SAND2019-5080C

Thunderbird UI

Redesigning the internal web of
Sandia National Laboratories

PRESENTED BY

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Introduction

What is Thunderbird UI and why did we do it?

What is Thunderbird UI?

- Thunderbird UI (TUI) is a **Design System**
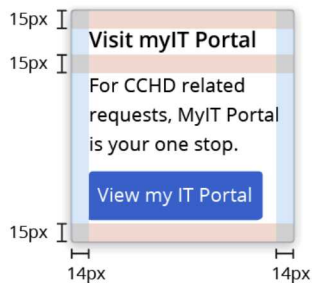
What is a design system?

- Style guide
- Common look and feel
- UI requirements
- Accessibility requirements

- Reusable interface components
- Common set of assets
- Color palette(s)
- Page templates

Thunderbird UI examples

Card

15px
15px

Visit myIT Portal

For CCHD related requests, MyIT Portal is your one stop.

View my IT Portal

15px

14px   14px

Button Toolbar

When you have a primary action that you would like to position next to a button group, use a button toolbar to separate the primary button from the secondary button group set. You can also use the `mr-2` class to add a right margin to the primary button.

| Save | Day | Month | Year |

```
<div class="btn-toolbar">
  <div class="btn-group mr-2" role="group" aria-label="Basic example">
    <button type="button" class="btn btn-primary">Save</button>
  </div>

  <div class="btn-group" role="group" aria-label="Basic example">
    <button type="button" class="btn btn-outline-primary">Day</button>
    <button type="button" class="btn btn-outline-primary">Month</button>
    <button type="button" class="btn btn-outline-primary">Year</button>
  </div>
</div>
```
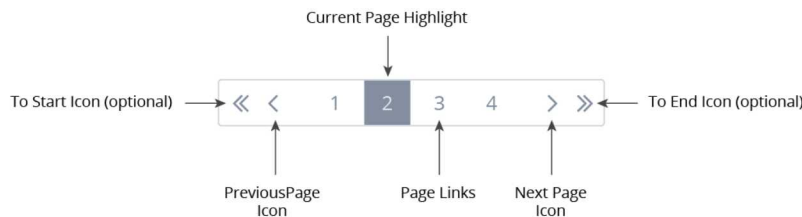
Modal

24px
28px

Delete all contact information?   ✕

Are you sure you want to delete all contact information? This action is irreversible.

32px

Cancel   Delete

24px

24px   8px   24px

500px

Spinner states

Default (V4)

Colors

Foreground: snl-blue-500
Background: snl-blue-400, 40%

Current Page Highlight

To Start Icon (optional) →   ≪ < 1 2 3 4 > ≫   ← To End Icon (optional)

PreviousPage Icon   Page Links   Next Page Icon

| snl-light-blue #00add0 rgb(0, 173, 208) | snl-light-blue-900 #004553 rgb(0, 69, 83) | snl-light-blue-800 #005f72 rgb(0, 95, 114) | snl-light-blue-700 #007992 rgb(0, 121, 146) | snl-light-blue-600 #0093b1 rgb(0, 147, 177) | snl-light-blue-500 #00add0 rgb(0, 173, 208) |
	snl-light-blue-400 #33bdd9 rgb(51, 189, 217)	snl-light-blue-300 #66cce3 rgb(102, 206, 227)	snl-light-blue-200 #99deec rgb(153, 222, 236)	snl-light-blue-100 #cceff6 rgb(204, 239, 246)	snl-light-blue-50 #e6f7fa rgb(230, 247, 250)
snl-blue #0066cc rgb(0, 102, 204)	snl-blue-900 #002952 rgb(0, 41, 82)	snl-blue-800 #003870 rgb(0, 56, 112)	snl-blue-700 #00478f rgb(0, 71, 143)	snl-blue-600 #0057ad rgb(0, 87, 173)	snl-blue-500 #0066cc rgb(0, 102, 204)
	snl-blue-400 #3385d6 rgb(51, 133, 214)	snl-blue-300 #66a3e0 rgb(102, 163, 224)	snl-blue-200 #99c2eb rgb(153, 194, 235)	snl-blue-100 #cce0f5 rgb(204, 224, 245)	snl-blue-50 #e6f0fa rgb(230, 240, 250)
snl-teal #008e74 rgb(0, 142, 116)	snl-teal-900 #00392e rgb(0, 57, 46)	snl-teal-800 #004e40 rgb(0, 78, 64)	snl-teal-700 #006351 rgb(0, 99, 81)	snl-teal-600 #007963 rgb(0, 121, 99)	snl-teal-500 #008e74 rgb(0, 142, 116)
	snl-teal-400 #33a590 rgb(51, 165, 144)	snl-teal-300 #66bbac rgb(102, 187, 172)	snl-teal-200 #99d2c7 rgb(153, 210, 199)	snl-teal-100 #cce8e3 rgb(204, 232, 227)	snl-teal-50 #e6f4f1 rgb(230, 244, 241)
snl-purple #5a3cbf rgb(90, 60, 191)	snl-purple-900 #24184c rgb(36, 24, 76)	snl-purple-800 #322169 rgb(50, 33, 106)	snl-purple-700 #3f2a86 rgb(63, 42, 134)	snl-purple-600 #4d33a2 rgb(77, 51, 162)	snl-purple-500 #5a3cbf rgb(90, 60, 191)
	snl-purple-400 #7b63cc rgb(123, 99, 204)	snl-purple-300 #9c8ad9 rgb(156, 138, 217)	snl-purple-200 #bdb1e5 rgb(189, 177, 229)	snl-purple-100 #ded8f2 rgb(222, 216, 242)	snl-purple-50 #efecf9 rgb(239, 236, 249)
snl-lavender #b312b1 rgb(179, 18, 177)	snl-lavender-900 #480747 rgb(72, 7, 71)	snl-lavender-800 #620a61 rgb(98, 10, 97)	snl-lavender-700 #7d0d7c rgb(125, 13, 124)	snl-lavender-600 #980f96 rgb(152, 15, 150)	snl-lavender-500 #b312b1 rgb(179, 18, 177)
	snl-lavender-400 #c241c1 rgb(194, 65, 193)	snl-lavender-300 #d171d0 rgb(209, 113, 208)	snl-lavender-200 #e1a0e0 rgb(225, 160, 224)	snl-lavender-100 #f0d0ef rgb(240, 208, 239)	snl-lavender-50 #f7e7f7 rgb(247, 231, 247)
snl-green #6cb312 rgb(108, 179, 18)	snl-green-900 #2b4807 rgb(43, 72, 7)	snl-green-800 #3b620a rgb(59, 98, 10)	snl-green-700 #4c7d0d rgb(76, 125, 13)	snl-green-600 #5c980f rgb(92, 152, 15)	snl-green-500 #6cb312 rgb(108, 179, 18)
	snl-green-400 #89c241 rgb(137, 194, 65)	snl-green-300 #a7d171 rgb(167, 209, 113)	snl-green-200 #c4e1a0 rgb(196, 225, 160)	snl-green-100 #e2f0d0 rgb(226, 240, 208)	snl-green-50 #f0f7e7 rgb(240, 247, 231)
snl-crimson #822433 rgb(130, 36, 51)	snl-crimson-900 #340e14 rgb(52, 14, 20)	snl-crimson-800 #48141c rgb(72, 20, 28)	snl-crimson-700 #5b1924 rgb(91, 25, 36)	snl-crimson-600 #6f1f2b rgb(111, 31, 43)	snl-crimson-500 #822433 rgb(130, 36, 51)
	snl-crimson-400 #9b505c rgb(155, 80, 92)	snl-crimson-300 #b47c85 rgb(180, 124, 133)	snl-crimson-200 #cda7ad rgb(205, 167, 173)	snl-crimson-100 #e6d3d6 rgb(230, 211, 214)	snl-crimson-50 #f3e9eb rgb(243, 233, 235)
snl-red #cc0000 rgb(204, 0, 0)	snl-red-900 #520000 rgb(82, 0, 0)	snl-red-800 #700000 rgb(112, 0, 0)	snl-red-700 #8f0000 rgb(143, 0, 0)	snl-red-600 #ad0000 rgb(173, 0, 0)	snl-red-500 #cc0000 rgb(204, 0, 0)
	snl-red-400 #d63333 rgb(214, 51, 51)	snl-red-300 #e06666 rgb(224, 102, 102)	snl-red-200 #eb9999 rgb(235, 153, 153)	snl-red-100 #f5cccc rgb(245, 204, 204)	snl-red-50 #fae6e6 rgb(250, 230, 230)
snl-red-orange #f23f00 rgb(242, 63, 0)	snl-red-orange-900 #611900 rgb(97, 25, 0)	snl-red-orange-800 #852300 rgb(133, 35, 0)	snl-red-orange-700 #a92c00 rgb(169, 44, 0)	snl-red-orange-600 #ce3600 rgb(206, 54, 0)	snl-red-orange-500 #f23f00 rgb(242, 63, 0)

What does a design system solve?

