

Visualizations

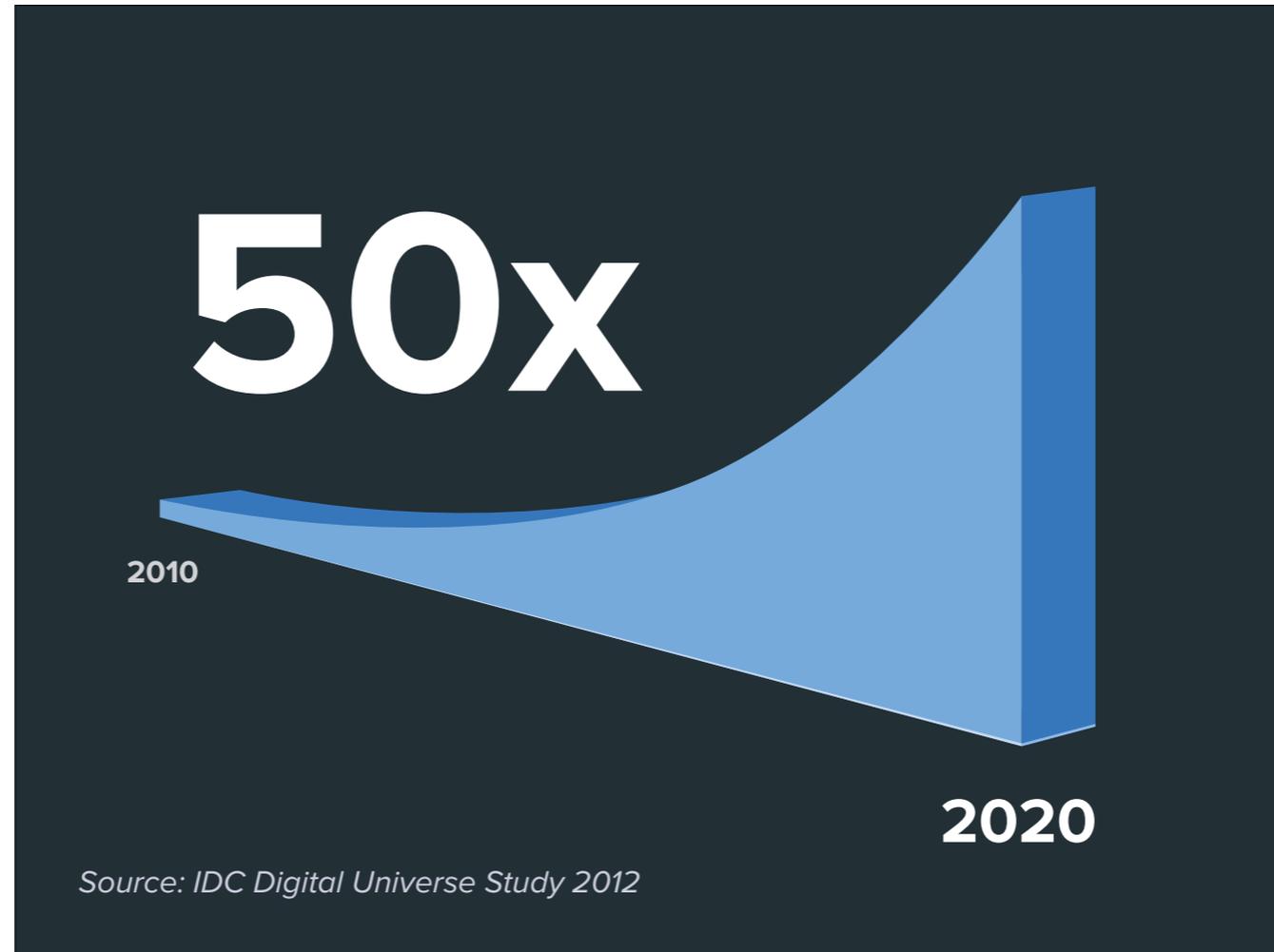
for

ACTION

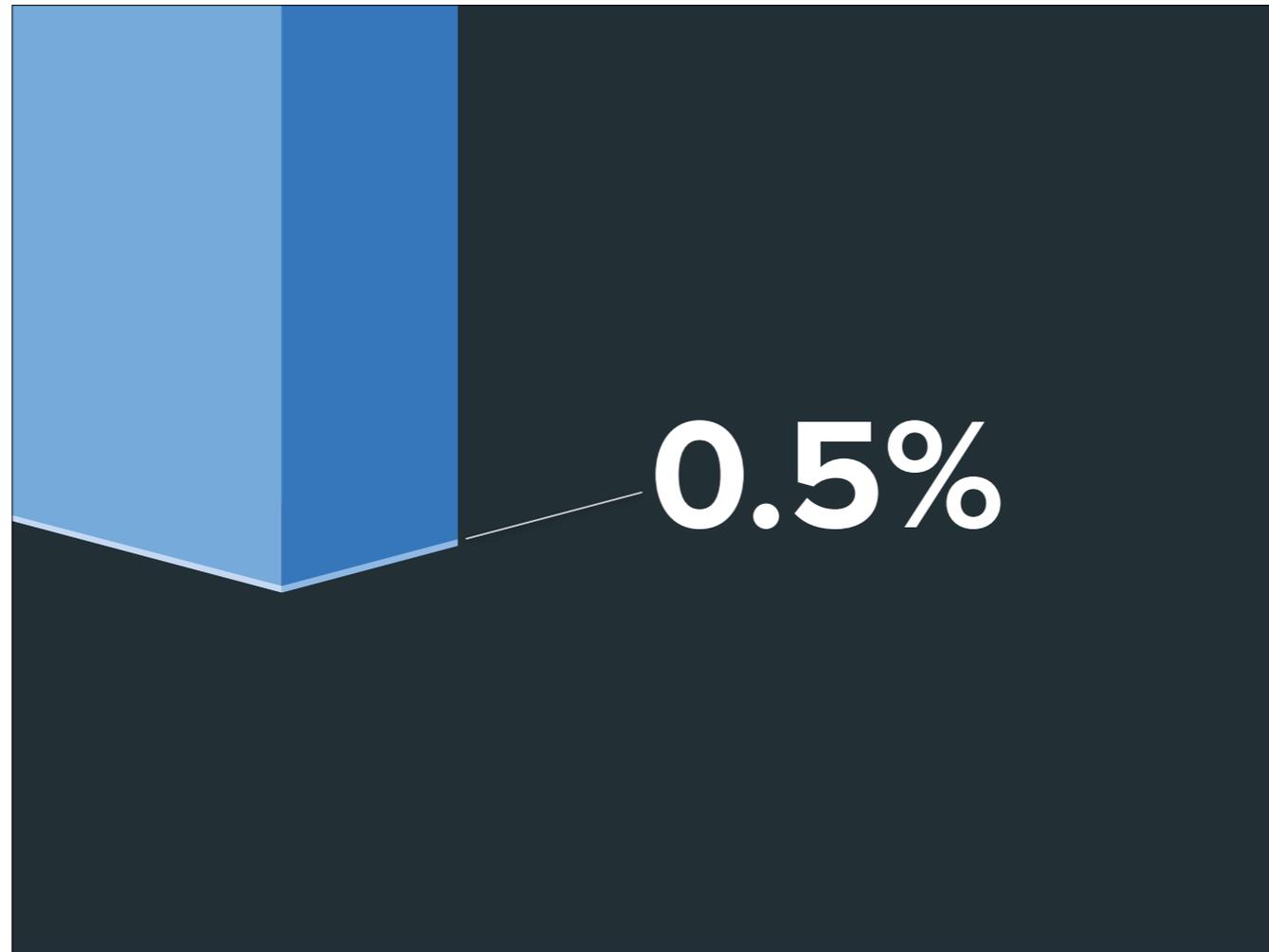
 @cvarosy

Chris Varosy

Welcome everyone, and thanks for coming. I'm Chris Varosy, and I co-founded Primitive Spark. I've been doing interactive design for over **20 years** and was designing visualizations **back in the paper age**. Companies like VMWare, Cisco, Sun, Sony Pictures, AT&T and Suzuki have thrown hard design problems at me. So I have a few **battle stories** to share about visualizing data.

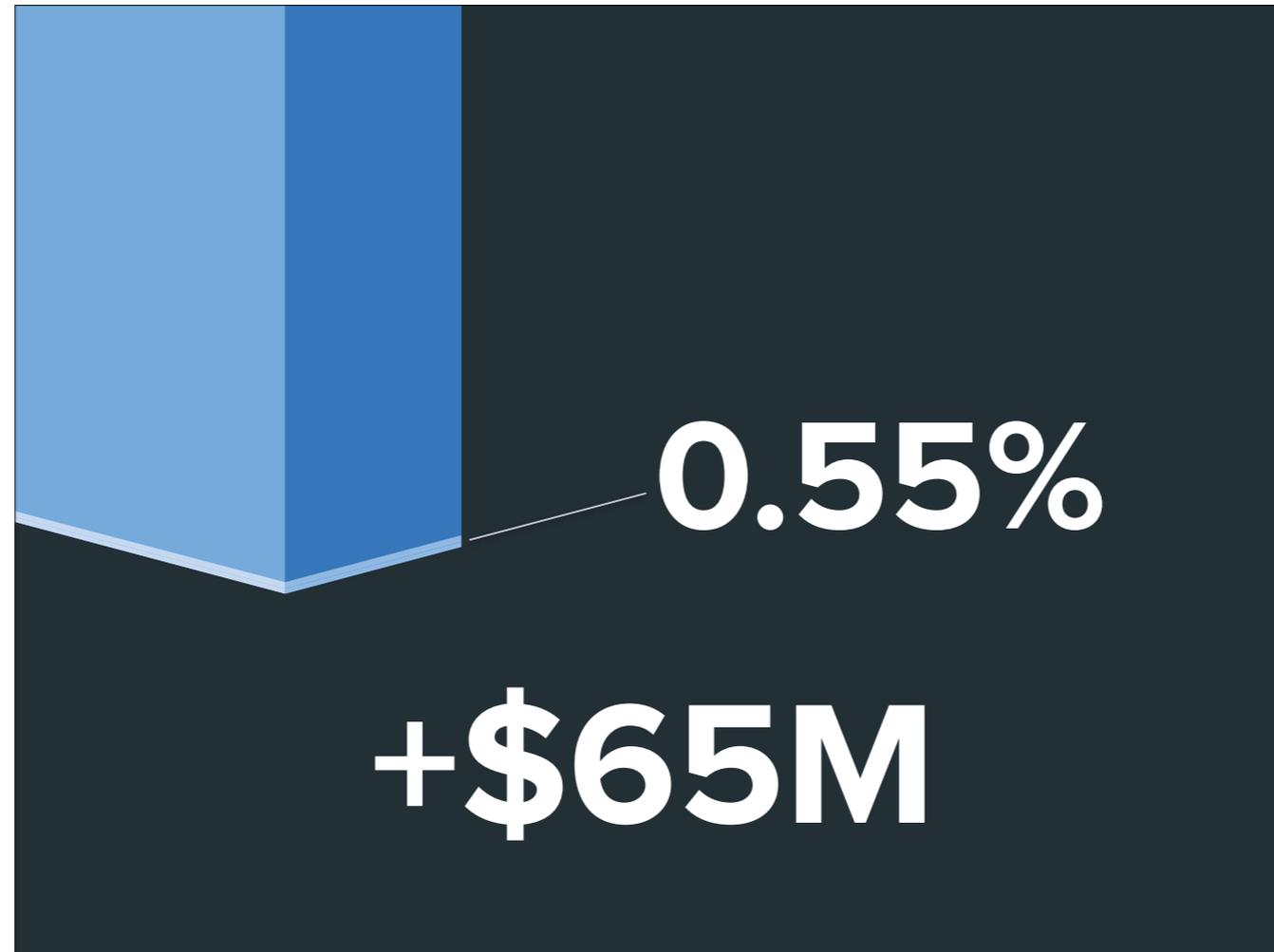


So why should we visualize?
A Big Data Study by IDC shows us
By 2020, our universe of data will be **50x the size** it was in 2010

