GitOps First Steps

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Part I – Introduction

- About Me
- Course Overview
- Discussion
- What is GitOps in One Slide

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GitOps and Me

- Worked in GitOps in Banks
- Consulting, working with smaller companies to make GitOps happen
- Blog on GitOps and related subjects at https://zwischenzugs.com
- Written books on Git, Docker, Terraform, Bash

Course Overview

- Part I – Introduction
- Part II - Why GitOps?
- Part III – Defining GitOps
- Break
- Park IV – Key GitOps Tools
- Part V – Demo
- Part VI – Implementation Challenges

Discussion

- How do you deploy software now?
- What are the challenges/bottlenecks?
- What tools do you use, and what are their characteristics?
- What do you understand by GitOps?

What is GitOps? In One Slide

- Can be defined in various ways, but at core:
  - 1) Everything as Code
  - 2) Declarative system operation definition
  - 3) Control Loop

- Packaging of older ideas (eg DevOps, Scripting, Versioned Source Control, configuration management, Make) into an opinionated movement.

Part II – Why GitOps?

What Problems Does GitOps Solve?

- Various deployment anti-patterns
  - Deployment by hand
  - State in a spreadsheet
  - Pipeline by GUI
  - ‘It’s all up here’

- Anti-patterns cost money

- GitOps (like DevOps) reduces cost of deployment

‘Deployment By Hand’ Anti-Pattern

- Place code into environments through a manual process
- May be sped up by scripting
- Documents with deployment commands in them are still not uncommon

‘State in a Spreadsheet’ Anti-Pattern

- State of system stored in a spreadsheet
- Often associated with firewall or proxy rule management
- Also often associated with traditional change control systems, eg ServiceNow