- No cohesive look and feel to sites and apps on the internal web
  - Example: Pacman loading spinner

- Inconsistent user experience
  - Users have to relearn how to interact with each new site (productivity drain)

- Developers kept reinventing the wheel
  - How many different implementations of a date picker do we need?

- The internal web looks unprofessional
  - Unbefitting a premiere science and engineering laboratory
  - Could effect employee moral and retention

Microsoft's Intranet
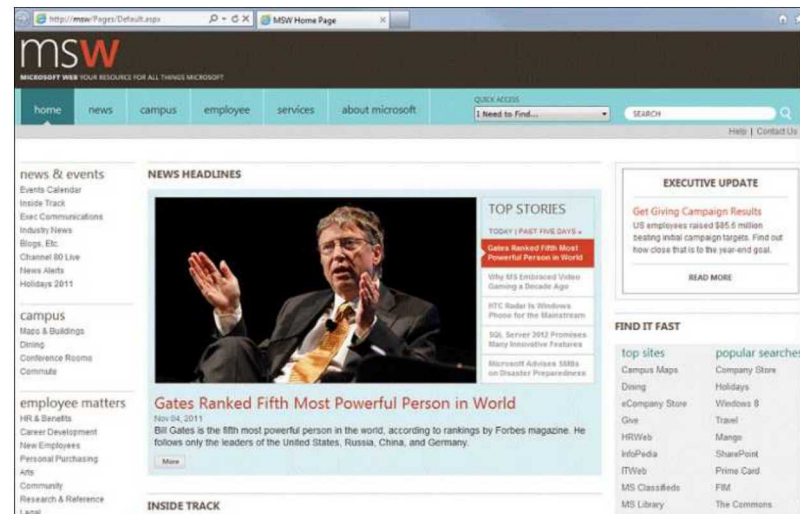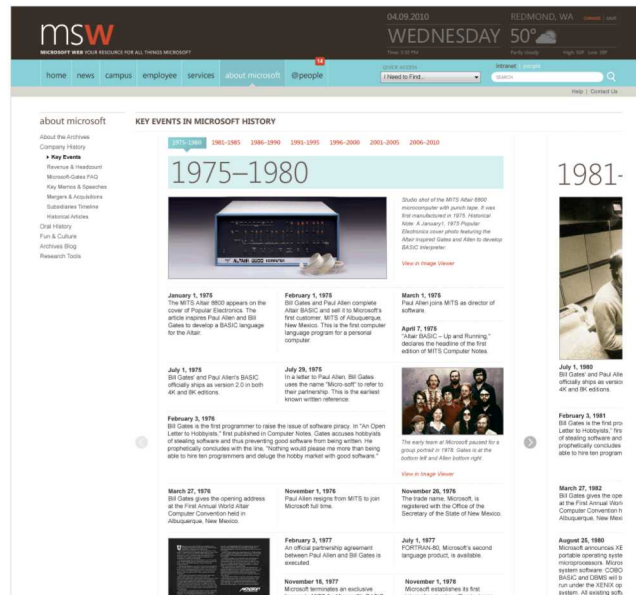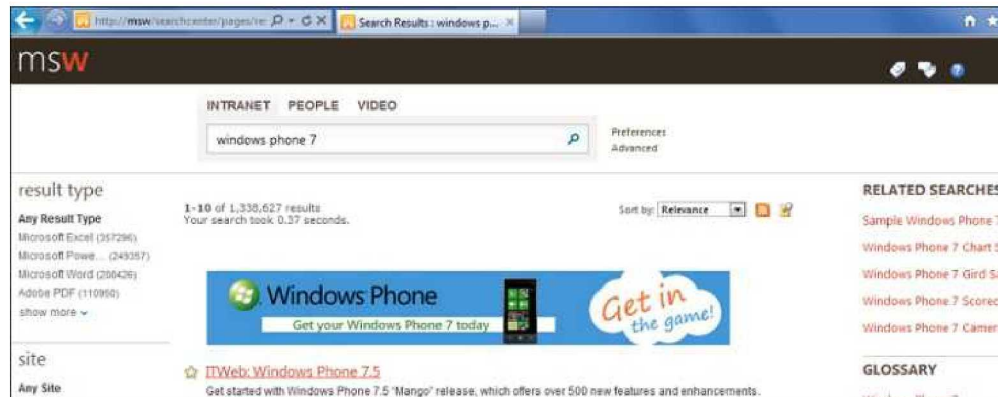
Adobe's Intranet
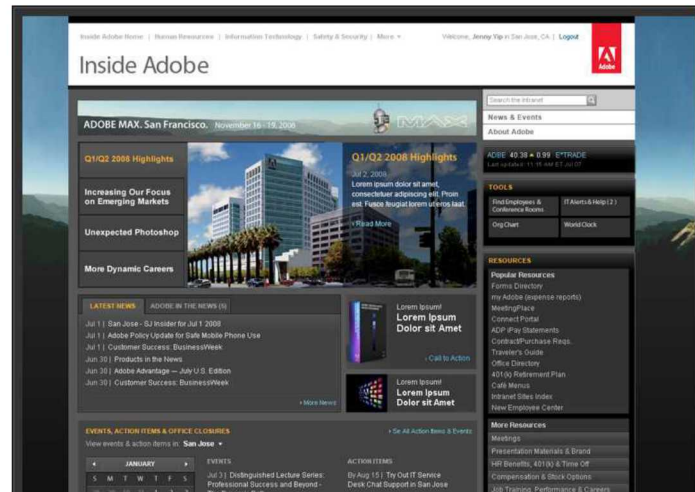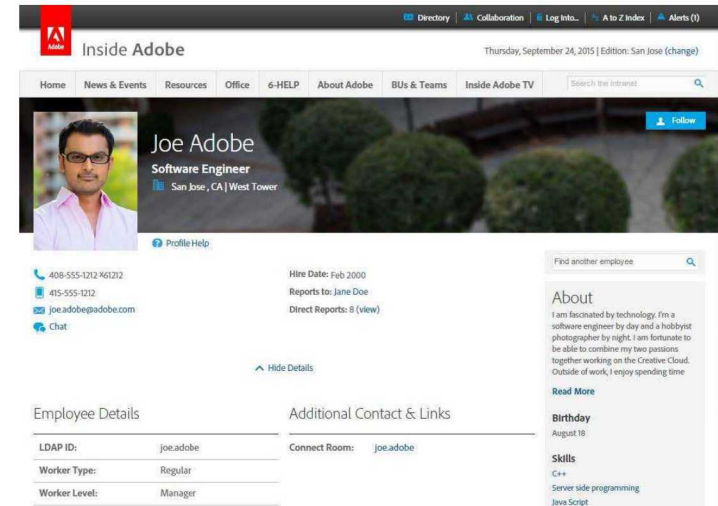
IBM's Intranet
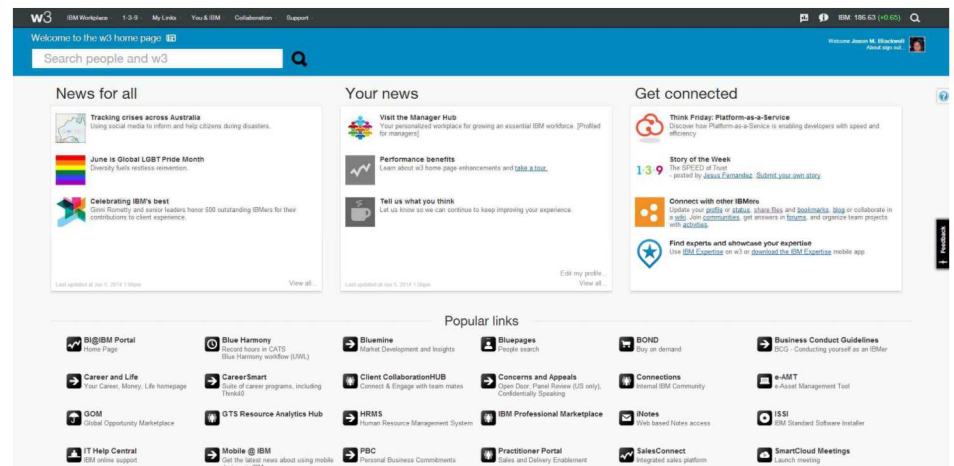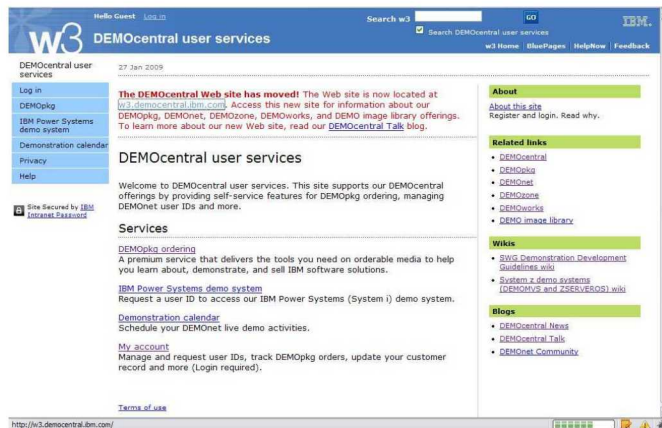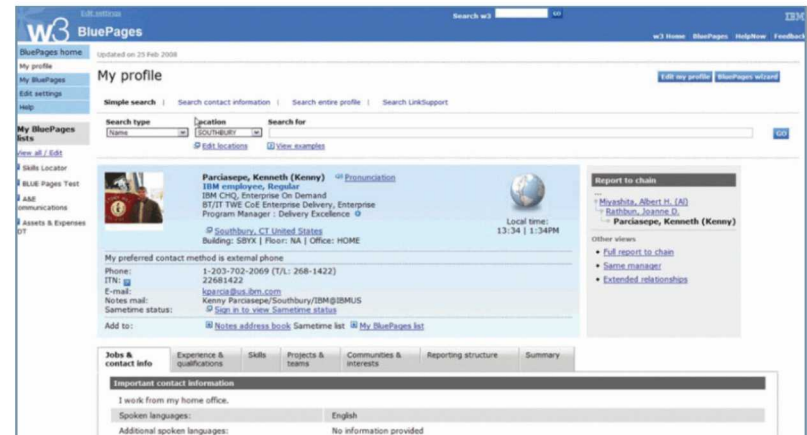
