

# Digital Transformation in Higher Education

**David J. Blezard**

*Director, Application Administration  
University System of New Hampshire*

# My World High Education IT



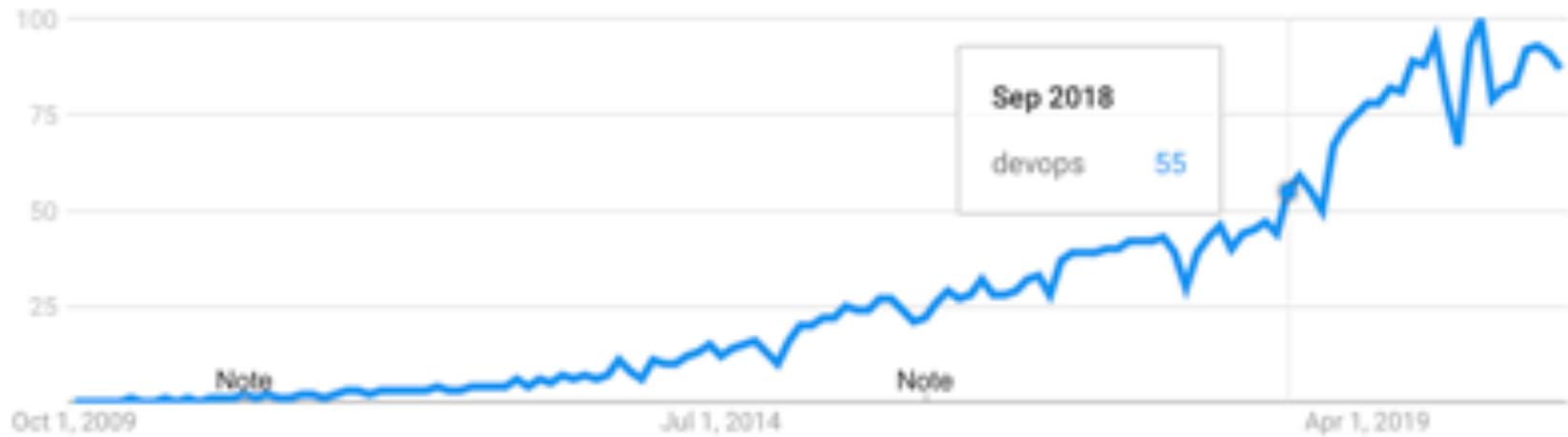
**University of  
New Hampshire**



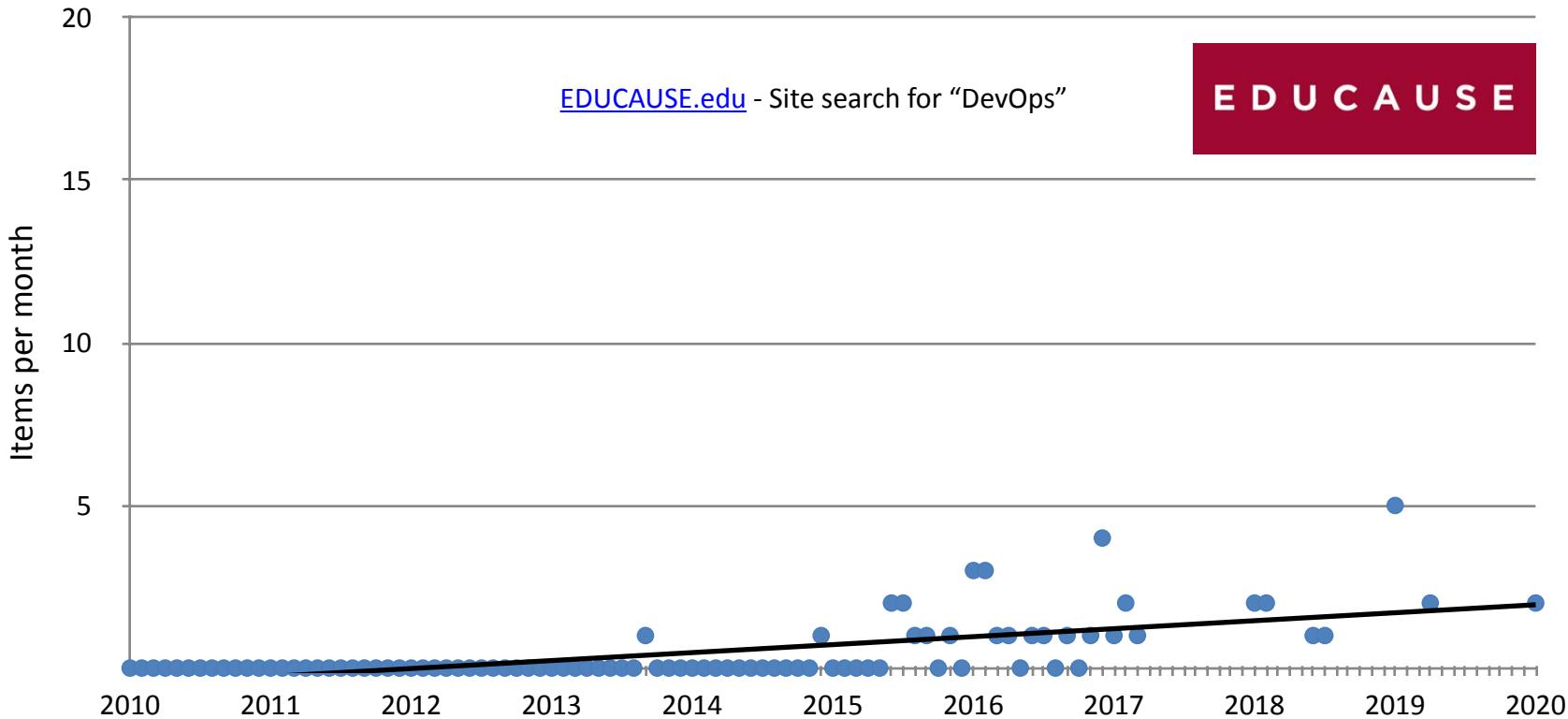
**Granite State College**  
UNIVERSITY SYSTEM OF NEW HAMPSHIRE

**Plymouth State**  
UNIVERSITY

## Interest over time



## Higher Ed &amp; DevOps



Not connecting...

<b>DevOps Pitches</b>	<b>Applies to Higher Ed?</b>
Integrate large Dev teams	No, usually small 
Beat competitors to market	Not really 
Deploy daily	No, probably not 
Run in the cloud	Maybe 

Filter your results:

Clear Filters

Sort By: Relevance

Alphabetical

Publication Date

**By Content Type** X

Presentations and Seminars (2160)

Article (1512)

Briefs, Case Studies, Papers,  
Reports (571)

Blog (553)

Multimedia (47)

Books and Monographs (31)

Government Documents, Laws,  
Letters, Testimonies or Reports (11)Policies, Guidelines, Plans and  
Procedures (9)

Committee Page (4)

Surveys (3)

Display a menu

**Digital Transformation Through Software Defined Anything (SDx)**

November 1, 2018

The emergence of the cloud has created a tremendous opportunity for many IT organizations to achieve digital transformations. Many of the concerns about the viability of the cloud have been addressed,...

**Digital Transformation: The Pathway To Organizational Value (Separate Registration Is Required)**

October 30, 2018

We hear about "digital transformation" in business, but what does it mean for higher ed? This workshop will examine the characteristics of digital transformation and its impact on technology, services...

**Dx: Digital Transformation Of Higher Education**

EDUCAUSE

“is a series of deep and coordinated culture, workforce, and technology shifts that enable new educational and operating models and transform an institution's operations, strategic directions, and value proposition.”

Dx: Digital Transformation of Higher Education

<https://www.educause.edu/focus-areas-and-initiatives/digital-transformation>

# The reality...

University System of New Hampshire—like many other public and private universities and colleges in the U.S.—is experiencing significant financial challenges, including:

- **Demographic trends that are particularly unfavorable for the northeastern states** and predicted to get worse for at least the next decade.
- **Rapidly changing educational program and curriculum needs.**
- **Increased competition** for students (58% of New Hampshire high school graduates leave the state to attend college—the highest percentage in the U.S.).
- Increasing competition from expanding regional and national online institutions.
- Maintaining the public mission goal of accessibility to higher education, coupled with growing pressure to control tuition levels.
- **Increased public funding** for regional public universities and community colleges is unlikely.