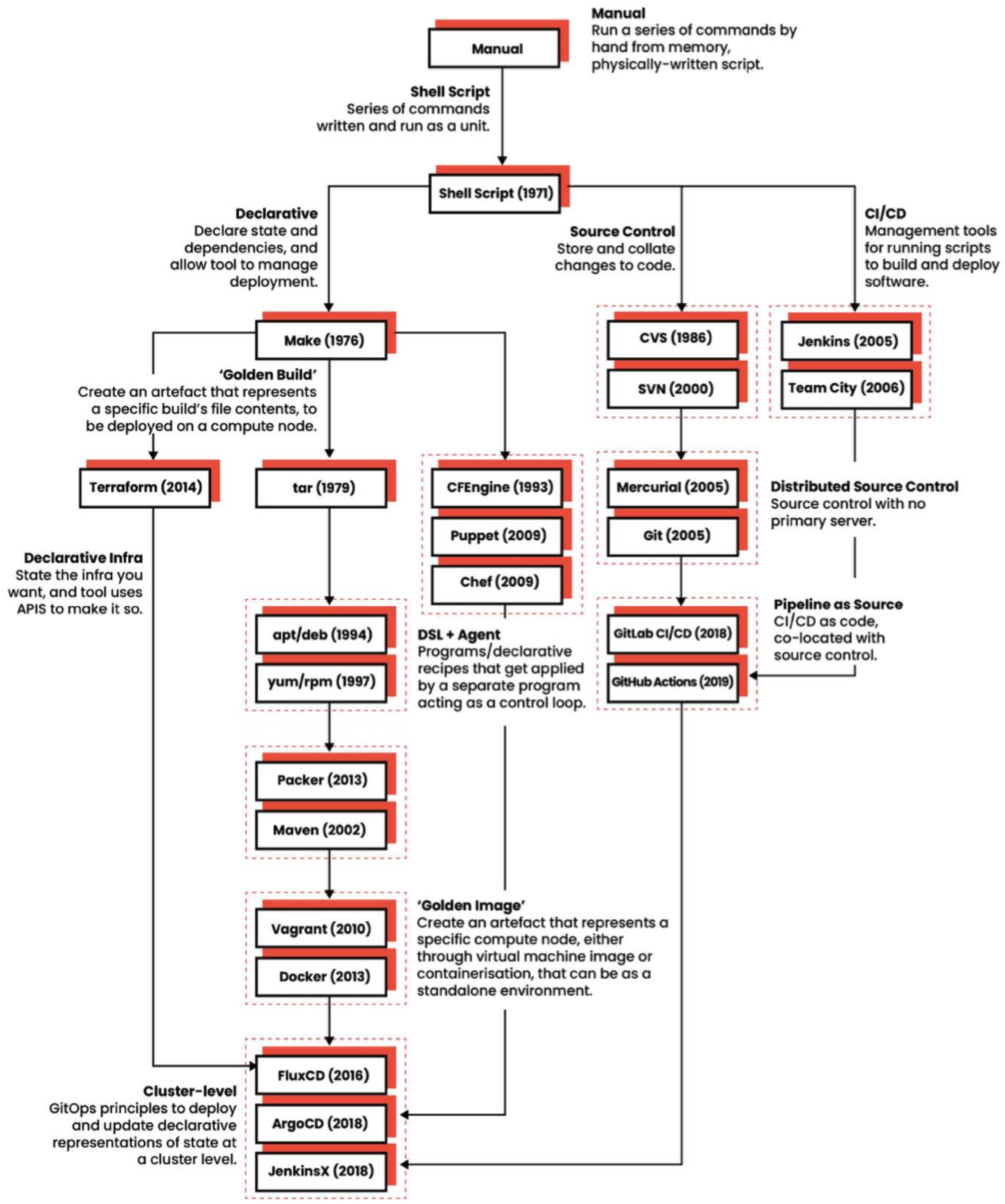
‘Pipeline By GUI’ Anti-Pattern

- Rise of DevOps brought Jenkins et al to the fore
- Pipeline was step forward in automation but often stateful through configuration by GUI

Anti-Pattern Outcomes

- Uncertain Desired State
- Uncertain Actual State
- Gap Between Desired and Actual State
- Control Challenges

Part III – Defining GitOps


Manual
Manual
Run a series of commands by hand from memory, physically-written script.
Shell Script
Series of commands written and run as a unit.
Shell Script (1971)
Declarative
Declare state and dependencies, and allow tool to manage deployment.
Source Control
Store and collate changes to code.
CI/CD
Management tools for running scripts to build and deploy software.
Make (1976)
'Golden Build'
Create an artefact that represents a specific build's file contents, to be deployed on a compute node.
CVS (1986)
SVN (2000)
Jenkins (2005)
Team City (2006)
Terraform (2014)
tar (1979)
CFEngine (1993)
Puppet (2009)
Chef (2009)
Mercurial (2005)
Git (2005)
Distributed Source Control
Source control with no primary server.
Declarative Infra
State the infra you want, and tool uses APIS to make it so.
apt/deb (1994)
yum/rpm (1997)
DSL + Agent
Programs/declarative recipes that get applied by a separate program acting as a control loop.
GitLab CI/CD (2018)
GitHub Actions (2019)
Pipeline as Source
CI/CD as code, co-located with source control.
Packer (2013)
Maven (2002)
Vagrant (2010)
Docker (2013)
'Golden Image'
Create an artefact that represents a specific compute node, either through virtual machine image or containerisation, that can be as a standalone environment.
FluxCD (2016)
ArgoCD (2018)
JenkinsX (2018)
Cluster-level
GitOps principles to deploy and update declarative representations of state at a cluster level.

What Exactly Is GitOps?

- Official Weave definition (2017)
  - An operating model for Kubernetes and other cloud native technologies, providing a set of best practices that unify deployment, management and monitoring for containerized clusters and applications.
  - A path towards a developer experience for managing applications; where end-to-end CICD pipelines and Git workflows are applied to both operations, and development.

The Three Key Concepts of GitOps?

- Audited source control and configuration management
- Declarative data definition of system configuration
- Reconciling control loop for configuration management

Declarative

- Declarative
  - Code that declares the desired configuration statically, rather than dynamically based on switching procedures
- eg
  - Make
  - Puppet
  - YAML
  - JSON