Sandia's Intranet – Before TUI
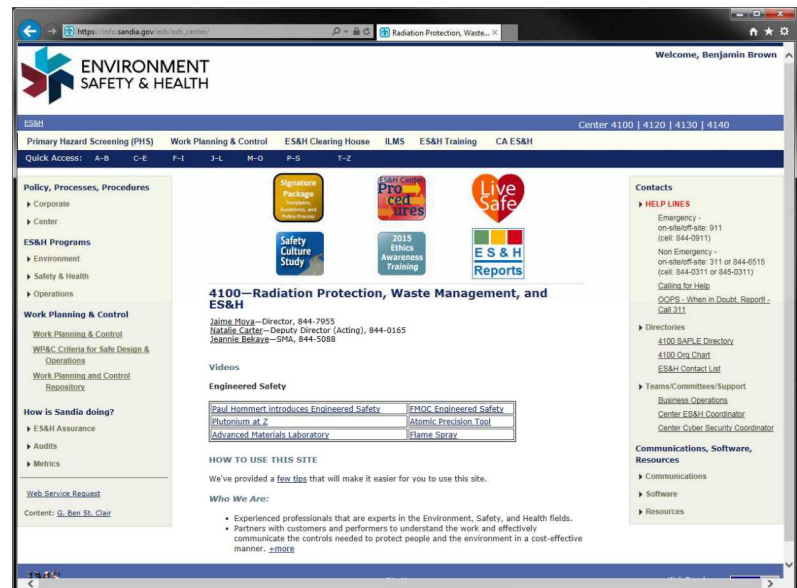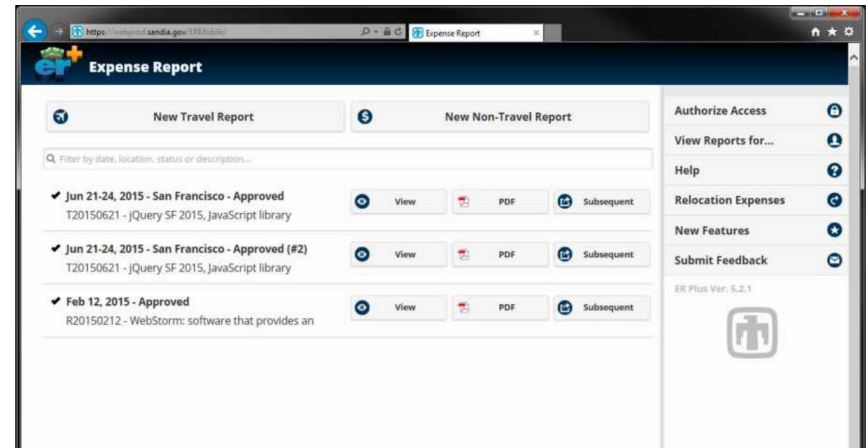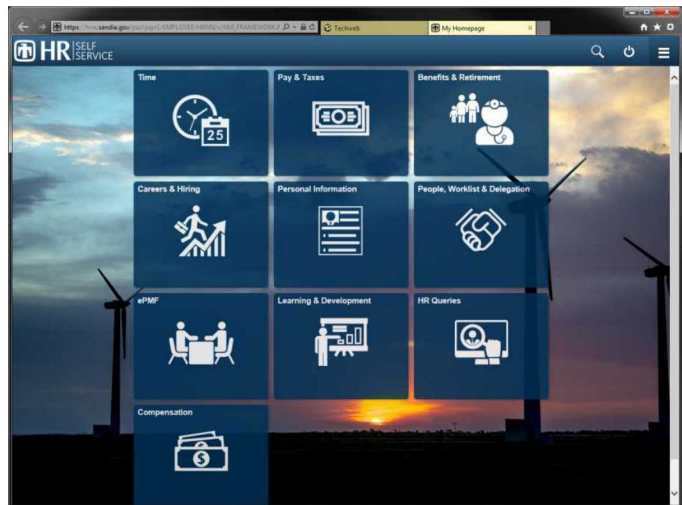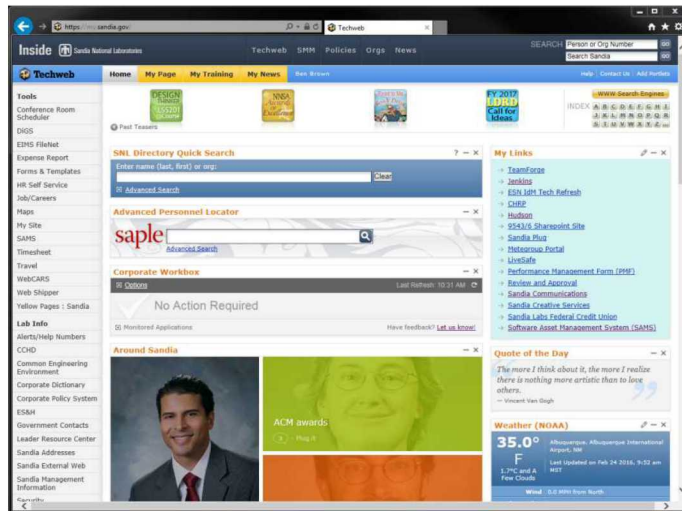
Sandia Intranet – After TUI
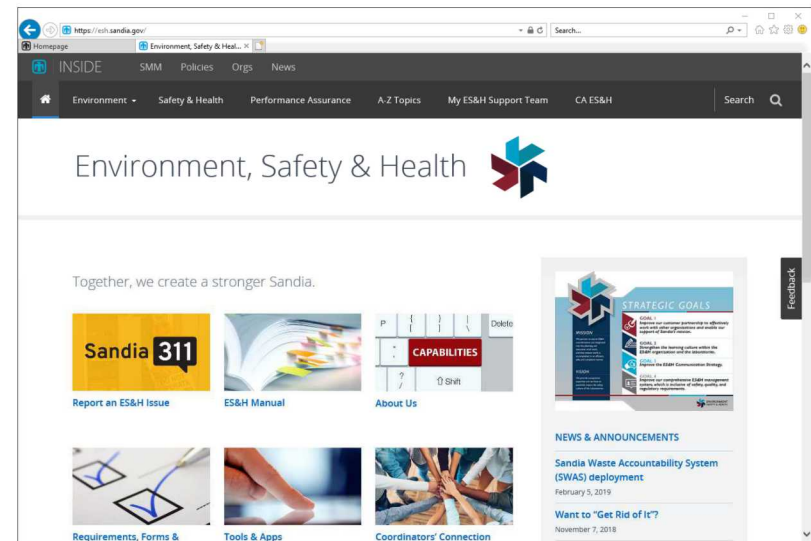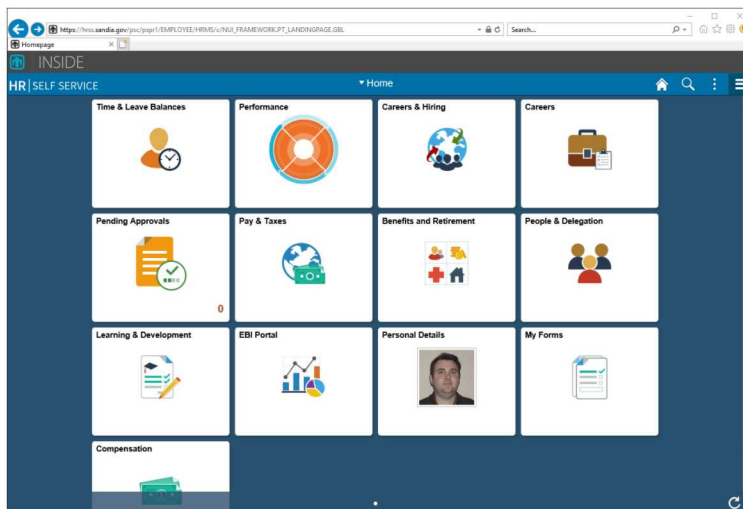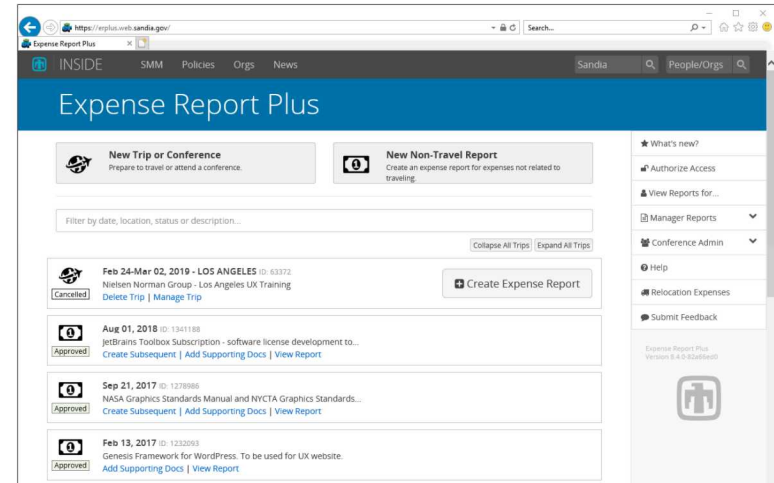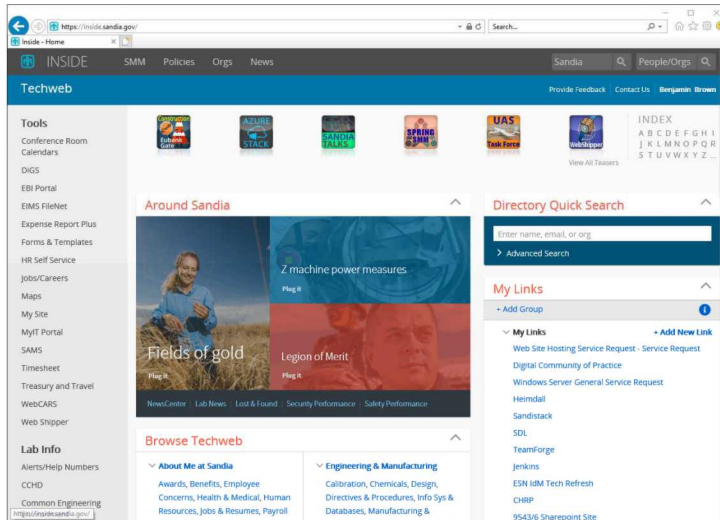
Notable design systems