In addition...COVID-19...refunds to those students, totaling \$42 million for fiscal year 2020.

Todd Leach, Chancellor, USNH, 9/24/2020  
(emphasis added)

# Our Journey, Part 1- Transformation via DevOps

And our “team” c. 2011

Ops

Me

Chris

Dev

Mike

John

Ember

Can’t say we had shared  
responsibly and shared  
culture, but at least we  
liked each other and sat  
close by

2011



3 physical servers:

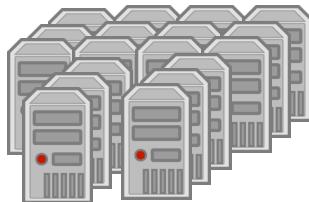
Shared resources for DB, apps, load balancing,  
dev/test/prod for 100's of websites

Static HTML, Drupal 6 & 7, WordPress,  
ColdFusion, more.

And one terrible, horrible, no good very bad  
deployment!

## Key measurement: Uptime

2014



VMs with separate functions:  
DB vs apps vs load balance vs utility  
Isolated tech stacks  
Separate dev/test/prod environments

## Started to pay down the technical debt!

# What we had: 2015

Code Repository



CI/CD



Testing

Hosting



Utility



SPACEWALK



And in late 2016, we welcome...



Our new key metric: Is it run in Docker?  
And then it took us until the early 2019 to fully implement.

- Increasing the speed with which software can get updated, including freeing ourselves from the one-day-per-week-only rollouts
- Removing repetitive, non-productive tasks from developer and system administrator workloads primarily via automation
- Increasing value to our clients by delivering more utility, higher quality, more consistency, more quickly

Any efforts, tools, techniques, processes, or communications means that can accomplish these goals are possible within the scope of this overall effort.