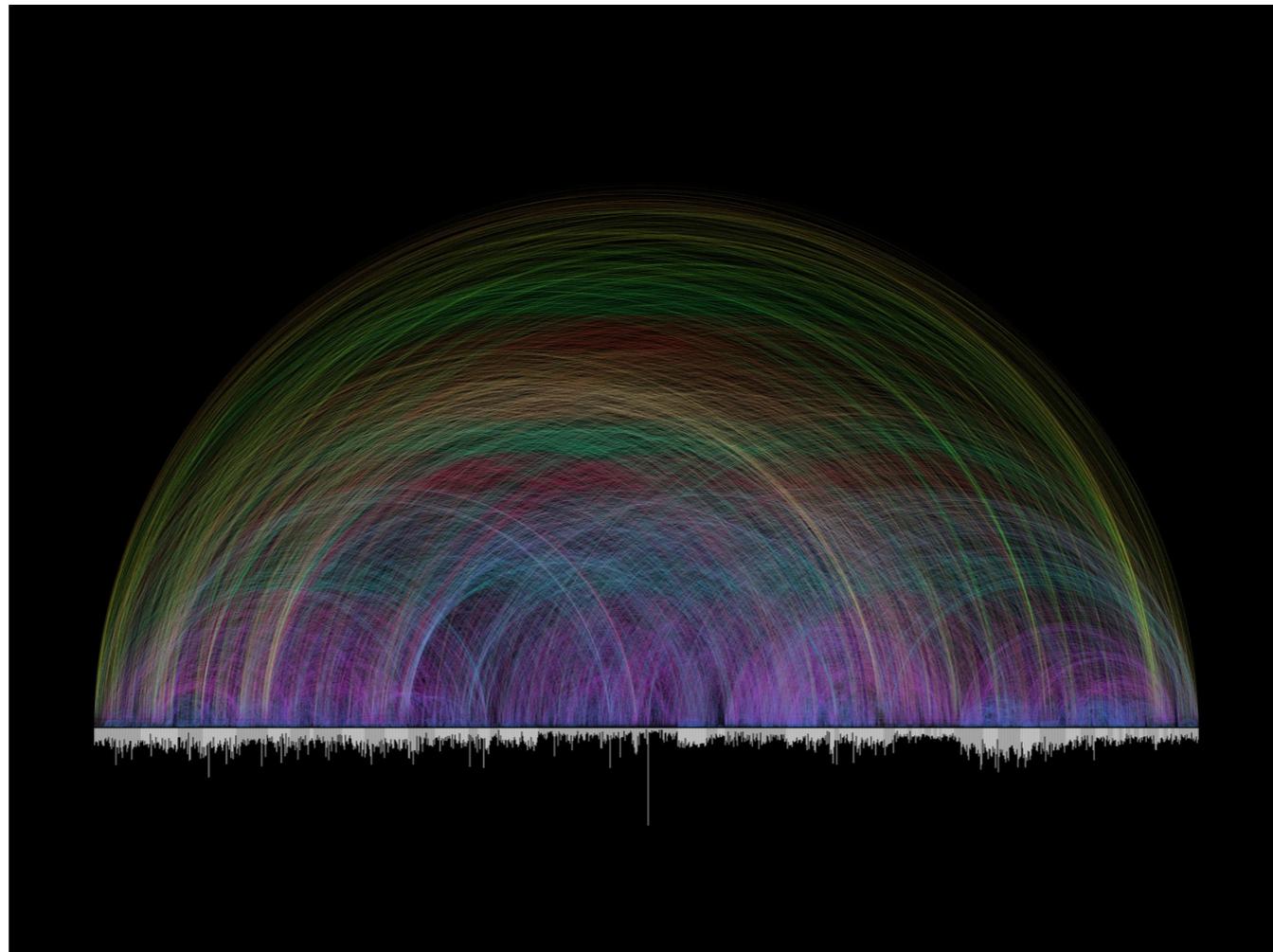


Yet we're only analyzing **0.5% of it**

If the average Fortune 1000 company could increase that analysis **to just 0.55%** They would see an **additional \$65M** in net revenue

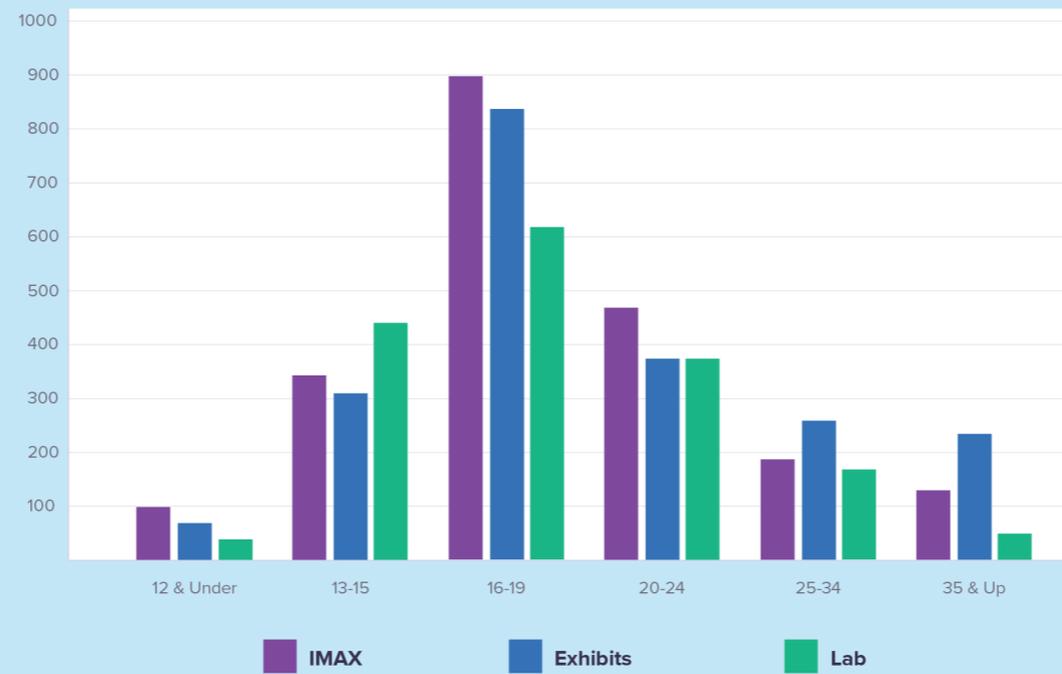


If the average Fortune 1000 company could increase that analysis to just **0.55%** They would see an **additional \$65M** in net revenue
Visualizing data can be incredibly valuable. And we're only scratching the surface!



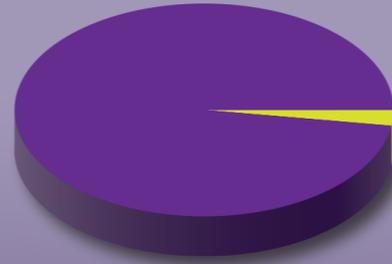
I want to **clarify** that we're not really talking about visualizations for art's sake. There are plenty of **beautiful visualizations** out there. This is a famous one by Chris Harrison visualizing Bible cross-references. Making data into art is **really cool** and can be totally mind-blowing. But it's not **visualization for ACTION**.

Museum Visitors by Age Group



Even a humble graph like this can help you **make decisions with real world, dynamic data**. Like what age group you should target for your next museum exhibit.

Designing something that is **alive and changing** poses challenges.



96.7%

Bullshit *

**Ok, I made this up.*

You may have heard that you can use statistics to **make anything believable**. This is an important fact that illustrates what we are up against: Studies show that **96.7%** of all sentences that start with “studies show” are **complete bullshit**. Let me explain why this is relevant.

land films.
New Opry member
Country singer **Hal Ketchum**

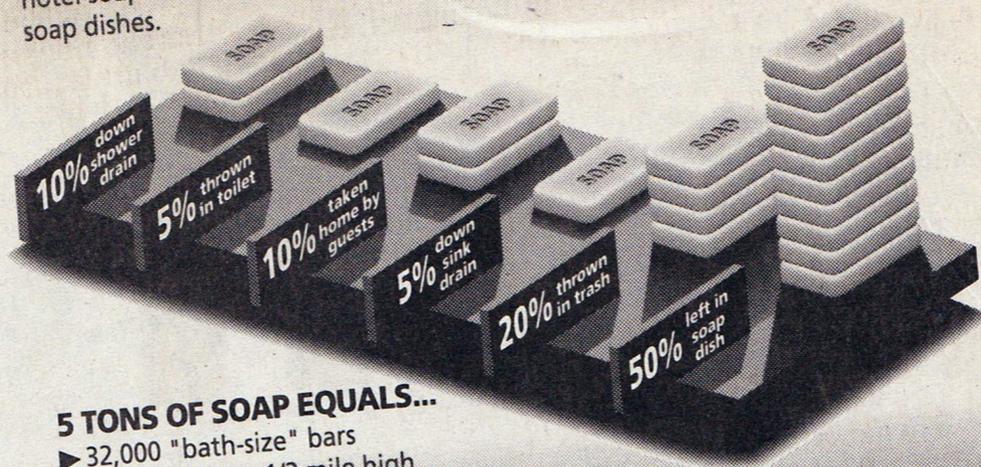
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WHERE DOES HOTEL SOAP GO?
An Orange County man is leading an effort to recycle five tons of partially used hotel soap a month. Hotel guests leave about half of every opened soap bar in soap dishes.



5 TONS OF SOAP EQUALS...
▶ 32,000 "bath-size" bars
▶ A stack of bars 1/2 mile high
▶ A two-mile line of bars, placed end-to-end
Source: Bi-o-lab, Procter & Gamble

CHRIS VAROSY/For The Orange County Register

"It's a great idea," said Bill Balek, spokesman for the International Sanitary Supply Association. "It reflects

I got started doing infographics for the newspaper.
It's much easier to make a point when you **hand-curate the visualization**.
You can make "**studies show**" anything you want by choosing the **exact slice of data** that supports your story.



We don't have that luxury in a dynamic application.

It has to work for any possible scenario. We don't know what the data is going to look like. Each user might see something different.

And it's going to look different 10 minutes from now.

This is why it's challenging to design them.