- United States Web Design System

- Material Design – Google

- Carbon Design System – IBM

- Global Experience Language (GEL) – BBC

- **Atomic Design – Brad Frost**
  - provides a framework for design system development
  - atoms, molecules, cells, organisms

How we went about it

This talk will cover:

- Design and Development

- Distribution and Adoption

- Return on Investment

- Path Forward and Lessons Learned

Design and Development

Phases of development

Industry Research & Community Outreach

Aesthetic Design

Code Development

Documentation & Presentation

UX Testing

Time
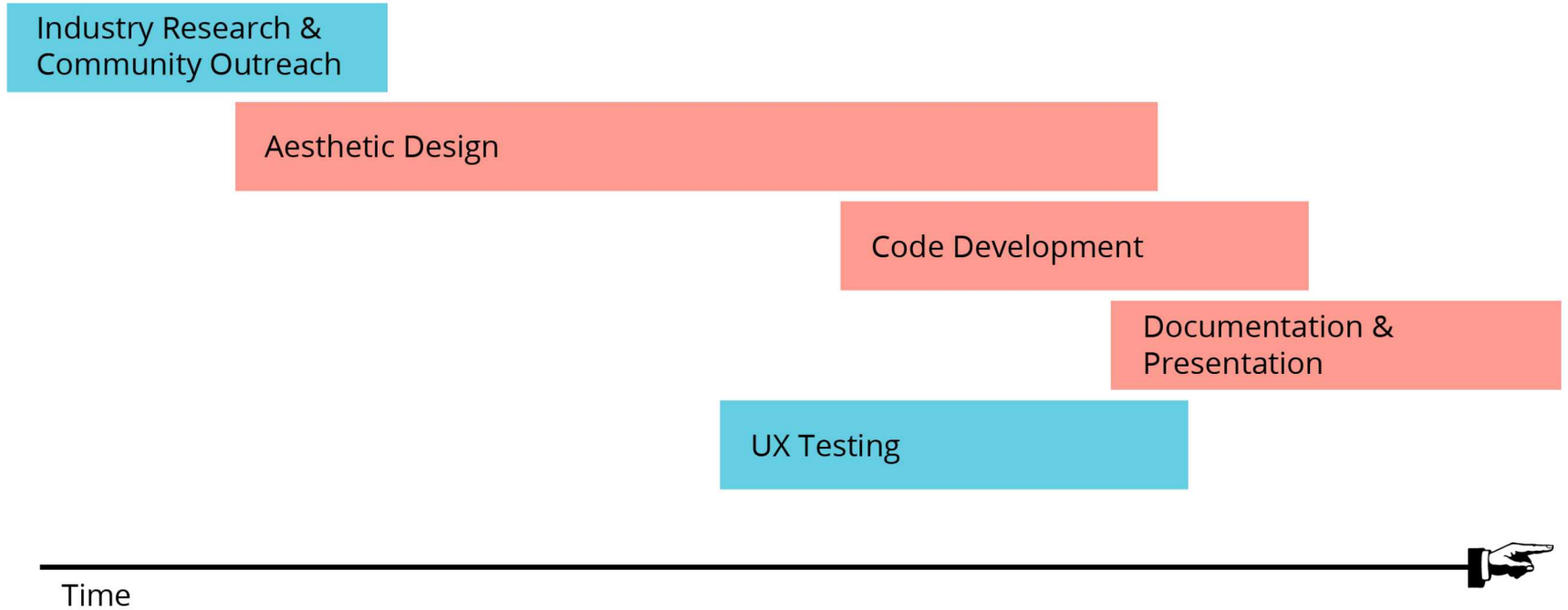
Code Library Architecture

- Bootstrap used as a foundation for UI code library
  - established starting point
  - accessibility already built in
  - developers already familiar with how to use it
  - can integrate with many other frameworks

- Code library split into two categories
  - Foundations
    - color, typography, icons, grid, etc.
  - Components
    - buttons, tabs, modals, tables, etc.

Library Structure

Foundations

- Accessibility
- Animation
- Borders, Shadows, and Light
- Colors
- Grid
- Icons
- Typography

Components

- Accordion
- Alert
- Badge
- Breadcrumb
- Button
- Button Group
- Card
- Carousel
- Checkbox
- Date/Time Picker
- Dropdown
- Form Elements
- Global Header and Footer
- Hero
- In-Page Navigation
- Loading Notification
- Modal
- Pagination
- People Picker
- Popover
- Progress Bar
- Radio Button
- Range
- Search Box
- Secondary Navigation
- Select
- Site Footer
- Site Header
- Switch
- Table
- Tabs and Pills
- Text Area
- Text Input
- Toast
- Tooltip

Aesthetic Design

- Team of 4 to 6 designers

- Primarily focused on look and feel

- Components divided amongst designers

- Biweekly design reviews

- Designs based on Bootstrap 4 and industry best practices

- Most time-intensive (expensive) phase
  - About 6 months (not full time project)

Code Development
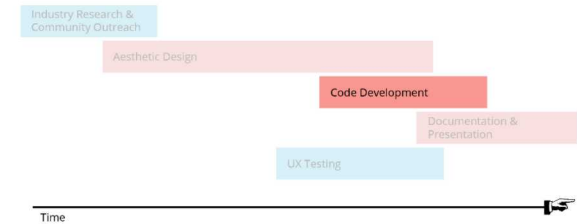
- Team of 3 to 4 developers
  - Subset of design team
- Components divided amongst developers
- Use Bootstrap 4 component as starting point
- Customize Bootstrap SASS variables
- Add custom SASS, JavaScript
- About 3 months

Documentation & Presentation
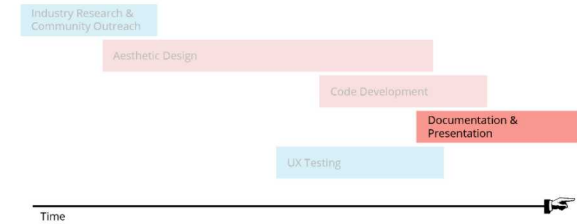
- Team of 2 to 3 writers

- Base documentation on existing UI requirements, industry design systems

- About 2 months

UX Testing and Validation

- First round with clickable prototypes
  - Testing designs, code didn't exist yet
  - Make changes to component design based on results

- Validation Study on Documentation Sections

- Eye-tracking Study on Headings
  - H1, H2, H3, etc.

Heading Study

- Question: How does heading size, weight, and spacing impact readability?

- Measures collected:
  - Comprehension
  - Eye movement data

- Design:
  - 32 passages, 3 heading levels
  - Black text, white background
  - Factors Manipulated (16 conditions)
    - Margin (small, large)
    - Scale (small, large)
    - Weight (regular, bold, light, mixed)

Heading Study Stimulus Examples

Margin 1, Scale 1, Regular Weight   Margin 1, Scale 2, Mixed Weight   Margin 2, Scale 1, Bold Weight   Margin 2, Scale 2, Light Weight   Margin 1, Scale 1, Mixed Weight   Margin 1, Scale 2, Regular Weight   Margin 2, Scale 1, Light Weight   Margin 2, Scale 2, Bold Weight

Margin 1, Scale 1, bold Weight   Margin 1, Scale 2, Light Weight   Margin 2, Scale 1, Mixed Weight   Margin 2, Scale 2, regular Weight   Margin 1, Scale 1, light Weight   Margin 1, Scale 2, bold Weight   Margin 2, Scale 1, regular Weight   Margin 2, Scale 2, mixed Weight

Heading Study Stimulus Examples

Margin 1, Scale 1, Regular Weight

Empire State Building

The Empire State Building is a 102-story Art Deco skyscraper in

Overview

As of 2017 the building is the 5th-tallest completed skyscraper

Structural Specifications

Designed by Shreve, Lamb & Harmon and completed in 1931, 1
its antenna. Its name is derived from "Empire State", the nickna

Construction

The original design of the Empire State Building was for a 50-st
with an airship mast on top, to ensure it would be the world's t

Modern Day

The Empire State Building has long been a popular tourist attra

World Records

The Empire State Building stood as the world's tallest building 1
1970. Following the September 11 attacks in 2001, it was again

Cultural Significance

It was designated a National Historic Landmark in 1986, and wa
been featured in more than 250 TV shows and movies since the

Margin 1, Scale 2, Mixed Weight

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Margin 2, Scale 1, Bold Weight

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Margin 2, Scale 2, Light Weight