Repository plus CI/CD - core and critical



Containerized everything: dev, test and prod



Replaced cron; modular scripts - scheduled or on demand



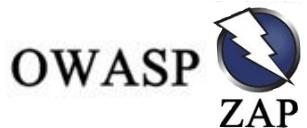
Standardizing on one scripting language



Centralized logging and alerting

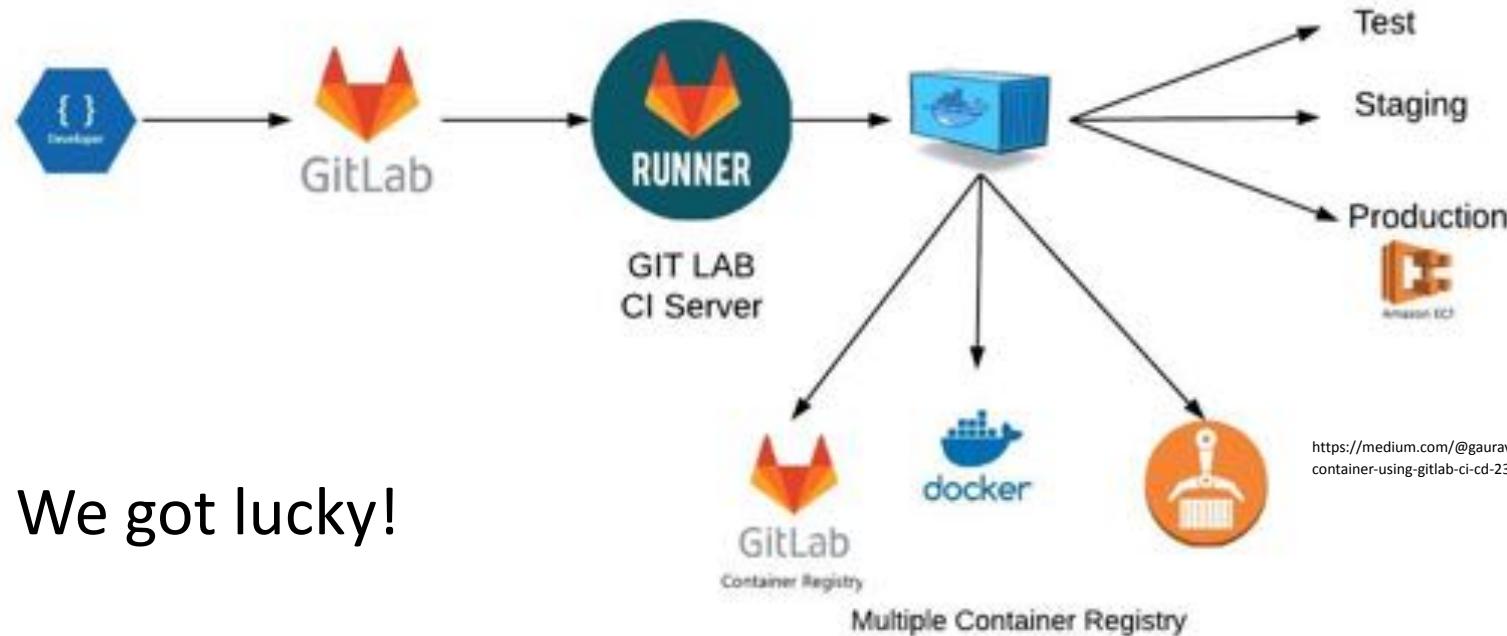


Starting on centralized configuration management



Introducing automated dynamic app testing

# Gitlab and CI/CD



Build Docker Container using GITLab CI / CD

# The UNH Development DevOps Toolkit - \$0.00

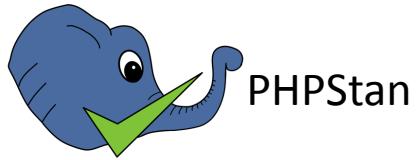
Dev Environments



Coding Standards  
Tests



Static Analysis



Unit Test



# The Basic UNH DevOps Toolkit - \$0.00

Code Repository



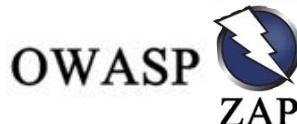
CI/CD



GitLab



Testing



Hosting



Utility



# Our Journey, Part 2 - The Data



## Our core institutional data

Actually Caerlaverock Castle. Simon Ledingham / Caerlaverock Castle / CC BY-SA 2.0  
[https://commons.wikimedia.org/wiki/  
File:Caerlaverock\\_Castle\\_from\\_the\\_air\\_1.jpeg](https://commons.wikimedia.org/wiki/File:Caerlaverock_Castle_from_the_air_1.jpeg)

Dragon from [https://pixabay.com/illustrations/  
dragon-3d-render-red-dragon-legends-4538390/](https://pixabay.com/illustrations/dragon-3d-render-red-dragon-legends-4538390/)

Actually, it lives here



# Institutional Data in Higher Ed



A screenshot of the University of New Hampshire Course Search website. The URL "courses.unh.edu" is prominently displayed. The page shows course search results for Fall 2014, including course titles like "Introduction to Sociology" and "Principles of Psychology".



Learning management system - students, faculty, courses, enrollments

Course evaluation system - students, faculty, courses, enrollments

Directories - students, faculty/staff

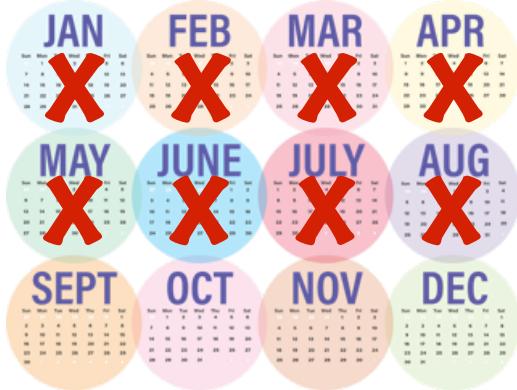
Department websites - faculty/staff, courses

Exam scanning - students

Why ask over and over and over???

How long to get data???