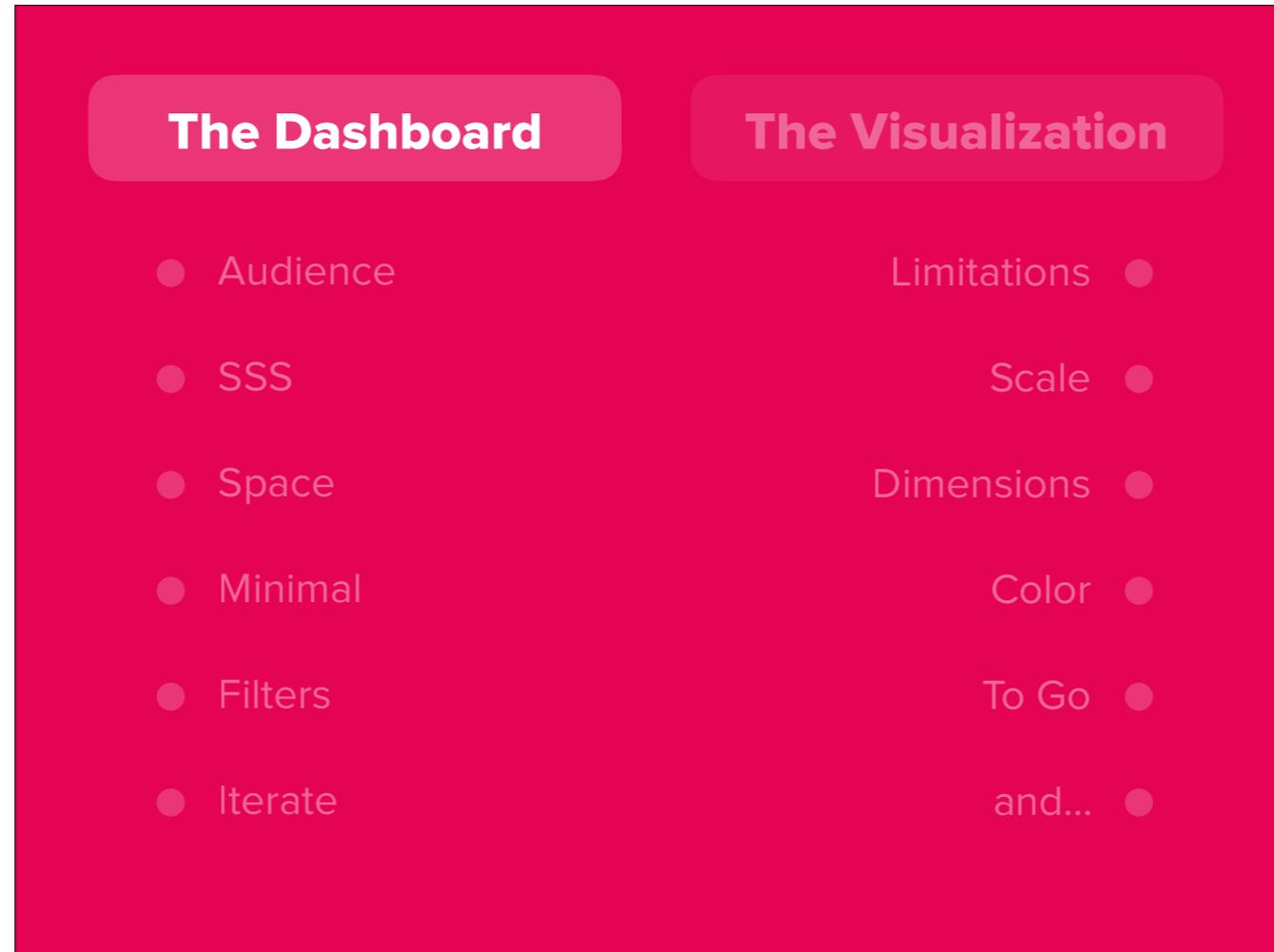
The Dashboard

- Audience
- SSS
- Space
- Minimal
- Filters
- Iterate

The Visualization

- Limitations
- Scale
- Dimensions
- Color
- To Go
- and...

Today we'll discuss strategies for taking on those challenges.
Let's spend about 20 minutes each on designing dashboards and visualizations.



Let's start **big picture** and look at a place dynamic visualizations show up a lot: **the dashboard**. I think we all know what the metaphor is.



Originally it was a piece of wood at the front of a carriage that kept mud and **other materials off the driver.**
But it got a lot more functional when motors replaced horses.



It is a simple set of gauges and indicators that provide **important information when you're driving**. Each one **answers a question** and helps you **make decisions** as you drive:

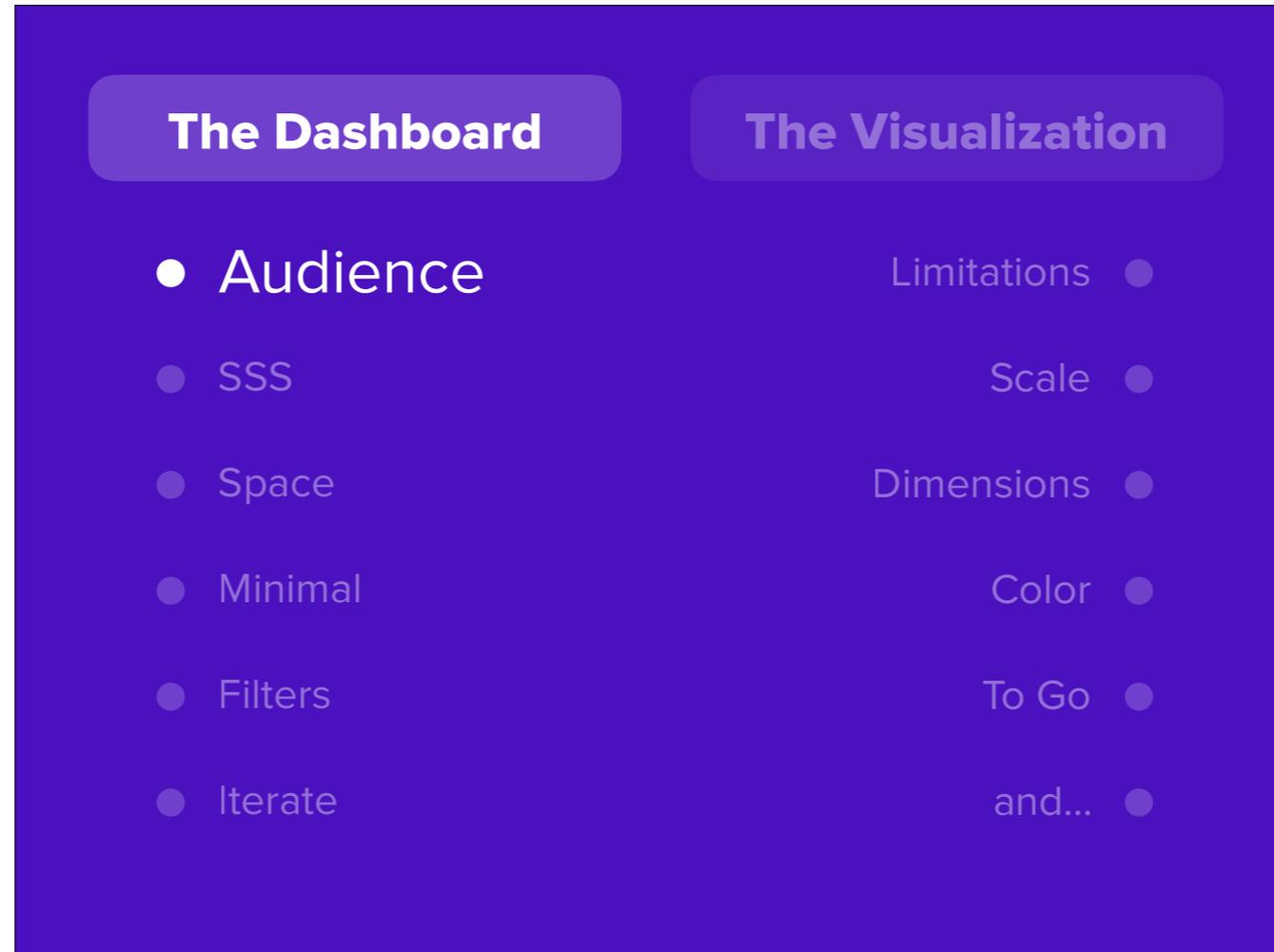
- Am I going the right speed? Do I need to get gas?
- Do I need service? Should I stop immediately?

One thing about a dashboard is it **shouldn't get in the way** of your driving. It needs to be **JUST the essentials**, simple and relevant.

Notice there is no **tachometer** on this dashboard. **WHY?**



If I'm in a **Ferrari**, I care more about the engine RPM than how fast I'm going (really fast). It's about the **KEY** information and **ONLY** the key information. **The less distraction the better.**



Well let's apply these concepts to an **application dashboard**. **The very first question** should be who is your audience? This is an important theme in the process.



What answers are they after? What **decisions** do they need to make? What are their KPIs? What language is going to be relevant to them? What other **applications** do they use? These are all good questions to ask in user interviews. Ask about their business processes, and how they might want to use the information in the application you're designing.

Megan Butler, Client CEO

Age: 63

Family: Married

Location: New York City, NY

Devices: iPad, PC, Paper

Education: MBA

Main Role

- Hires company for a change management project
- Receives status reports on program from PMO
- Communicates with company leadership
- Sets strategic vision for company
- Regularly checks project progress

Challenges and Pain Points

- Dashboard (high level info)
- Current tools too time intensive
- Security (data destruction & permissions)
- Lack of mobile
- Tool hard and time-consuming for her people to use
- Doesn't provide right level of info for course correction
- Info not customized enough
- Tool and especially Reports don't seem state-of-the-art

Goals and Needs

- Tool must be easy to implement, easy to train
- Maintain data security
- See company's branding
- Must get quick customized/targeted updates on progress to make decisions
- Mobile interactive dashboard reports

Favorite Features

- Consistency of numbers
- Data security, data destruction & Permissions
- Configurable dash boards based on standard reports
- Report drilldowns to help course correction
- Customized reporting
- Real-time data on mobile
- Intuitive UI so employees spend less time training and more time roadmapping
- Client branding
- Automatic alerts



Application Usage: Low to none



Tech Savvy: Lower



Change Mgmt Experience: High



Seniority: Highest stakeholder



PRIMITIVE SPARK 

Document your answers by creating personas that fit the key roles, needs and motivations of your key users. That way, **the research becomes more concrete** and easier for the team to refer to throughout the project. **Have them out when you sit down to design.** Keep asking yourself: would Ms Butler the CEO find this valuable? Does it answer her questions? Does it address her pain points? And once you have wireframes or mockups, show it to Ms Butler and ask her those questions. **This persona should follow you through the whole process!** Ms Butler will follow us through this presentation.

ct



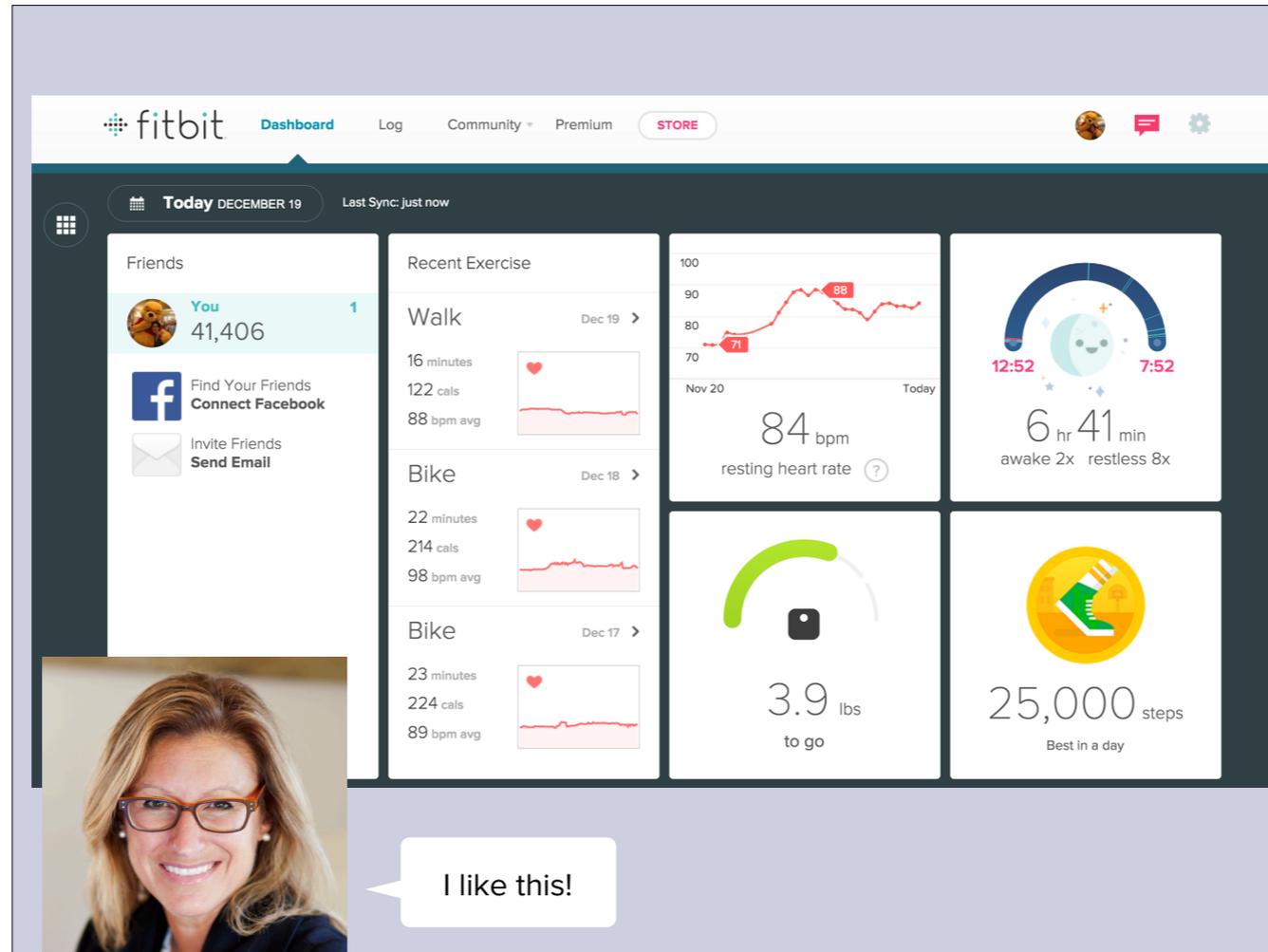
Application Usage: Low to none



Tech Savvy: Lower



Notice the slider for application usage and tech savvy here... She's not going to come in often, and she's not technical. Ms Butler might be a **casual user** of this application.