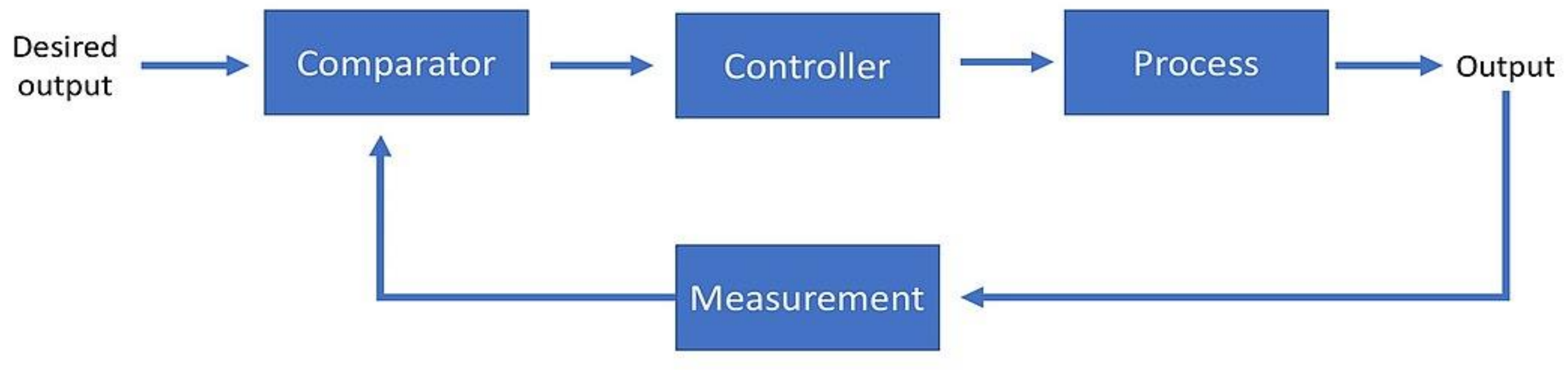
Source Controlled (I)

- SCM (Source Control Management) tool should provide:
  - Easy and cheap branching of code
  - Change history integrity
  - Change sharing protocols
  - Integration with identity systems

Source Controlled (I)

- Git is the *de facto* tool here
  - Branching is O(1)
  - SHA hashing of commit contents
- GitHub, GitLab et al have evolving standards and enterprise integrations
- Extremely widespread adoption
  - Stack Overflow: 83% of devs on GitHub

Control Loop (I)



- Control Systems (Wikibooks link)

Control Loop (II)

- A control loop:
  - Checks whether system is in desired state
  - If it is not, effects changes to get into desired state
- eg thermostat
- ‘Controller’ a familiar concept to Kubernetes users – K8s name itself means ‘governor’, a similar engineering concept around speed of system

How GitOps Helps (I)

- These concepts, together, improve:
  - Reliability
    - Automated, zero-touch, self-correcting systems
    - Fewer ad hoc, unmonitored system changes
    - Reduced bespoke logic
  - Auditability and accountability
    - Full audit history via souce control

How GitOps Helps (II)

- **Which deliver benefits:**
  - **Improved productivity and lower cost of system ownership**
    - **Less time spent debugging systems in unknown state**
    - **Less time maintaining systems with recurring problems**
    - **Cheaper and simpler workflow/approval systems**
    - **Easier to implement automated testing**

Part IV – Key GitOps Tools

- **Fast-growing space**
  - **Kubernetes (Deployment Platforms)**
  - **Terraform (Infrastructure Provisioning)**
  - **ArgoCD/FluxCD (‘Pull’ tools)**
  - **Kustomize / kubectl (‘Push’ tools)**
  - **JenkinsX (Curated GitOps products)**

Kubernetes

- Runs Docker (or industry standard) containers
- Deployment configurable by code (YAML/JSON)

Terraform

- Specifies and maintains infrastructure setup
- Declarative language (HCL)
- Source-code friendly

ArgoCD / FluxCD

- Two similar ‘control loop’ solutions
- Within Kubernetes clusters, these applications track git repositories and apply changes to cluster
- Projects’ efforts are consolidating to https://github.com/argoproj/gitops-engine