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Heading Study Results: Comprehension Question Accuracy
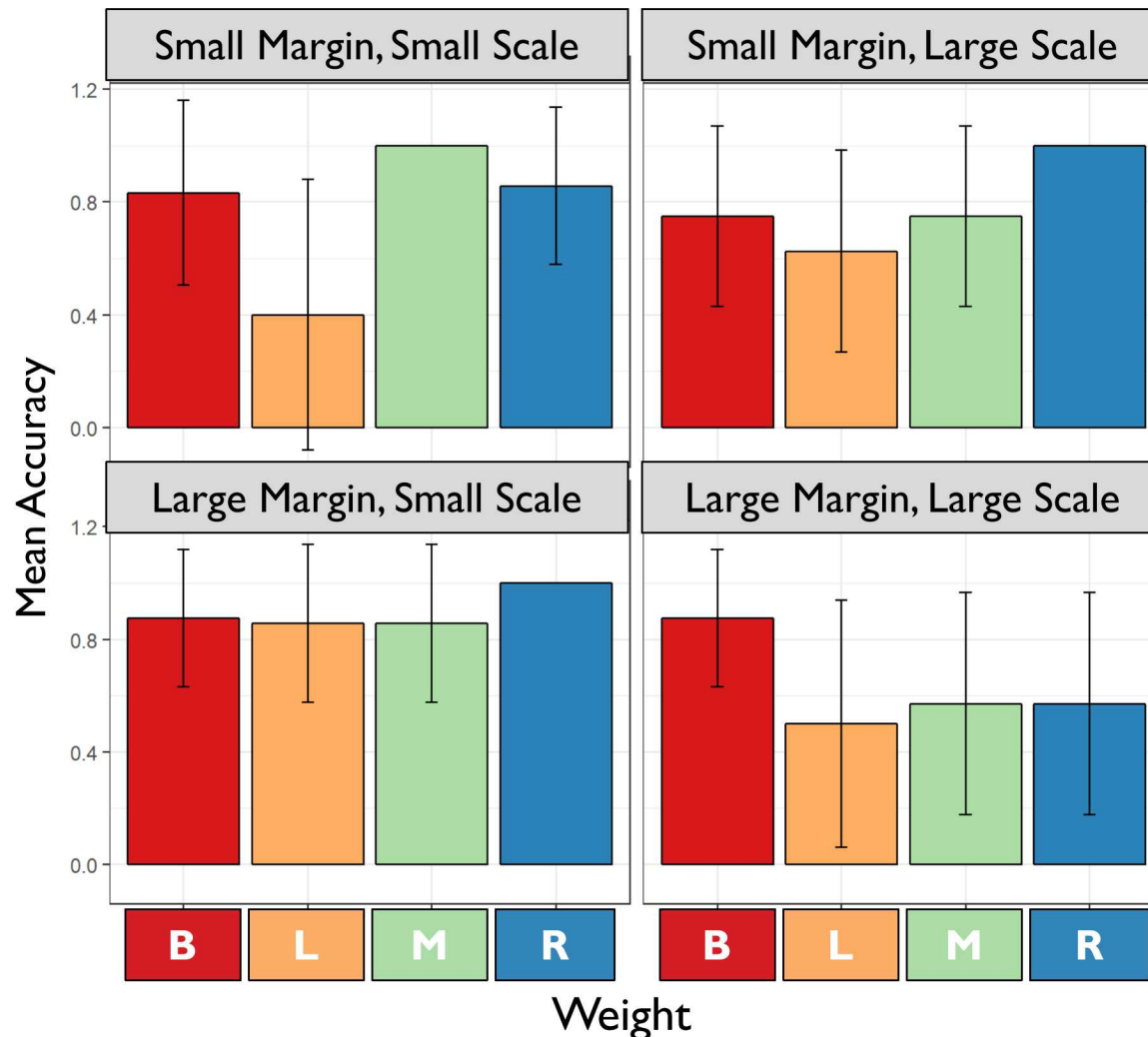
- Passages with light headings had the lowest accuracy, especially with small margin, small scale (*top left*)

- Large margin, large scale combination showed lowest comprehension accuracy (*bottom right*)— except for bold

Heading Study Results: Viewing Patterns

EyeLink Fixation Map (Duration Based) for IP: "ReadingPeriod". Aggregate Data for "2: 2: y" - Trials=29, Fixations:7942. Max: 1559.4 msec.
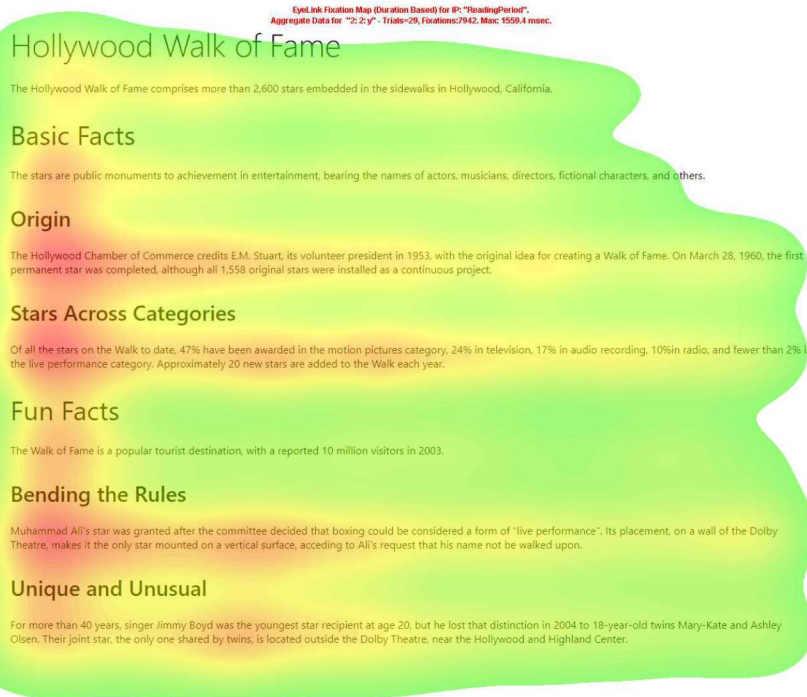
- People read whole passage
- No clear differentiation between looks to heading versus body text
  - Poor "return sweep" targeting
  - This could explain why the bolder font helps comprehension in the more compressed passages

Heading Study Results: Heading Dwell Time
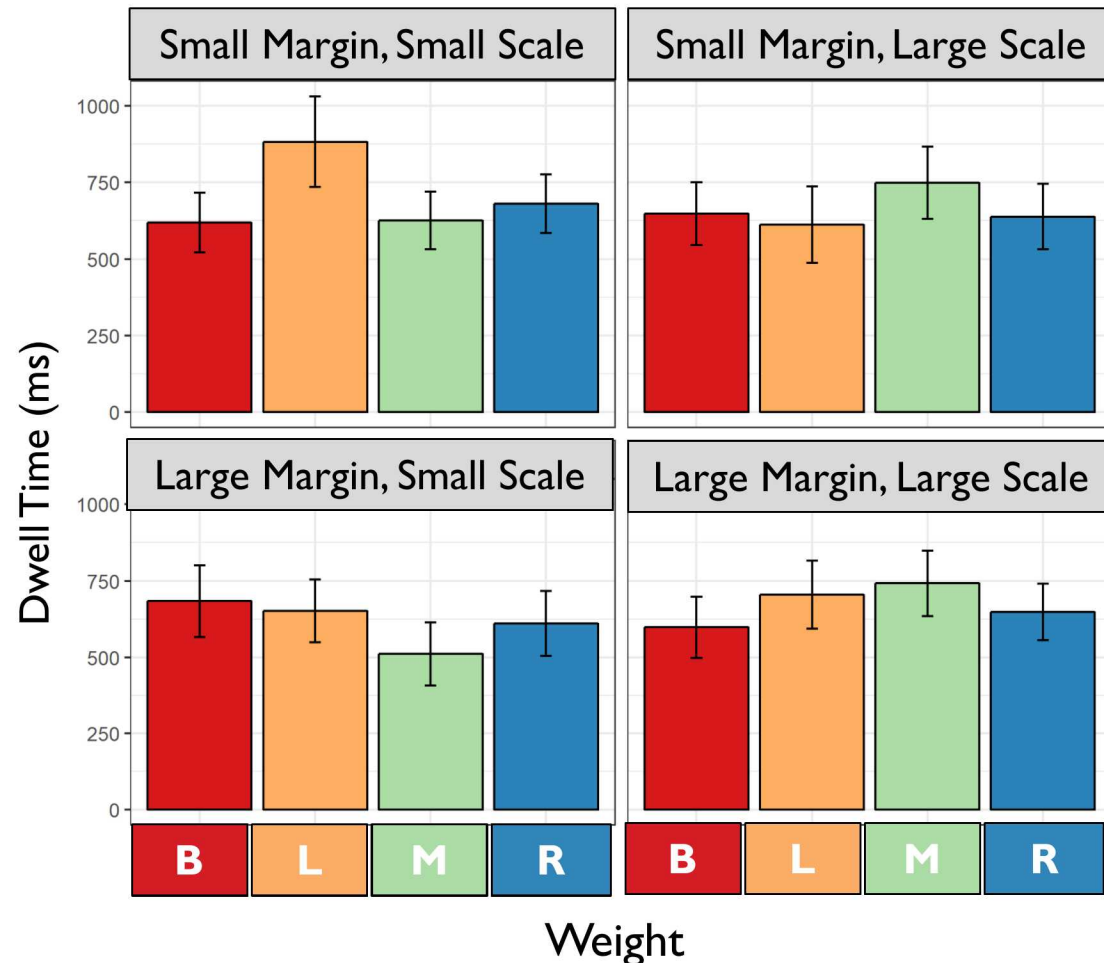
- Dwell times were longest for conditions with worst comprehension
  - Light headings (Small scale, small margin)
  - Light and mixed headings (Large margin, large scale)