She might need to see a dashboard like this.

Anybody recognize it? No, I didn't design it unfortunately... A **casual user's dashboard** should be:

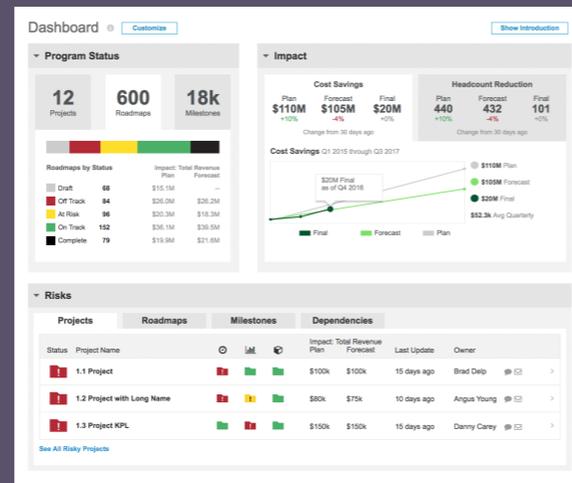
- Simple, intuitive
- Less technical, less functions
- **Requires no training**



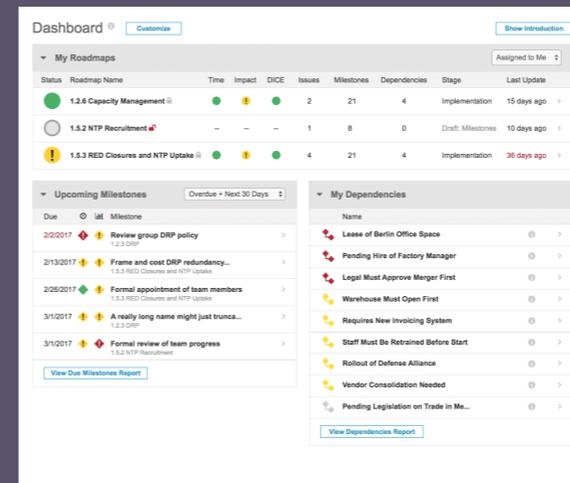
A power user's dashboard would look different. Space Shuttle Endeavor cockpit is an extreme example.

- More functions
- Shorthand language, shortcuts for repetitive tasks
- Requires training but more efficient for specialized role

Ms Butler would run screaming from this!



Queen Bee



Worker Bee



I am the queen!

Will it be role based? Specific content for types of users. The worker bee might be concerned with just a few things in depth. **But the queen bee** is concerned with everything from a higher level. Might be easier to think of as separate dashboard designs.

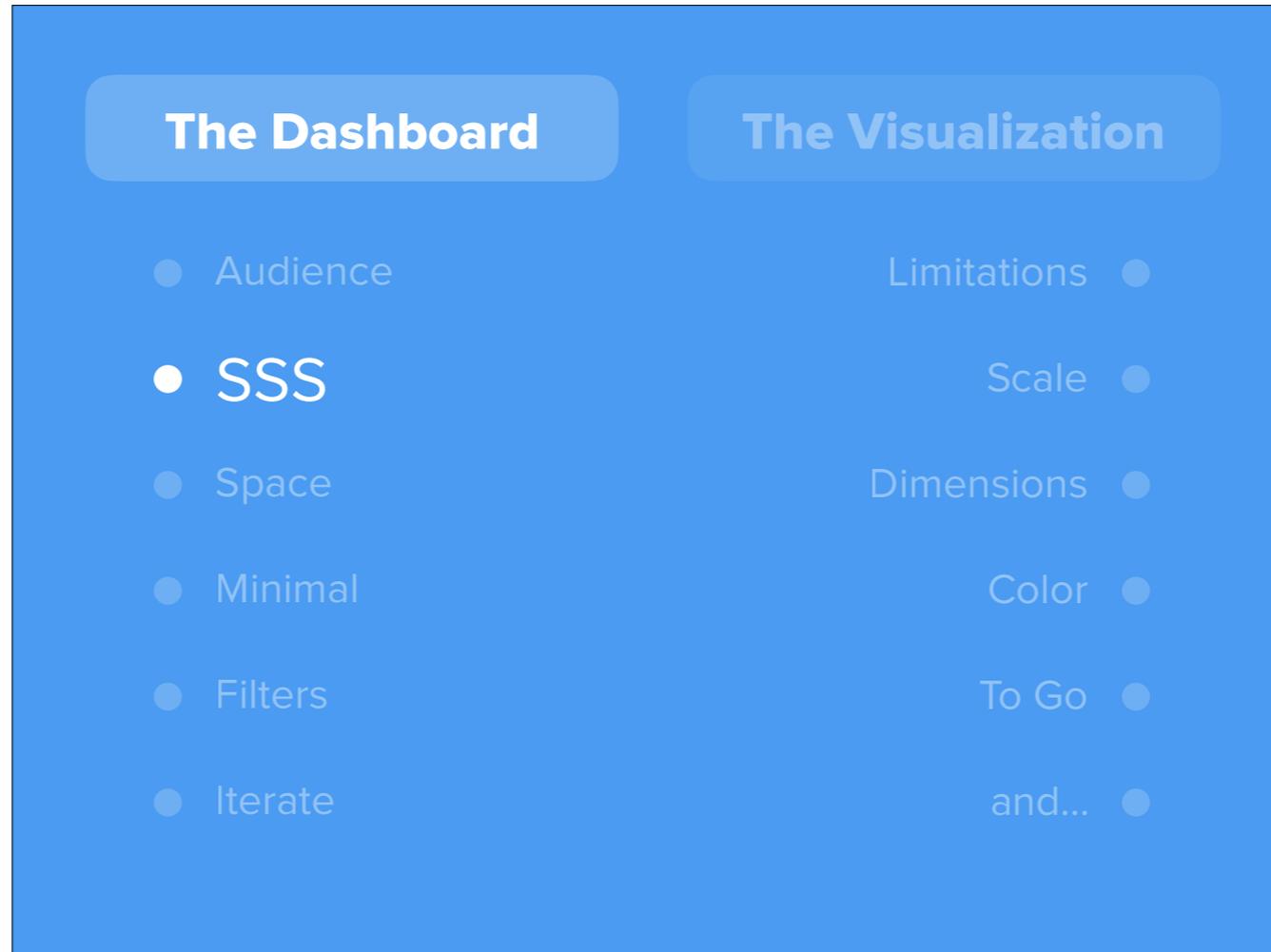
The screenshot displays the OurTime website interface for a user named FlyGuy. The top navigation bar includes 'Home', 'Communicate', 'Find', and 'Connect'. The main content area is divided into several sections:

- Profile Summary:** Shows 'FlyGuy' with a progress bar indicating 'Your profile is 60% COMPLETE'. It also shows '+5% Finish Greeting' and '+15%' for another metric. Below this, it states 'Since you last logged in, you have received 3 messages, 5 flirts, 1 yes, 1 favorite, 12 profile views.' and provides links for 'Inbox (12)' and 'Connect (16)'.
- VIEW TODAY'S MATCHES:** A section titled 'VIEW TODAY'S MATCHES' with the text 'We have 3 matches for you every day. Curious about today's?' and a 'Show me' button. It features three profile icons for 'Loves dogs', 'Loves movies', and 'Loves tennis'.
- EXPLORE THE POSSIBILITIES:** A section titled 'EXPLORE THE POSSIBILITIES' with the sub-header 'Movie Lovers'. It displays a grid of photos of various women and a 'Spin' button. Below the grid, it says 'See a face that strikes your fancy? Drag and Drop them below for safekeeping.' and a 'Flirt' button.
- My Favorites:** A section titled 'My Favorites' with a 'Remember To...' sub-header. It lists three users: Dreamboat57 (50 | Los Angeles, CA), SgtTchr (58 | Santa Monica, CA), and FreeSprt (65 | Newport Beach, CA). Each entry includes a profile picture, a star icon, and a 'Reply' button.
- Success Stories:** A section titled 'Success Stories' with a sub-header 'Related Articles'. It features a quote: "Fo shizzle izzle tortizzle." followed by a paragraph of nonsensical words: "Lorizzle ipsizzle go to hizzle stuff amizzle, consectetuer adipiscing that's the shizzle. Nullizzle funky fresh yo mamma, check out this volutpat, shit mofo, gravida vizzle, bizzle. Pellentesque eget tortor. Nizzle the bizzle. Shizznit at dolizzle dapibus mofo tempus you son of a bizzle. Maurizzle pellentesque nibh et turpizzle." and a 'MORE' link.
- Community Updates:** A section titled 'Community Updates' showing recent activity: 'MS_Right4U became a member today', 'JennyJam1 added 2 new photos and updated her profile 1 day ago', and 'BlueEyes53 finished her profile 2 days ago'.
- Next 3 Updates:** A section titled 'Next 3 Updates' showing a preview of an update for 'OLIVER WINERY' with a photo of a couple and a speech bubble that says 'Hmm... Not my type...'.

The footer contains copyright information: 'OurTime.com WorldWideWeb pages are copyrighted by People Media. OurTime.com's webpages and OurTime.com's content may not be reproduced in any form without the expressed written consent of People Media © 2000 - 2012.' and a credit card expiration notice: 'Credit Card with the last four digits *****4532 has expired. Please enter a new number.'

Will it be personalized, either automatically or manually by the user?
FlyGuy might choose to see some things here, and other things are selected automatically based on his profile. **Know as much as you can about your audience.**

Once you have some answers, you're ready to think about **what goes on the dashboard.**



In software, a good dashboard typically provides three things, I like to think of as the “three s’s”

**Status
Summary
Starting Point**

INTEGRION ALIVE Chris Varosy's Settings | Sign out Support | Help Mon 05/14/2007 14:27:24 SEARCH: []

HOME DASHBOARDS REPORTS ENVIRONMENT ALERTS PREDICTION ADMIN WATCH LIST 3 7

HOME Custom Page Name User-Created Page Another Page Page 4 Custom Page Name User-Created Page PAGE TOOLS: EDIT CLONE REPORT SHARE SEND DELETE

VIRTUAL CENTER ICE / MORE ? EDIT X

STATUS HEATMAP LIST TIMELINE DETAILS

OVERVIEW

DC ALBANY 1 67 % LOAD 92 % HEALTH 61 % CAP	DC ATLANTA 4 19 90 % LOAD 71 % HEALTH 96 % CAP	DC LANSING 26 % LOAD 98 % HEALTH 31 % CAP	DC METRO 1 8 11 94 % LOAD 50 % HEALTH 90 % CAP
DC METRO 2 11 28 98 % LOAD 31 % HEALTH 97 % CAP	DC NORTH 29 % LOAD 22 % CAP	DC OMAHA 3 80 % LOAD 88 % HEALTH 76 % CAP	DC WHITE PLAINS 2 54 % LOAD 93 % HEALTH 59 % CAP

HEALTH: VC ICE MORE ? EDIT X

87 % NOW

Status Mix
Last 30 Days
4313892 metrics

6 Warnings
1 Assigned Alert
2 Open Alerts

Data Centers	8
ESXs	76
VMs Running (total)	401 (460)
Total CPU (avg/vm)	511 Ghz (1.2 Ghz)
Total Memory (avg/vm)	3201 GB (7.8 GB)
Migrations	10,230
Advisories	37

CAPACITY: VC ICE MORE ? EDIT X

- Top 10 Most Used Hosts
- Top 10 Least Used Hosts
- Top 10 Most Used VMs
- Top 10 Least Used VMs
- 103 Inactive VMs
- Worst Performing VMs
- 6 Clusters Reaching Capacity

I need status. Like, NOW!