JenkinsX

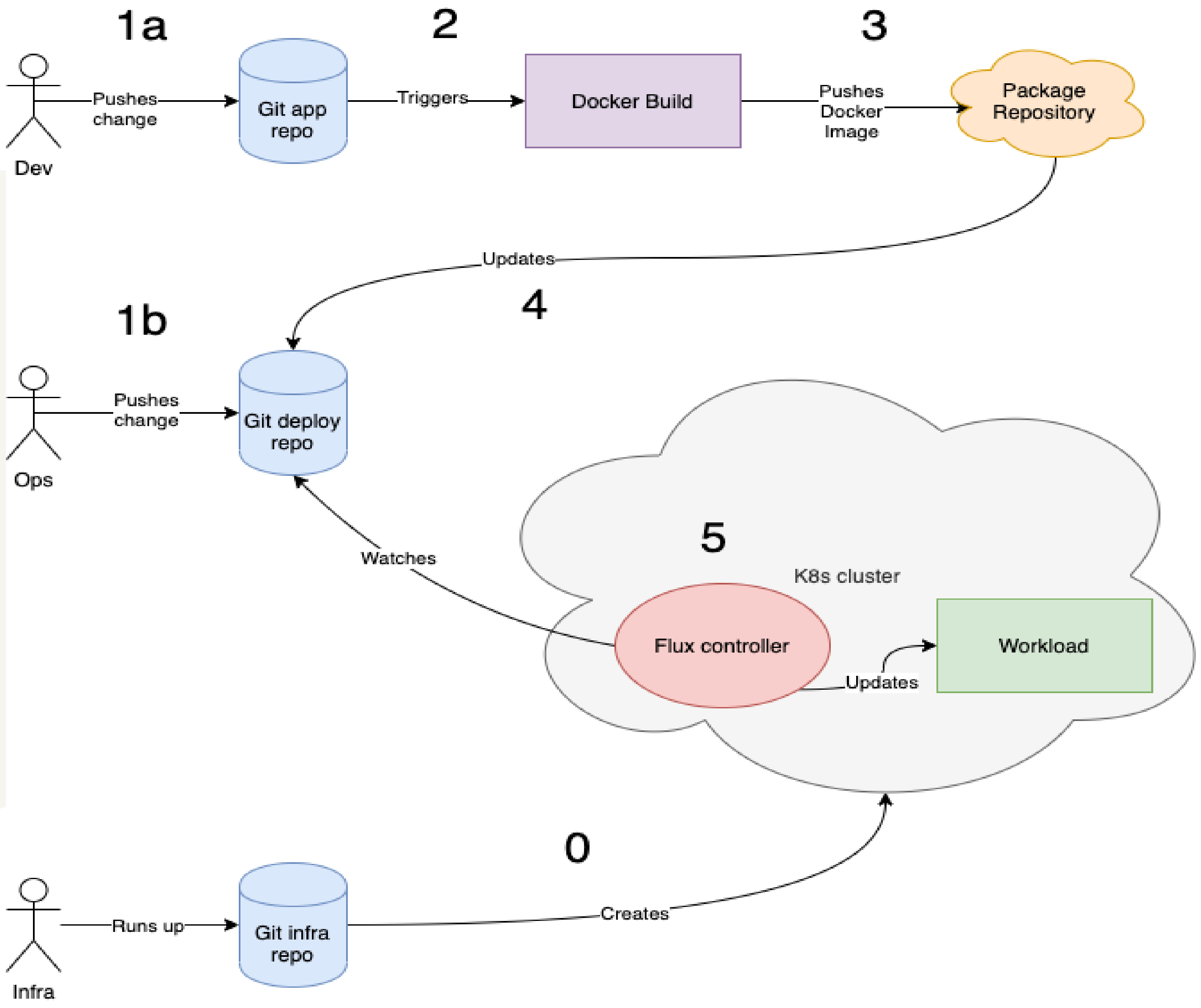
- Monolithic ‘all-in-one’ GitOps solution
- Nothing (much) to do with Jenkins CI

