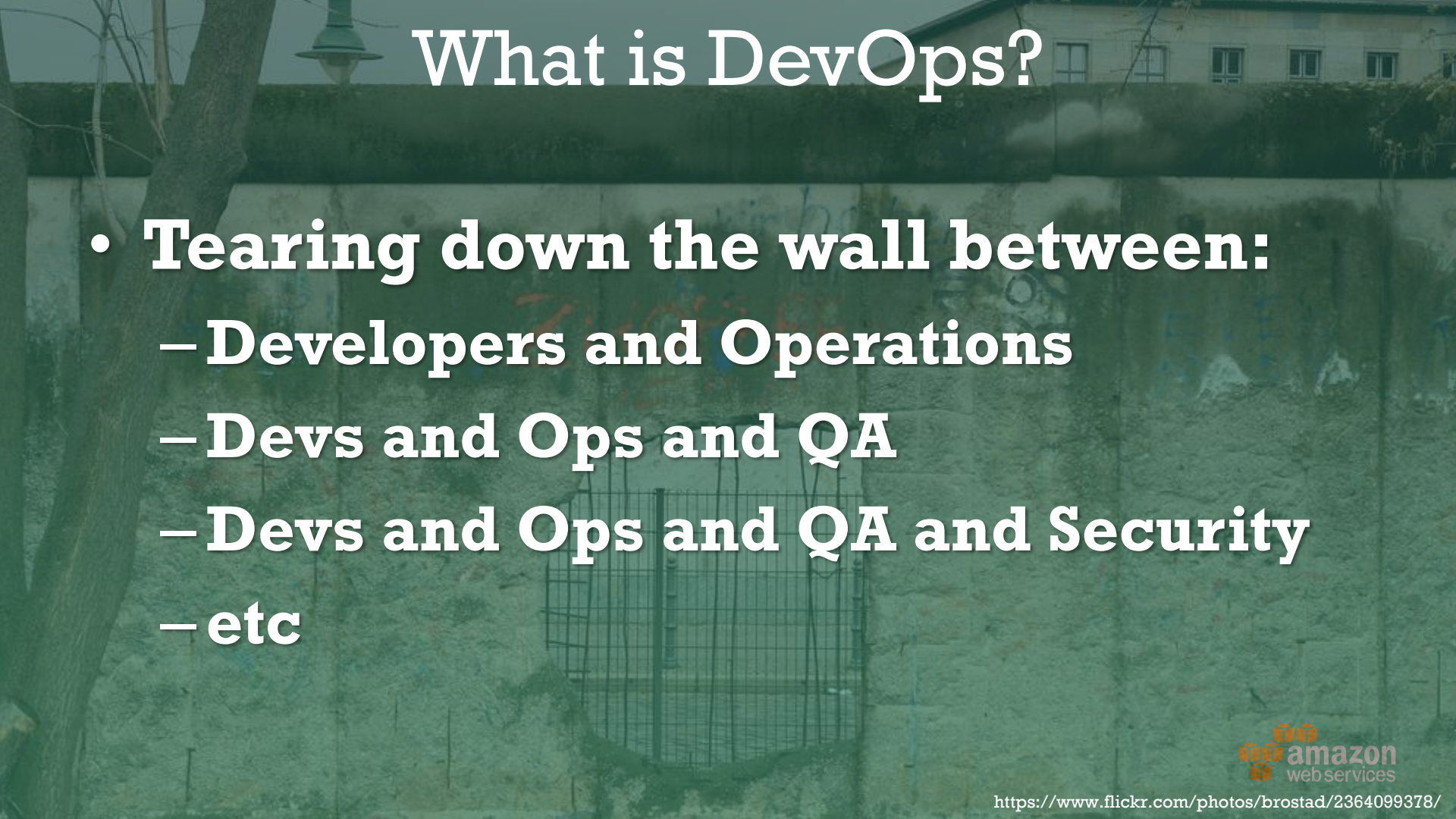
Practices

Tools

- Automated development pipeline tooling
  - Application testing frameworks
  - Code review/feedback tools
  - Automated static analysis
- Consistent and predictable application management & configuration management tools
- Consistent infrastructure measurement tools
  - Metrics
  - Logging
  - Monitoring
  - APM
- Security analysis and management tools

# What is DevOps?

- **Tearing down the wall between:**
  - **Developers and Operations**
  - **Devs and Ops and QA**
  - **Devs and Ops and QA and Security**
  - **etc**