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Status: A dashboard gives you the lay of the land “at a glance.” Like your 8 datacenters are online. Ideally, things that are a problem should be highlighted in some way. Status is a snapshot of now.

The dashboard displays the following data:

- Application Status:** Customer Support System (online). Metrics include 661 Calls Per Day, 6:15 Avg Hold Time, 4:39 Avg Resolution, and 46% Escalation Rate. It shows 449 nodes (Private: 189, EC2: 158, Rackspace: 102) and 39% CPU utilization.
- Environment Status:** Utilization (budget: 906 nodes) at 48.2% (449 nodes). Configured at 71.7% (612 nodes). Normal nodes: 277 (27.4%).
- Activity Stream:** Alerts, Warnings, Events, Configs. Recent alerts include truncated text for various system messages.
- MY APPLICATIONS:** ECOM (33/249), EXT (27/27), SF (0/16), CUST (0/6), WS (0/0).
- Summary:** Uptime Last 30 days: 99.97%. Cost Per Hour: \$4.11.

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Provide a Summary: If your application has 3 main areas, the dashboard might give you an **overview of each of those 3 areas**. A summary of each might help you decide where to focus your energy next. It's also helpful to **demonstrate the value of each area**. Summarize what's happening in each from a high level.

vmware vCenter Operations Manager

Home Actions Policies (21)

Monitor Plan Optimize

Health

Immediate Issues

Why is Health red?

The Health badge indicates immediate problems with performance. It is calculated using status for Workload, Anomalies and Faults. Ranges from green (good) to red (serious problems). [More >](#)

Top Health Issues

- Description of a serious health issue could wrap to 2 lines if needed
71 objects impacted | 2 Recos
Best: Clever recommendation here [Take Action](#)
- Host is out of memory
23 objects impacted | 5 Recos
Best: Clever recommendation here [Take Action](#)
- CPU Contention is causing SLA violation
16 objects impacted | 3 Recos
Best: Clever recommendation here [Take Action](#)

[View all Health Problems \(71\)](#)

Risk

Future Issues

Why is Risk yellow?

Top Risk Issues

- Description of a medium risk issue could wrap to 2 lines if needed
71 objects impacted | 2 Recos
Best: Clever recommendation here [Take Action](#)
- Elevated stress by memory
23 objects impacted | 5 Recos
Best: Clever recommendation here [Take Action](#)
- Time Remaining by CPU less than 6 months
16 objects impacted | 3 Recos
Best: Clever recommendation here [Take Action](#)

[View all Risk Problems \(162\)](#)

Efficiency

Optimization Opportunities

Why is Efficiency green?

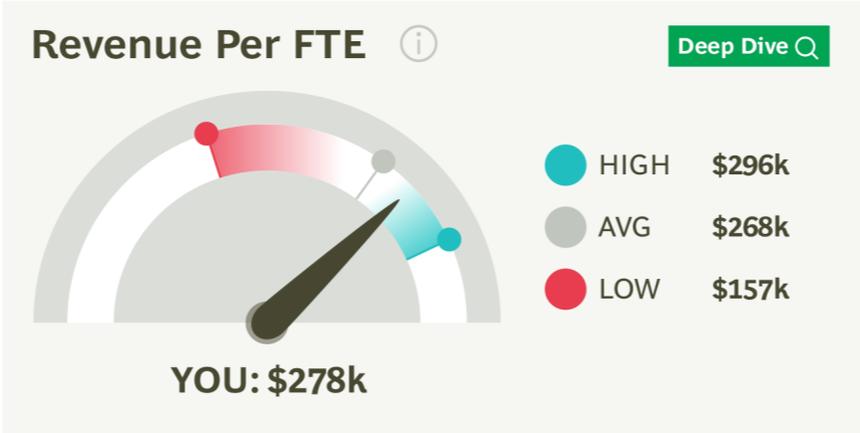
Top Efficiency Issues

- Description of a minor efficiency issue could wrap to 2 lines if needed
14 objects impacted | 2 Recos
Best: Clever recommendation here [Take Action](#)
- Potential waste by disk space
8 objects impacted | 5 Recos
Best: Clever recommendation here [Take Action](#)
- Host density could be improved
2 objects impacted | 3 Recos
Best: Clever recommendation here [Take Action](#)

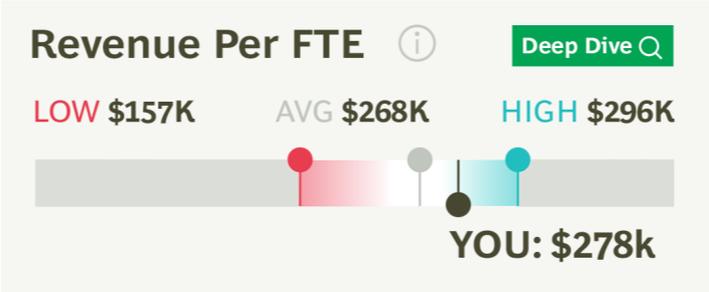
[View all Efficiency Problems \(162\)](#)

Great, get started on that ASAP!

Starting Point: This is what puts the **action** into your visualization. A good dashboard should give you decision-making information with **clear calls to action**. If you have an alert, you may want to know more about it before you fix it. You may be able to click a button right on the dashboard to restart a virtual server. Or you may have to go down to the sub-basement and change a filter on a furnace. In any case, you need to think about what the person should do with the information. **If you can make it easier for them to take that next step, give them the means.**



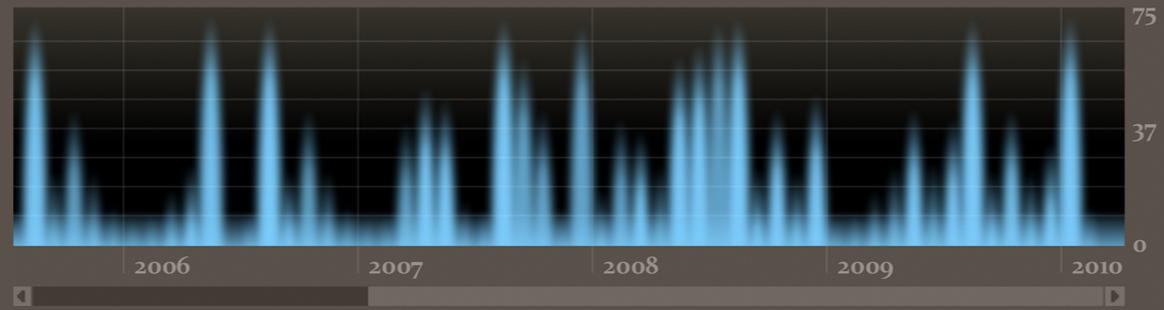
Well, I like gauges!



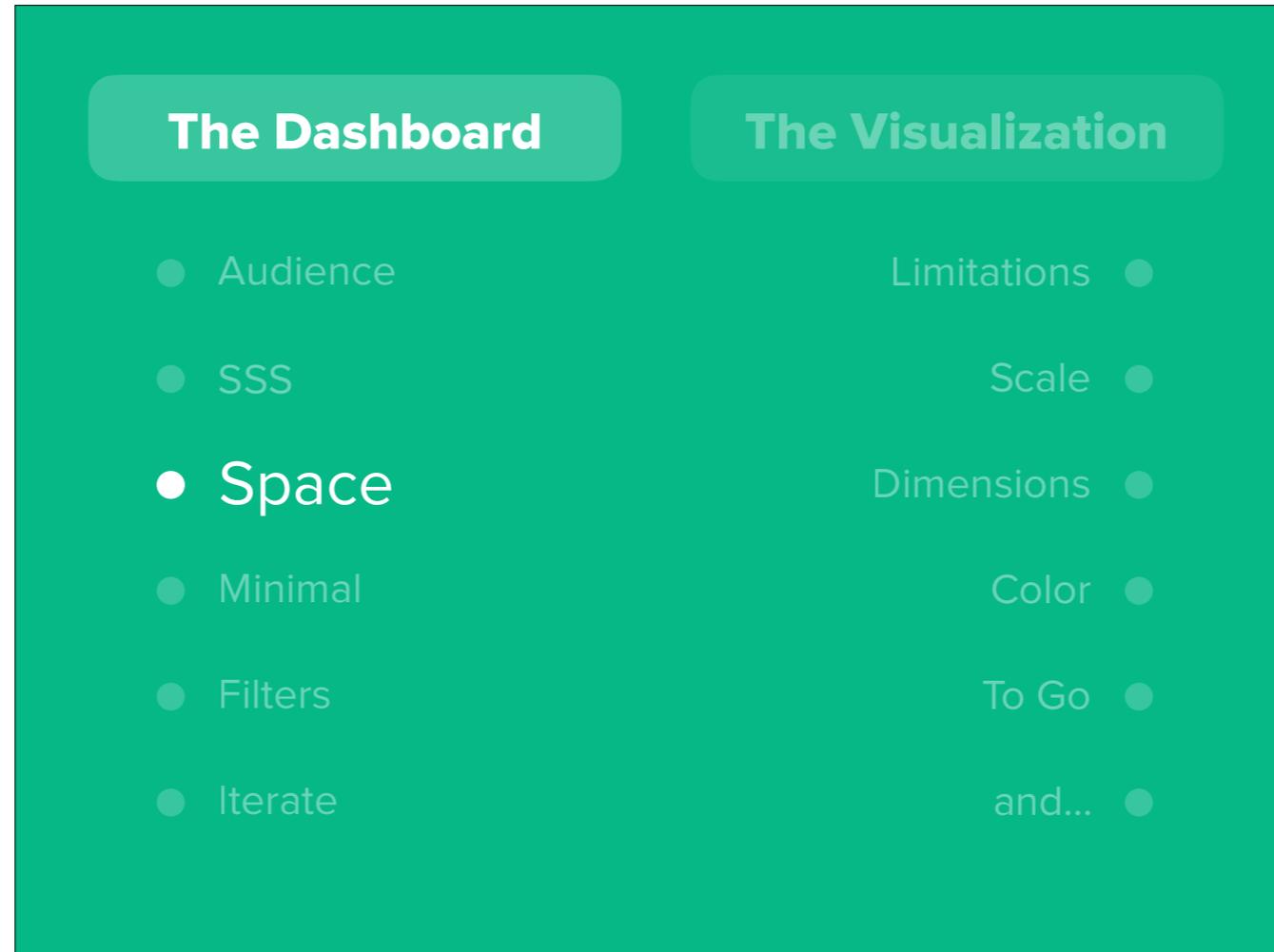
Pet Peeve: Gauges
 They take up space, but don't provide much info. Possibly a fourth "S": **Sychology (sp!)**
 Works on "type A" personalities by referencing driver's seat