Part V – Demo

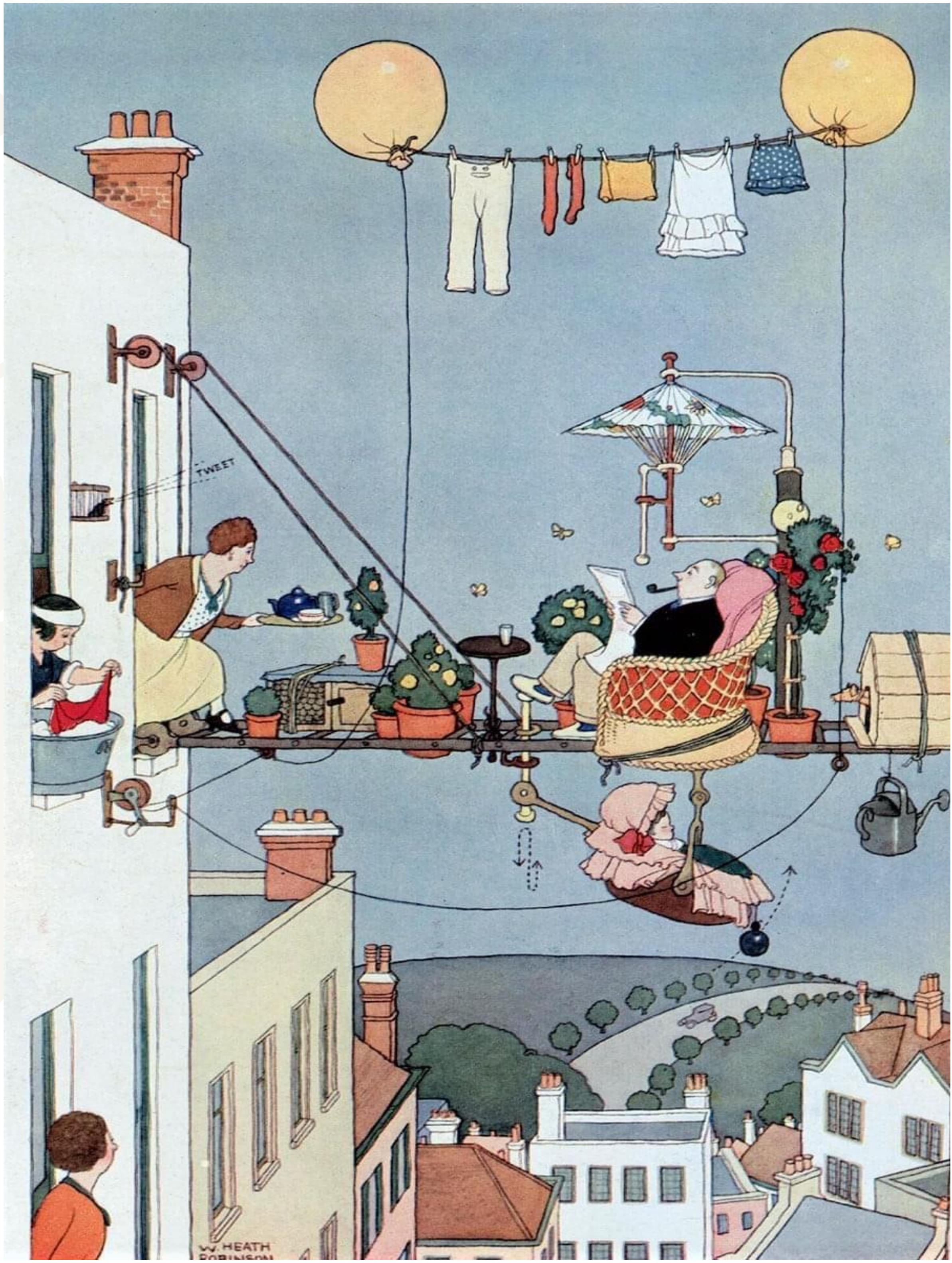
Demo Resources

- https://github.com/ianmiell/gitops-example
- Uses:
  - GitHub
  - GitHub Actions
  - Terraform (optional)
  - Kubernetes
  - Shell
  - Flux
  - Docker

Demo Overview



Part VI – GitOps Implementation Challenges



Challenges - Technical

- Many new technologies to learn/master
- Git, Terraform, Kubernetes (none of these are trivial)
- Many small decisions need to be made when building up your GitOps capability

Challenges - Cultural

- Need to change delivery mindset
- ‘Hero’ culture of ‘logging in and fixing’ needs to be challenged
- The deployment process/code is king and discipline needs to be maintained
- Onboarding new teams to this way of working can generate a lot of friction if they are not prepared

Challenges - Business

- GitOps work is very front-loaded
- Can take a long time to ‘bed in’ good practices within an organization before seeing a return on investment
- Benefits are not immediately obvious to non-technical people
- Emergent area: there is no ‘safe, proven choice’ for a GitOps approach

Challenges - Solutions

- Technical: Invest in spreading expertise and gaining experience across teams. Ensure documentation and pairing etc used to pass on knowledge.

- Cultural: Invest early in outreach, bring staff with you. Point out opportunities for growth and development.

- Business: Be realistic, don’t over-promise, and measure costs and compare old/new costs to demonstrate business value.

Thank you!

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