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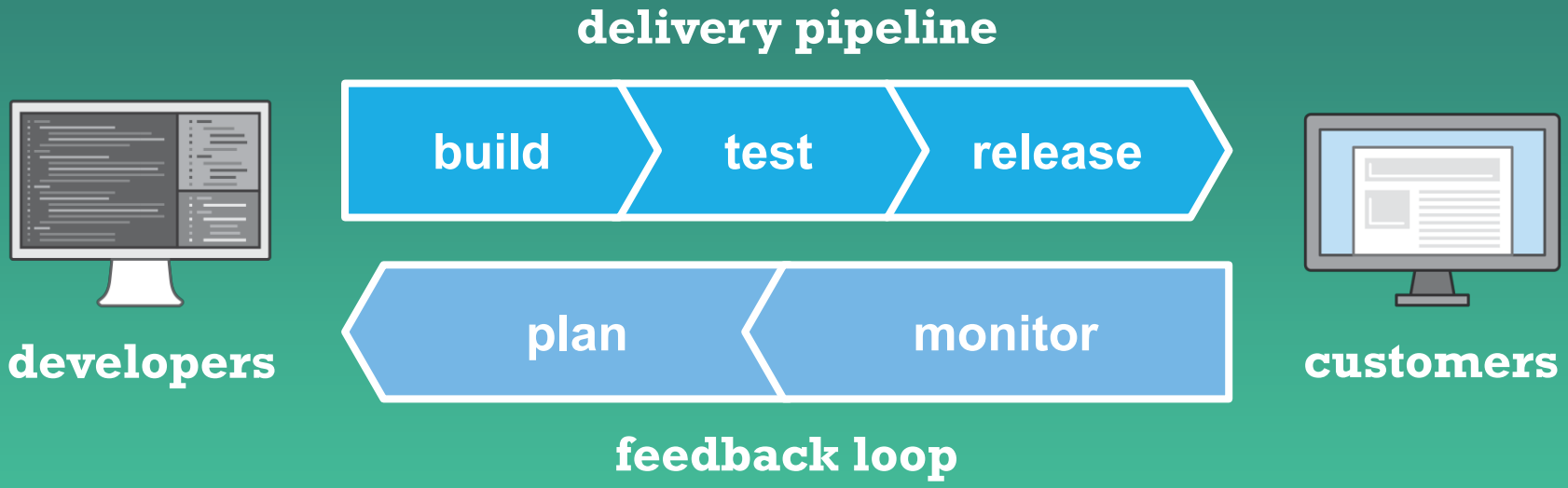
# What is DevOps?




DevOps == efficiencies that speed up this lifecycle

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# DevOps – Don't Take It Just From Us:

- **Oscar Health**: 2 systems engineers, 45+ Developers, self service infrastructure tools, HIPAA requirements
- **AirBNB**: 5 Operations people for 1000+ instances
- **Gilt**: several hundred microservices, self service tools extending AWS, almost entirely on t2 instances
- **Intuit/TurboTax**: "deployed over 40 simultaneous experiments during the peak filing season"
- **MLB**: scale up massively during Minor League games and events, turn it off later





# DevOps – Don't Take It Just From Us:


- Capital One's moved from traditional waterfall to DevOps:
- 100s of code commits per day,
- Integration from once a month to every 15 minutes
- QA from once per month to 4 times per day
- Deployment from manual to completely automated
- Production release from monthly/quarterly to once per sprint

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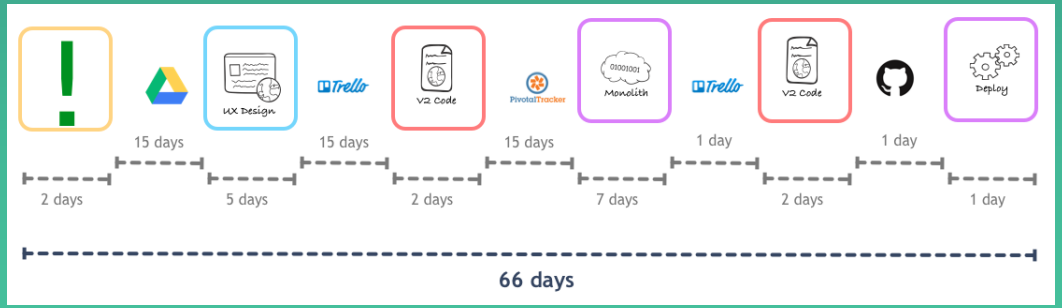
# DevOps – Don't Take It Just From Amazon:

In September 2015 Phil Calcado, ex-SoundCloud, wrote in "How we ended up with microservices." how SoundCloud reduced product development lead times from 66 days to 16!*





*http://philcalcado.com/2015/09/08/how_we_ended_up_with_microservices.html

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# 5 Key technology areas to focus on:

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Why these 5?

- Typically under-invested areas for most organizations
- Areas where developers/operations folks are constantly reinventing the wheel
- Important key components of DevOps technology and practices
- Mastering these areas will lead to better:
  - development velocity
  - reduced RTO/RPO
  - better cost management
  - reduction in ”fire from the hip” data-less infrastructure/application tweaks
  - improved security/governance/compliance

# 5 Key technology areas to focus on:

- Continuous Integration/Delivery
- Infrastructure as Code
- Monitoring/Metrics/Logging/APM
- APIs/Microservices Management
- Communication & Collaboration

## DevOps Technology Partners















## DevOps Consulting Partners














# FIN, ACK

Some take aways:

- By stepping back and looking at the big picture of how we were working we were able to drive numerous improvements over the years
- By automating and *as-a-Service-ing as many work flows as possible we remove the majority of waiting, which was a majority of the overall time
- DevOps: Every company will have their own unique culture but the practices are looking fairly consistent
- DevOps: By investing in tools you can standardize on you remove the burden of developers needing to figure out how they will solve these problems on their own
- DevOps: If culture isn't driven from the top down it rarely will work out


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