- Indicates poor comprehension driven by difficult attentional allocation

Headings Study: Recommendations for TUI

- Avoid extreme Margin / Scale combinations
  - If must use extremely compressed or spaced out text, bold font weight will help readers target fixations
  - Especially avoid light headings, as they produced longest viewing times and lowest comprehension

- "Best" Combinations:
  - Small Scale/Large Margin or Large Margin/Small Scale, with regular weight
    - Produced best comprehension and lowest viewing times

- Caveats
  - Task constraints
  - Differences in visual layout
  - Small sample

Distribution and Adoption

Distribution - Package Manager

Application

User / Client

npm

Thunderbird UI

NexusOSS - internal package manager host
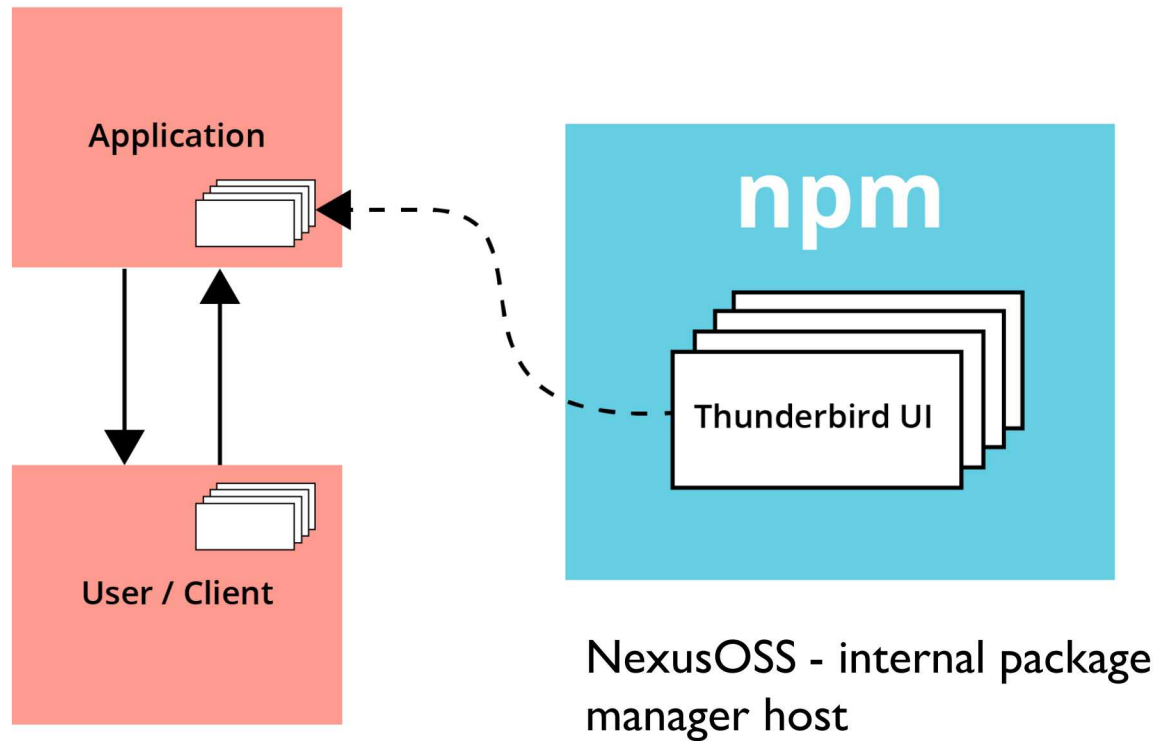
Distribution - CDN
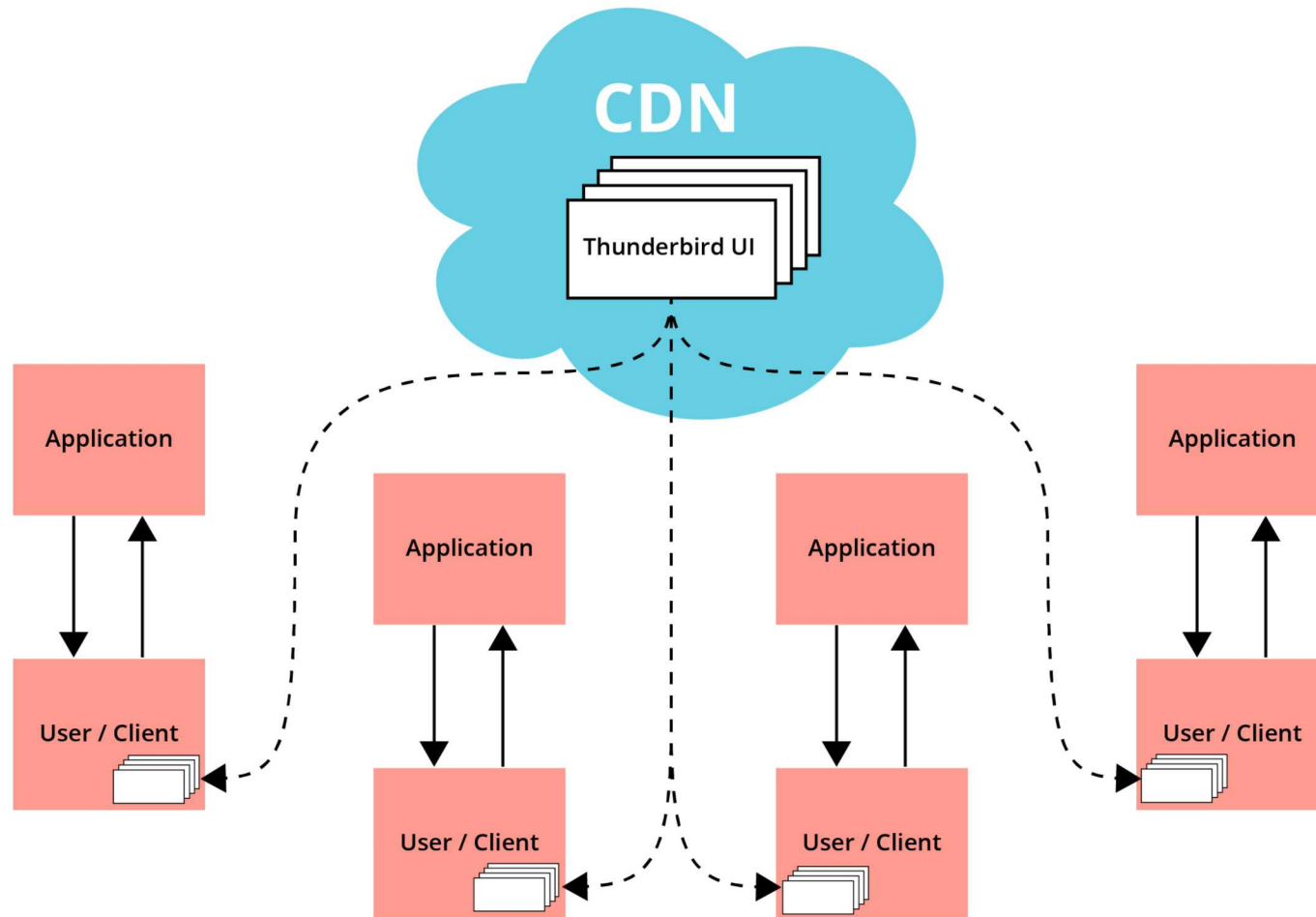
Socialization and Outreach

- Grassroots approach
  - Conceive of TUI as "everyone's design system"
  - Aspire to run project as "open source"

- Community Engagement
  - Developer team interviews
    - 16 interviews with 17 development teams
  - Brown Bag Sessions

Management Support

Success!