# Before

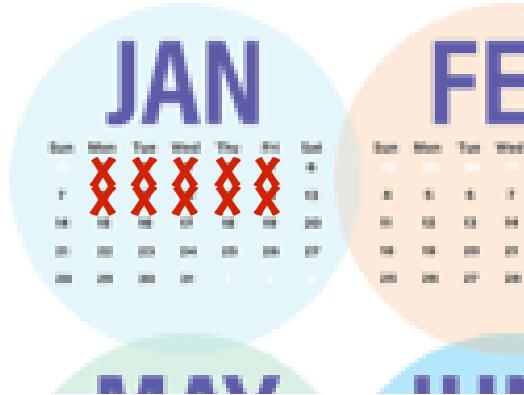


240 days

Central secure  
data hub for  
core data



# After



10 days

# Sources of Truth

HR data (Banner) - faculty contact info

Research information system (Elements) - bio, CV, research interests, publications, courses taught

Campus calendar (Master Calendar) - events

Programs of study (CourseLeaf) - majors and degree requirements

Publishing platform (In house - Drupal) - news items



Central secure data hub for core data



One Drupal-based infrastructure for 15 schools

Build one infrastructure to maintain and then reuse

New features, fixes, and enhancements get rolled out to all sites



# Navigation Inconsistent

COLA

[About](#) [People](#) [Academics](#) [Research & Creativity](#) [Arts](#) [Student Resources](#) [Faculty Resources](#) [Alumni & Friends](#) [How to Apply](#)

Marine

[About](#) [People](#) [Academics](#) [Facilities](#) [Research](#) [Centers of Excellence](#) [Outreach and Events](#) [Funding & Opportunities](#) [Apply](#)

CHHS

[About](#) [Academics](#) [Centers & Institutes](#) [Research](#) [Student Resources](#) [Alumni & Friends](#) [Admissions](#)

Carsey

[About](#) [News and Events](#) [Research Publications](#) [Program Areas](#) [Degree Programs](#) [Professional Education](#) [Resources](#) [Give to Carsey](#)

Online

[Home](#) [About](#) [Degrees & Certificates](#) [Ready for Online Learning?](#) [Faculty Resources](#)

COLSA

[About](#) [Admissions](#) [Academics](#) [Faculty & Staff](#) [Research](#) [Careers](#)

Law

[UNH Law Experience](#) [Academics](#) [Admissions](#) [Centers & Institutes](#) [Career Planning](#) [Library](#) [About](#) [Alumni](#)

UNHM

[Admission & Aid](#) [Academics](#) [Student Experience](#) [Research](#) [Career Planning](#) [About](#)