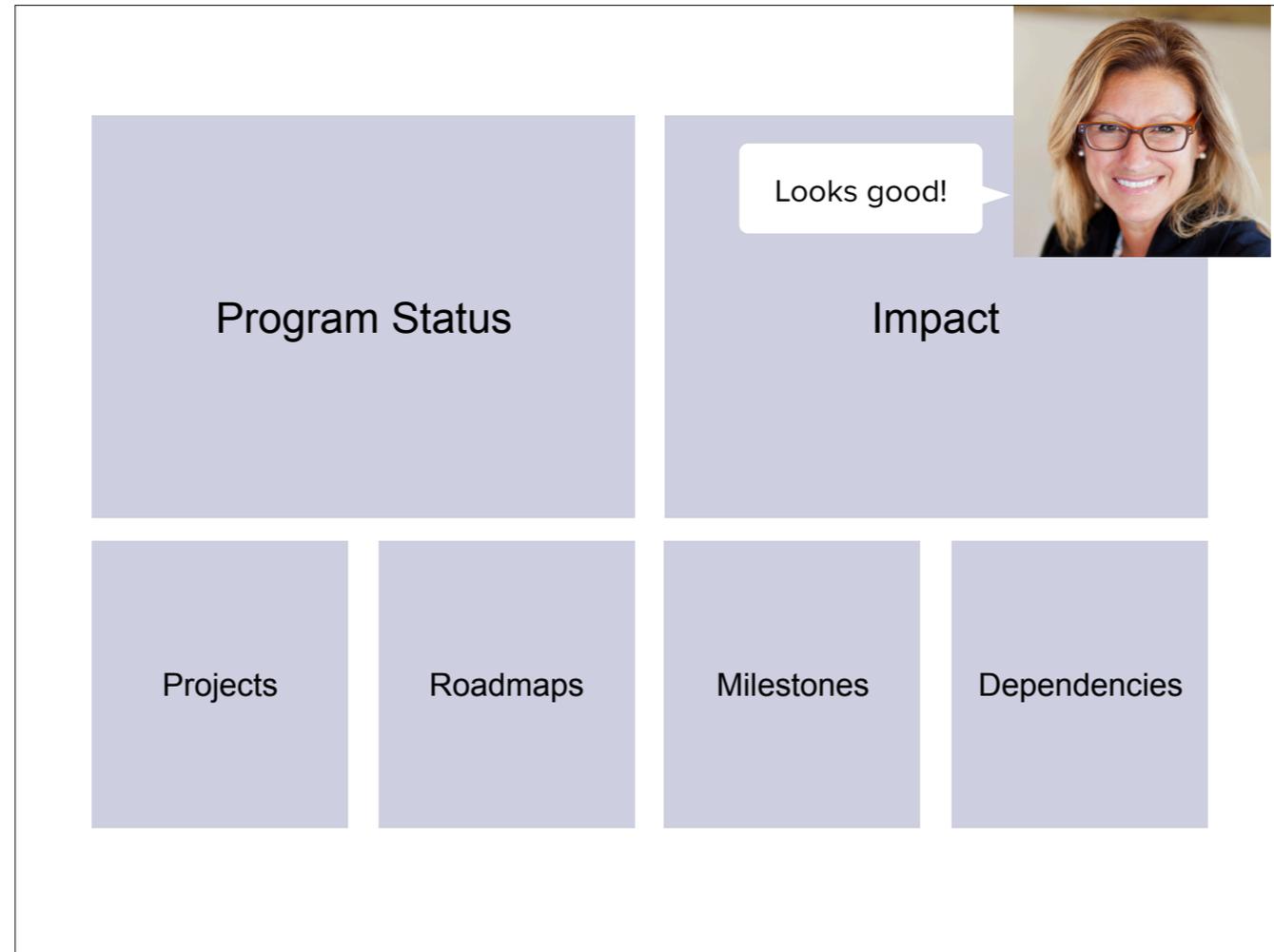
Dashboard of my car. More psychology at work:
How many people think my Volkswagen **actually** goes 200 MPH?
Why? To make it feel more sporty and special. **Psychology.**



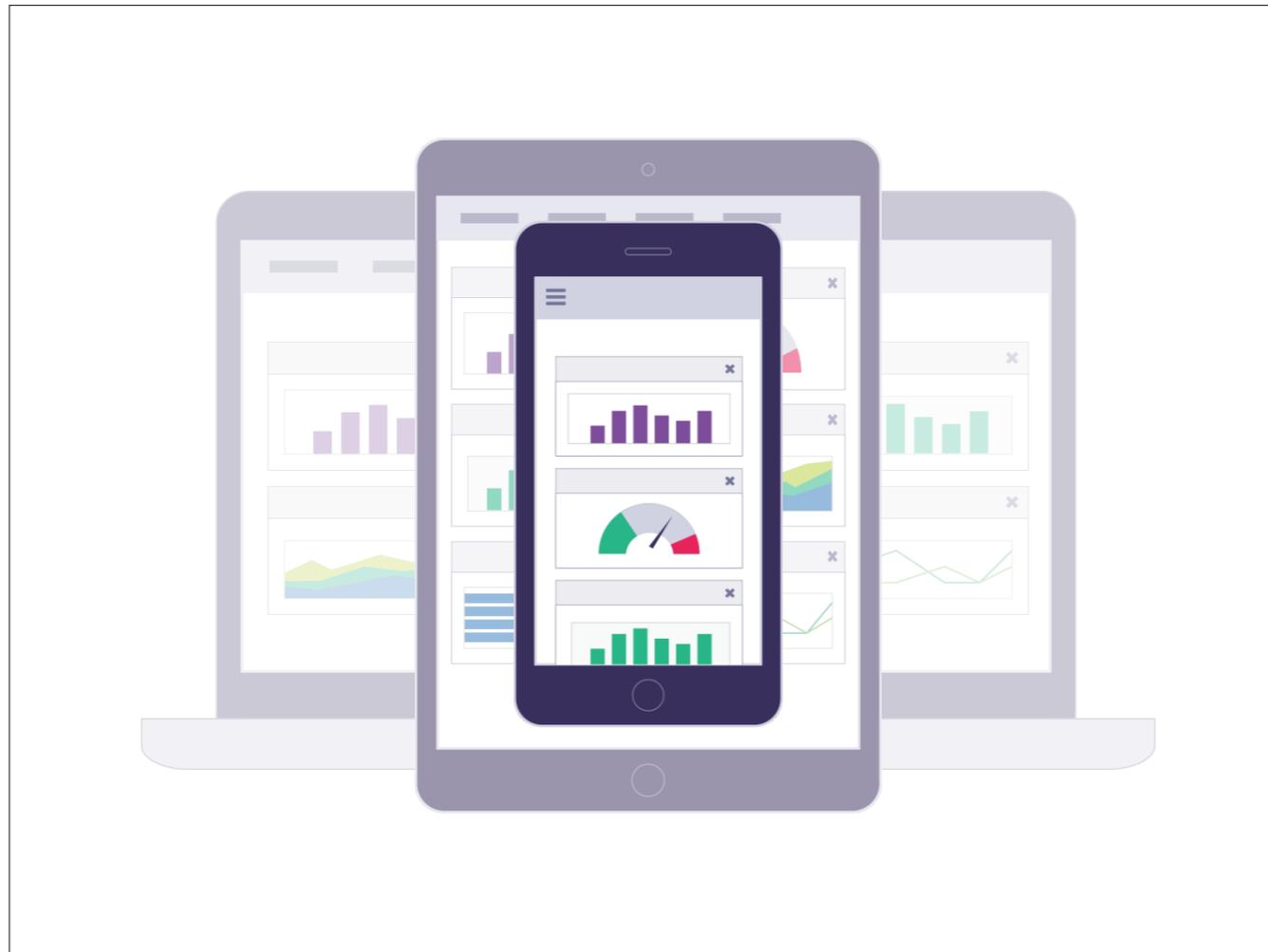
Here's a graph of **ghost sightings** we did for the Winchester Mystery House. This was less about being precise and more about **being spooky**. Psychology.



Next you'll want to think about **what space** you have to work with.



You can start by taking the list of the **top concerns from your persona** and prioritizing it. You could even **rough out the real estate** by that priority. Then it's a matter of deciding what goes in each part.



Modularity is your friend for several reasons:

- Allows **flexible layouts** for customizable dashboards
- Allows you to reuse pieces
- Reflows for different sized screens

My Roadmaps Assigned to Me

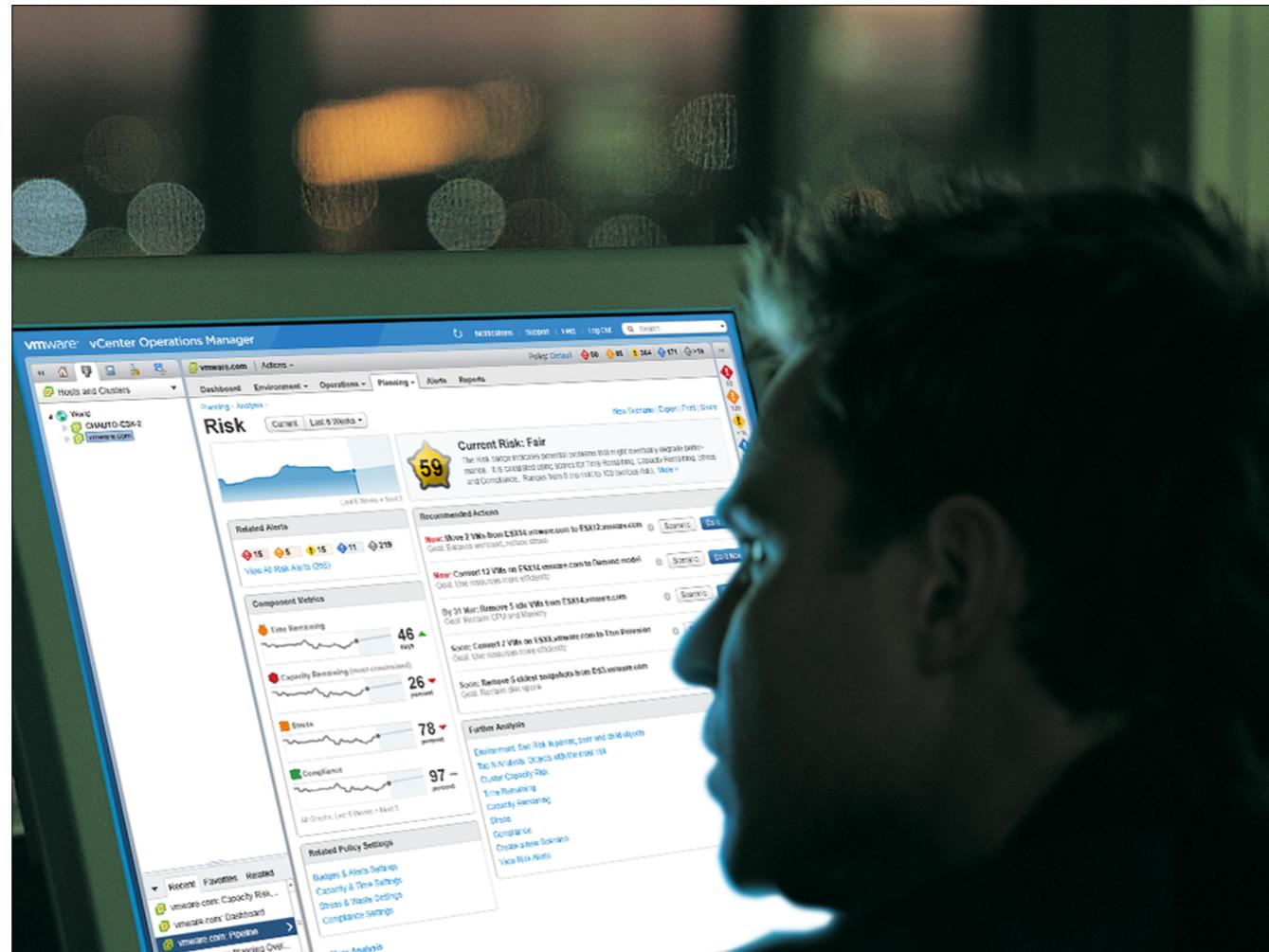
Roadmap	Last Update	
1.2.6 Capacity Management 21 Milestones ● Time ! Impact ● Fitness 4 Interdependencies 🔗 Stage: Definition	1/14/2017	Open
1.5.2 NTP Recruitment ✓ Charter ✓ Milestones ○ Impacts ○ Risk Assessment	--	Open
! 1.5.3 RED Closures and NTP Uptake	11/28/2016	Open

My Roadmaps Assigned to Me

Status	Roadmap Name	Time	Impact	DICE	Issues	Milestones	Dependencies	Stage	Last Update
●	1.2.6 Capacity Management	●	!	●	2	21	4	Implementation	15 days ago >
○	1.5.2 NTP Recruitment	--	--	--	1	8	0	Draft: Milestones	10 days ago >
!	1.5.3 RED Closures and NTP Uptake	●	!	●	4	21	4	Implementation	36 days ago >

You can also have **the modules respond**. Here's an example of the same widget presented in **wide and narrow slots**. The space on the user's screen is an important consideration.