Grassroots Buy-In

Resistance and Barriers

- Perception that it's expensive to implement

- Teams want control over their own design

- Teams want control over their own code

- Lack of trust
  - Trusting other team's code
  - Global Header fiasco!

INSIDE   SMM   Policies   Orgs   News   Sandia   🔍   People/Orgs   🔍

Return on Investment

How to Assess Return on Investment (ROI) for TUI?

- Given the significant time and money investment made to develop TUI, does it increase efficiency?

- We assessed this in two ways:
  - Development team efficiency
    - Semi-structured interviews
    - Compared responses between teams currently using TUI or not to assess whether it saved them time or money
  - User efficiency on websites using TUI
    - Web analytics metrics of sites using TUI to assess whether it streamlined user interactions relative to sites not using TUI

Measuring ROI:
Development Team Efficiency

- Interviewed 5 development teams over 7 interview sessions
  - 3 sites were using TUI, 2 were not
- Questions included:
  - Did you use TUI in your development process? Why or why not?
  - How was TUI implemented?
  - How did it affect your development process? (If you didn't use it, how do you *think* it would have impacted your team?)

Measuring ROI:
Development Team Efficiency (1)

- Development teams were highly positive
  - Generally think it saves time
  - More professional-looking and consistent sites
  - Saves M&O costs (bug fixes automatically rolled out)

- Difficult to provide *measurable* ways TUI helped
  - Estimates range from 20% time savings on a regular site to 80-90% time savings for a very simple site
  - One site said a high school intern created a site from scratch in ~53 hours

Measuring ROI:
Development Team Efficiency (2)

- All teams reported that TUI saved them time when:
  - Setting up a new site
  - Implementing basic features (which is "tedious")

- Time-savings on basic tasks allowed developed to:
  - Develop more custom features
  - Address customer-specific requests
  - Work on more creative, challenging work

Measuring ROI:
Development Team Efficiency

- Not all teams used TUI in intended way
  - Some sites were being developed in parallel, and so they custom-coded elements to *look like* TUI
  - Some sites store locally-hosted versions of TUI, which causes challenges:
    - Changing referenced paths
    - Re-downloading when new versions are released

- Noted drawbacks include:
  - Addition of features not in TUI
  - Customization of TUI assets to meet customer needs
  - Limits developer freedom and creativity
  - Lack of features present in more mature libraries

Measuring ROI: Development Team Efficiency

- Caveats of findings:
  - Small sample size
  - Lack of baseline of development team efficiency (and general difficulty with measuring development team efficiency/productivity)
  - Lack of quantitative measurement of TUI efficiency gains
  - TUI Maturity at time of use

Measuring ROI:
Web Analytics Metrics

- Web analytics metrics capture data regarding how users naturally interact with websites

- Basic metrics include:
  - Number of visitors (unique or total)
  - Time on site
  - Number of pageviews per visit

- Recommendation for usage:
  - Establish baseline levels of time MOWs spend on internal websites
  - Measure changes to these levels after TUI implementation
  - Direct measurement of corporate time savings across large population (12,000+ employees)

Measuring ROI:
Web Analytics Metrics (Example)

Identify sites with highest number of visitors to target improvements
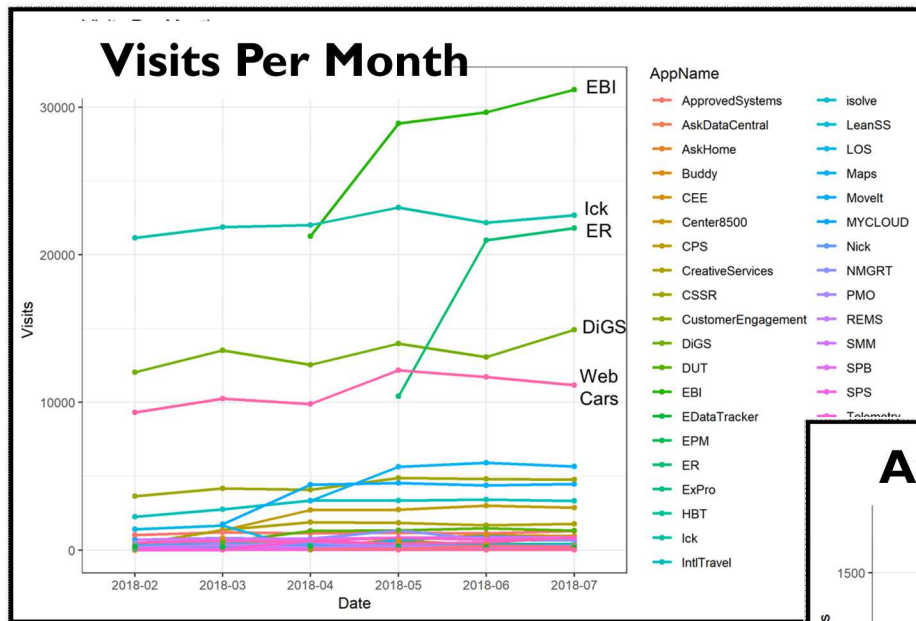
Identify sites with the longest visit durations to target improvements
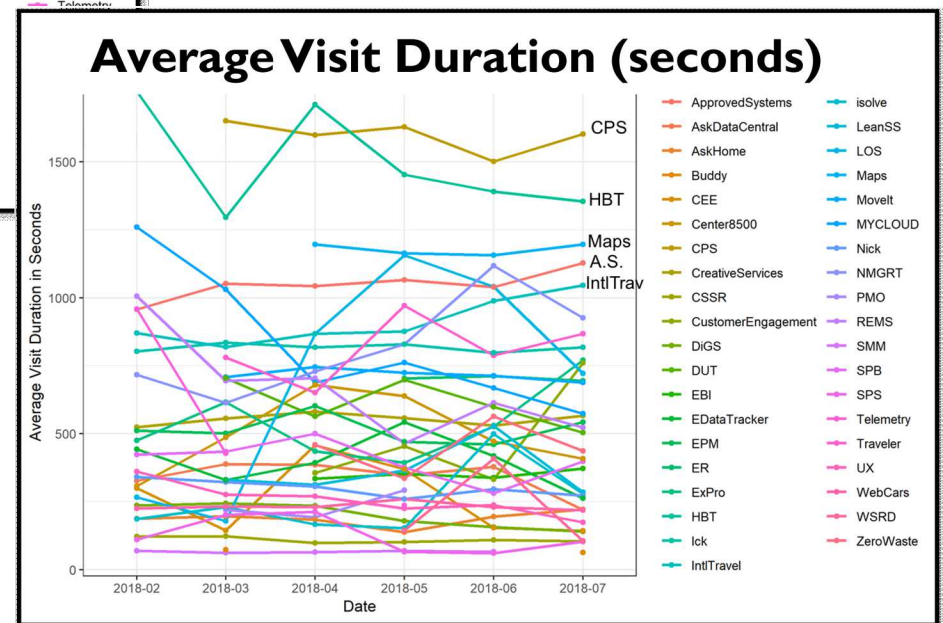
"Is this better?"

- Than what?
  - Need to establish baselines on key metrics *before* making changes in order to measure improvements
- For whom?
  - Improving development team efficiency is a very thorny issue. May depend on:
    - Site/application characteristics: complexity, purpose, budget
    - Team characteristics: size, experience level, etc.
  - Improving user efficiency might be easier to measure using web analytics
    - Goal in enterprise applications (i.e., reduce time on sites) likely different from commercial applications (i.e., increase time on site, profits, etc.)

Path Forward and Lessons Learned

Path forward for Thunderbird UI

- Implement governance

- Additional front-end technologies
  - Angular
  - React

Lessons Learned

- Buy-in can be a challenge
  - Do lots of outreach
  - Cultivate grassroots, open source approach
  - Need executive leadership support

- Make the design system easy to use
  - Easily accessible. Don't make devs jump through hoops.
  - Keep code clean! Improves trust.

- Measuring ROI
  - Establish a baseline before you start making changes

Thank you!

Questions?