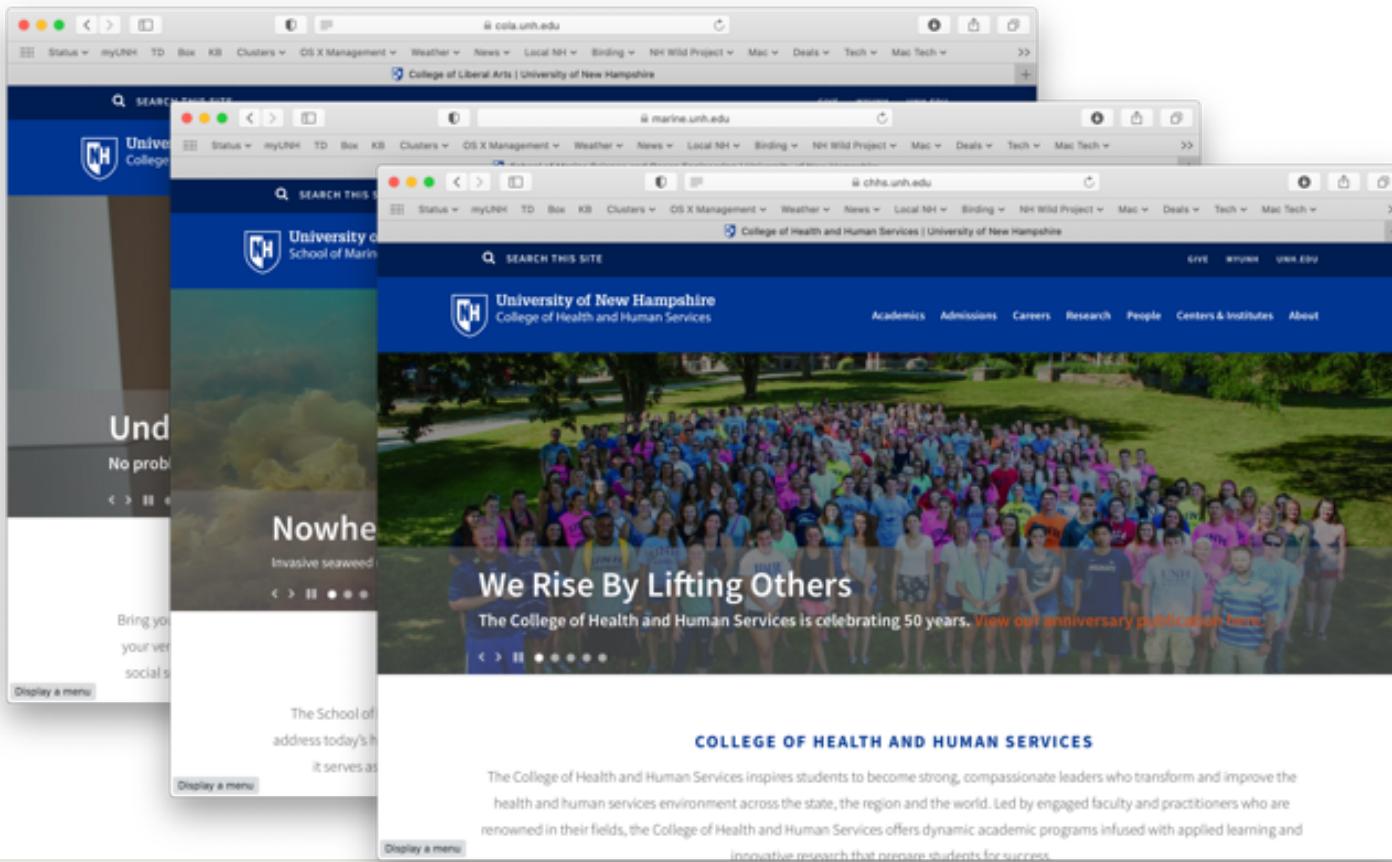
Paul

[About Us](#) [Undergraduate](#) [Graduate](#) [Executive Education](#) [Research](#) [Faculty & Staff](#) [Career Services](#) [Make a Gift](#)

CEPS

[About](#) [Academics](#) [Research & Facilities](#) [Career Services](#) [K-12 Outreach](#) [Student Resources](#) [Faculty & Staff](#) [Alumni](#) [Admissions](#) [Industry](#) [Give](#)

# User-focused, consistent, data driven



Better service  
to our users

Accurate  
information

Up to date

Continually  
improving

Releasing  
about every 10  
days to all sites

# Our Journey, Part 3 - What's Next?

## DevOps is a Journey



- Starts with a single step
- Has no finish line
- Recognizes the unique skills and experience of each contributor
- Expects discipline and commitment from all levels
- Takes time and patience
- Learns from success and failures

From Essential DevOps, delivery by Jayne Groll, DevOps Institute at CD Summit Boston Boston, May, 2016

# Higher Ed Software and Services

Academic Technology and Support  
Alumni and Advancement  
Assessment Systems and Learning Analytics  
Athletics  
Auxiliary Systems  
Business Capability and Process Automation  
Business Continuity and Disaster Recovery  
Conferencing and Telephones  
Continuous Improvement and Innovation  
Data Center Services  
Data, Reporting, and Analytics  
Database Management  
Desktop and Mobile Device Support  
Digital Accessibility  
E-Portfolio Management  
Email and Collaboration Services  
Facilities Management  
Faculty Information Systems

Financial and Procurement Systems  
Hardware Lifecycle Services  
Human Resource Systems  
Identity and Access Management  
Instructional Technology and Design  
Integration Services  
IT Communications and Documentation  
IT Service Delivery and Support  
IT Strategy, Governance, and Enterprise Architecture  
Lab Management Systems  
Learning Management  
Lecture Capture  
Library Systems  
Mass Communications and Emergency Notifications  
Media and A/V  
Medical and Health Systems  
Monitoring and Alert Management