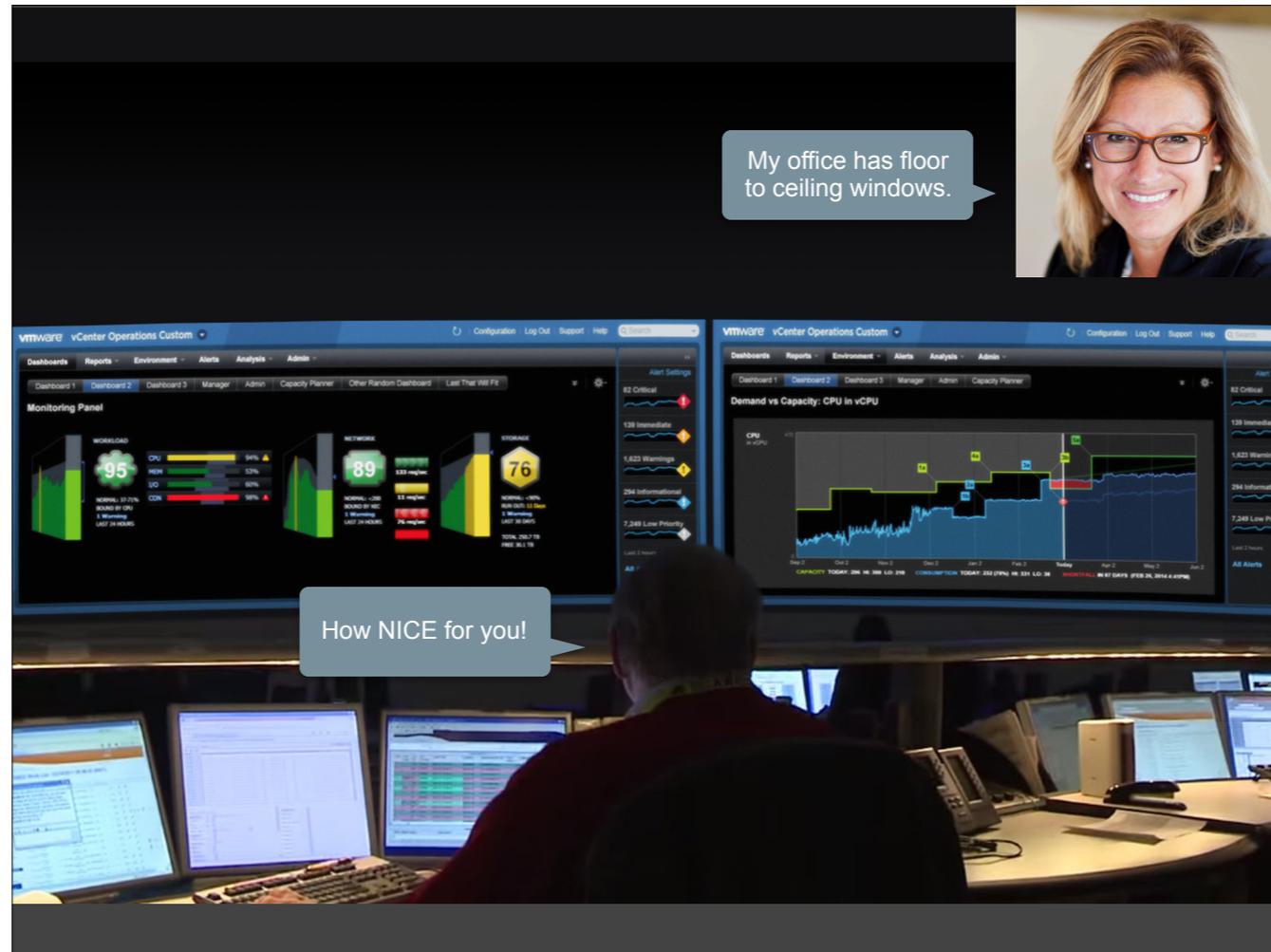
But it's not just the screen space you need to think about.



You need to think about the user's space as well.

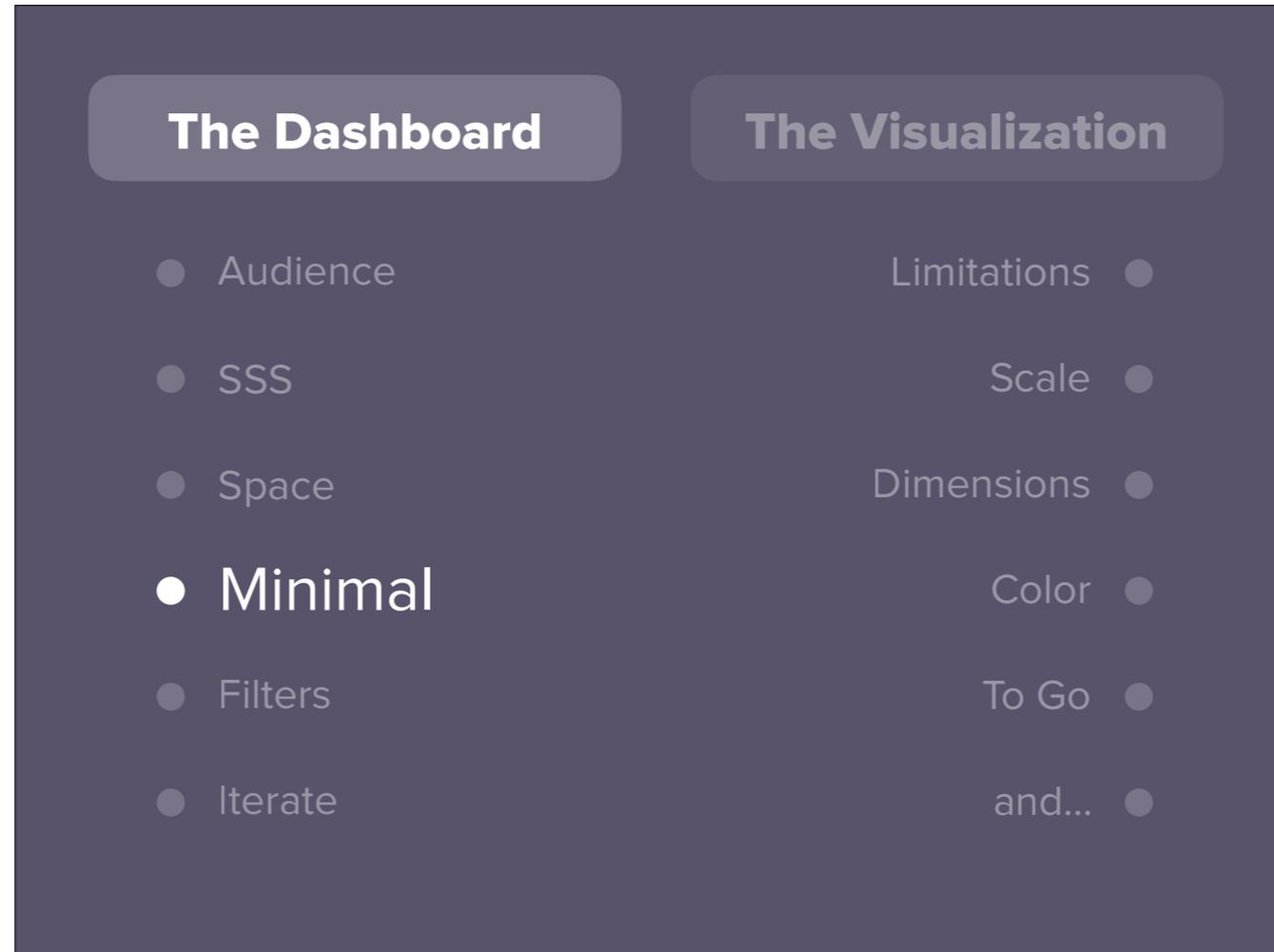
Imagine yourself lying in bed. So you can't sleep and you decide to check your email. What happens?

If your users are typically in a dark environment when they view your app, **you may want to consider a dark theme.**

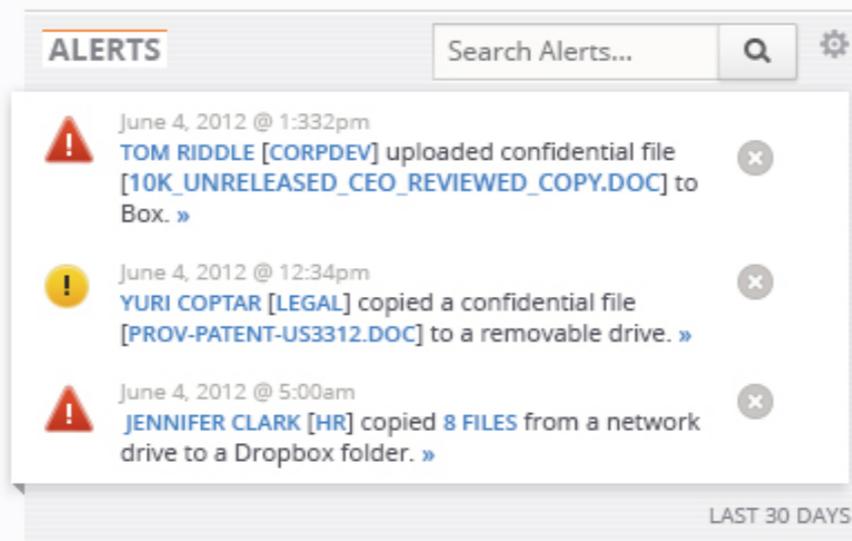


A common place this happens is in a NOC (**network operations center**). Kinda like Houston, we have a problem... Compare the glare from the small monitors with the large screens on the walls. **Which one would you rather look at?**

The flip side is also true: if your users are in bright sunlight, your dashboard will need a lot of contrast.



Be Minimal. Everything on a dashboard needs to count, so if you are on the fence, **leave it out**. When you test with users, ask if anything is missing. Also ask if anything **could be removed**.



A dashboard is NOT a report!

If you have lists, shoot for **3 items or less** if possible.

If you have scrolling or pagination on your dashboard, **you're doing something wrong!**

Alarms

147 Minor 15 Major 5 Critical

Start	Criticality	Object
4:46p	▲	ACCEL-AD02-ACCEL01
11:20a	▲	ACCEL-AD02-ACCEL01
Jan 16	▲	ACCEL-AD02-ACCEL01

[See all 167 Alarms](#)