Network and Connectivity Management  
Polling and Surveys  
Portfolio and Project Management  
Printing and Related Services  
Research Administration Systems  
Research Data Services  
Research Software  
Research-Specific Computing and Applications  
Secure Computing  
Security Consulting and Education  
Security Incident Response and Investigation  
Security Policy and Compliance  
Server and Storage Management  
Software and Applications Distribution  
Student Information Systems  
Training and Outreach  
Web Services

From The Higher Education Service Catalog Model:

<https://library.educause.edu/resources/2019/11/higher-education-it-service-catalog-second-edition>

# Higher Ed Software and Services

Academic Technology and Support

Alumni and Advancement

Assessment Systems and Learning Analytics

Athletics

Auxiliary Systems

Business Capability and Process Automation

Business Continuity and Disaster Recovery

Conferencing and Telephones

Continuous Improvement and Innovation

Data Center Services

**Data, Reporting, and Analytics**

Database Management

Desktop and Mobile Device Support

Digital Accessibility

E-Portfolio Management

Email and Collaboration Services

Facilities Management

Faculty Information Systems

Financial and Procurement Systems

Hardware Lifecycle Services

Human Resource Systems

**Identity and Access Management**

Instructional Technology and Design

**Integration Services**

IT Communications and Documentation

**IT Service Delivery and Support**

IT Strategy, Governance, and Enterprise

Architecture

Lab Management Systems

Learning Management

Lecture Capture

Library Systems

Mass Communications and Emergency

Notifications

Media and A/V

Medical and Health Systems

Monitoring and Alert Management

Network and Connectivity Management

Polling and Surveys

Portfolio and Project Management

Printing and Related Services

Research Administration Systems

Research Data Services

**Research Software**

Research-Specific Computing and Applications

Secure Computing

Security Consulting and Education

Security Incident Response and Investigation

Security Policy and Compliance

Server and Storage Management

Software and Applications Distribution

Student Information Systems

**Training and Outreach**

Web Services

From The Higher Education Service Catalog Model:

<https://library.educause.edu/resources/2019/11/higher-education-it-service-catalog-second-edition>

## We do Dev at USNH

# The Apps



DevOps requires “Dev”, but the principles can still apply, even if there is no development

Shared responsibility for the entire system and service

Measurement

Automation

We can also apply pieces of the DevOps toolchain to application admin work

Automated testing

“as code”

Microservices

DevOps pipelines use automated testing to validate that code is safe to release and that systems are running as expected

Why not use automated test tools to validate our SaaS or locally run apps:

- Confirm functionality during upgrades

- Validate that config changes are in place

- Don't wait for users to complain that something is down

Examples: Behat, Selenium

# Proof of concept: Validate Canvas logins using Behat

```
$ bin/behat --strict --colors
Feature: Sign in to the website
  In order to access Canvas
  As a visitor
  I need to be able to log in to the website

Scenarios: Log in with username and password # features/login-backend.feature:6
  Given I am on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::visit()
  When I fill in the following:
    | pseudonym_session[unique_id] | dbl |
    | pseudonym_session[password] | [REDACTED] |
  And I press "Log In" # Behat\MinkExtension\Context\MinkContext::pressButton()
  Then I should be on "/login_success=1" # Behat\MinkExtension\Context\MinkContext::assertPageAddress()
  And I should see "Dashboard" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()

Scenarios: Log in with bad credentials # features/login-backend.feature:15
  Given I am on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::visit()
  When I fill in the following:
    | pseudonym_session[unique_id] | dbl |
    | pseudonym_session[password] | XXXXXXXX |
  And I press "Log In" # Behat\MinkExtension\Context\MinkContext::pressButton()
  Then I should be on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::assertPageAddress()
  And I should see "Invalid" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()

Feature: Homepage redirects to SAML login
  I want to verify that I get redirected to the SecureAuth login page

Scenarios: Verify the login redirect # features/login-redirect.feature:4
  When I am on the homepage # Behat\MinkExtension\Context\MinkContext::iAmOnHomepage()
  Then I should see "myCourses Login" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()
  The text "myCourses Login" was not found anywhere in the text of the current page. (Behat\Mink\Exception\ResponseTextException)

--- Filed scenarios:
  features/login-redirect.feature:4

3 scenarios (2 passed, 1 failed)
12 steps (11 passed, 1 failed)
0m1.98s (11.17MB)
$
```

```
$ bin/behat --strict --colors
Feature: Sign in to the website
  In order to access Canvas
  As a visitor
  I need to be able to log in to the website

Scenarios: Log in with username and password # features/login-backend.feature:6
  Given I am on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::visit()
  When I fill in the following:
    | pseudonym_session[unique_id] | dbl |
    | pseudonym_session[password] | [REDACTED] |
  And I press "Log In" # Behat\MinkExtension\Context\MinkContext::pressButton()
  Then I should be on "/login_success=1" # Behat\MinkExtension\Context\MinkContext::assertPageAddress()
  And I should see "Dashboard" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()

Scenarios: Log in with bad credentials # features/login-backend.feature:15
  Given I am on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::visit()
  When I fill in the following:
    | pseudonym_session[unique_id] | dbl |
    | pseudonym_session[password] | XXXXXXXX |
  And I press "Log In" # Behat\MinkExtension\Context\MinkContext::pressButton()
  Then I should be on "/login/canvas" # Behat\MinkExtension\Context\MinkContext::assertPageAddress()
  And I should see "Invalid" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()

Feature: Homepage redirects to SAML login
  I want to verify that I get redirected to the SecureAuth login page

Scenarios: Verify the login redirect # features/login-redirect.feature:4
  When I am on the homepage # Behat\MinkExtension\Context\MinkContext::iAmOnHomepage()
  Then I should see "myCourses Login" # Behat\MinkExtension\Context\MinkContext::assertPageContainsText()

3 scenarios (3 passed)
12 steps (12 passed)
0m1.29s (11.21MB)
$
```

# Configuration as Code

Example: Create a large number of categories and assign rights in our media hosting tools to support a new online platform for undergrad research presentations

Old way - Data entry via the UI

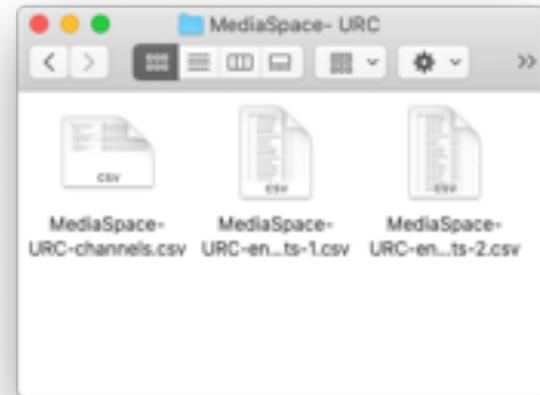
Click button, type, save. Repeat. Repeat. Make typo. Undo. Repeat.... Get department to review. Find mistakes. Go back and fix all in production.

Hours of (boring) work. No permanence.

“Configuration as code”

Create input files with all of the categories. Test load via API. Get confirmation. Modify input files to correct. Load exact same config into production.

< 1 hour and 100% right from the start plus ability to reuse



Provide just-in-time, automated service delivery using simple web forms to call application APIs (mostly just plans still due to COVID)

Create sandbox course in an LMS

Setup and modify groups for media hosting/sharing

Manage reopening classes for students with incompletes

Redeveloping our provisioning system for the LMS around independent, simple tasks (add 1 student to 1 course) instead of a monolithic script that does the entirety of the process

Removing the rough edges, the technological weaknesses, the over-engineered, the “we have always done it this way”, and the silos that keep us for doing our real jobs in higher education:

Learning

Sounds a lot like DevOps...

Got ideas, suggestions, or want to know more?

David J. Blezard

[david.blezard@unh.edu](mailto:david.blezard@unh.edu)



NOTE: This presentation leaves copyright of the content to the presenter. Unless otherwise noted in the materials, uploaded content carries the [Creative Commons Attribution 4.0 International \(CC BY 4.0\)](#), which grants usage to the general public, with appropriate credit to the author.