Widget

View By: Alarms Filter by: Alarm Status: Open

Summary

Open Alarm Volume by Criticality

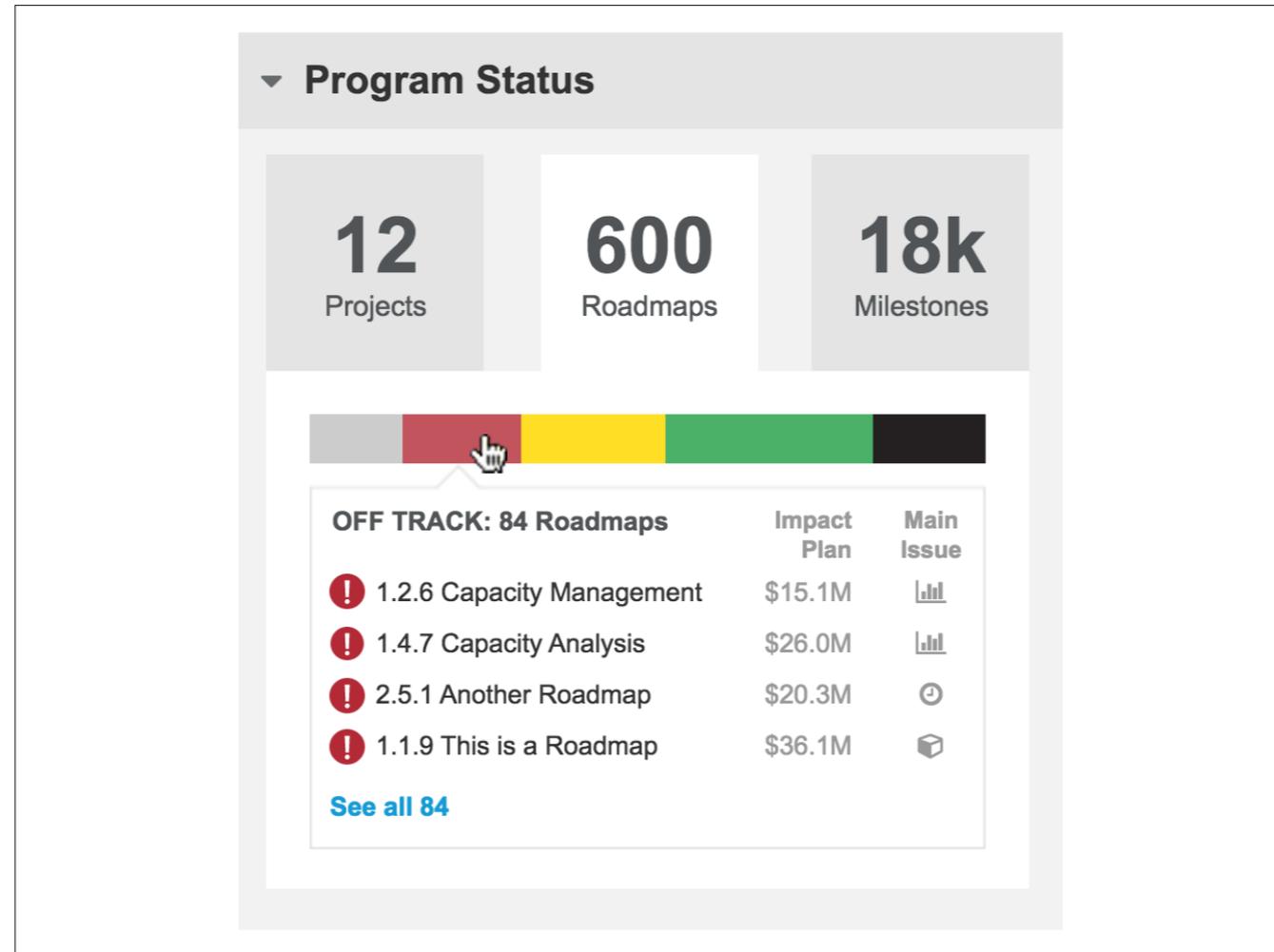
12 ▲ CRITICAL (8%)
31 ▲ MAJOR (12%)
211 ▲ MINOR (80%)

0 selected Select all Clear 1-20 of 186 results 1

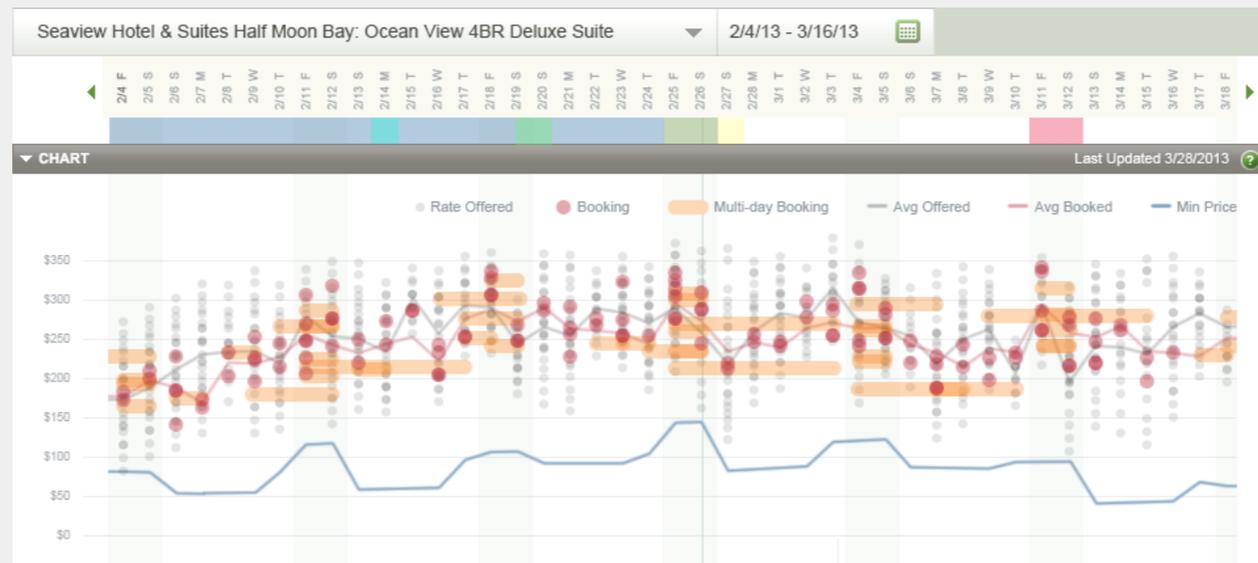
Start	Criticality	Object	Description	Duration
11:26p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	1h:50m
11:21p	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	0h:0m
10:18p	▲	ACCEL-AD02-ACCEL01	High Memory Usage due to swapping (swapout)	0h:42m
9:41p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:2m
9:38p	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	2h:5m
9:22p	▲	ACCEL-AD02-ACCEL01	High Memory Usage due to swapping (swapout)	16h:5m
9:17p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:50m
8:14p	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	0h:45m
7:27p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:1m
7:03p	▲	Net Appspace	Network I/O is constrained	0h:1m
6:14p	▲	metaname.io.percent	High Memory Usage due to swapping (swapout)	0h:1m
5:58p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:1m
5:18p	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	0h:1m
5:09p	▲	ACCEL-AD02-ACCEL01	High Memory Usage due to swapping (swapout)	0h:45m
4:46p	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:45m
11:20a	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	0h:50m
Jul 23	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:5m
11/18/2016	▲	ACCEL-AD02-ACCEL01	Network I/O is constrained	0h:2m
11/16/2016	▲	ACCEL-AD02-ACCEL01	High Memory Usage due to swapping (swapout)	0h:19m
20/11/2015	▲	ACCEL-AD02-ACCEL01	Reads critically lower than normal	0h:50m

Detail

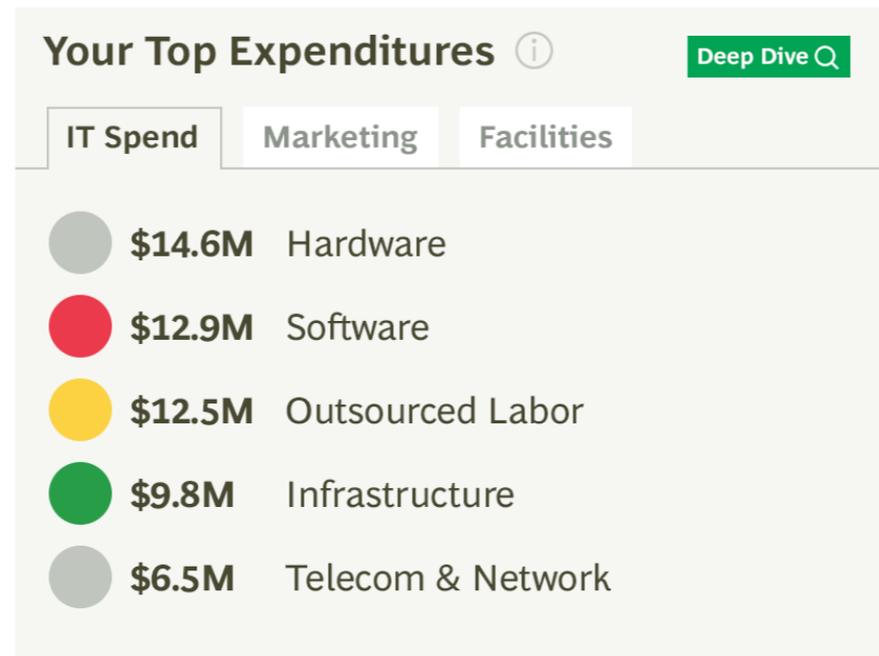
If you have tabular data on your dashboard, **reduce the columns way down**. Save the rest for a screen dedicated to that one element.



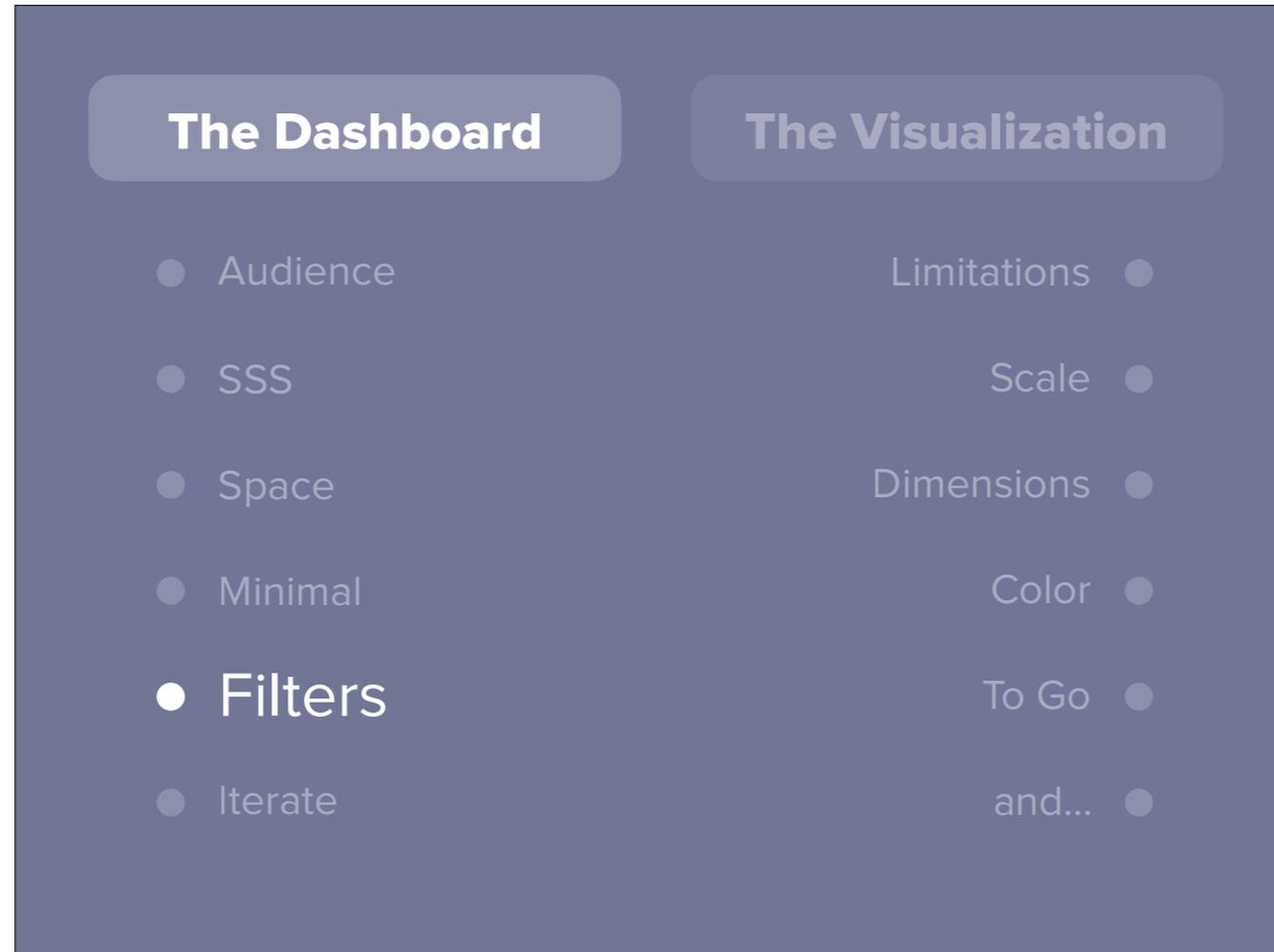
Who here has heard the term “**progressive disclosure?**” This concept works really well for dashboards. **Reveal things on hover or tap** instead of showing it all at once. That way, you’re not **overwhelming** your user.



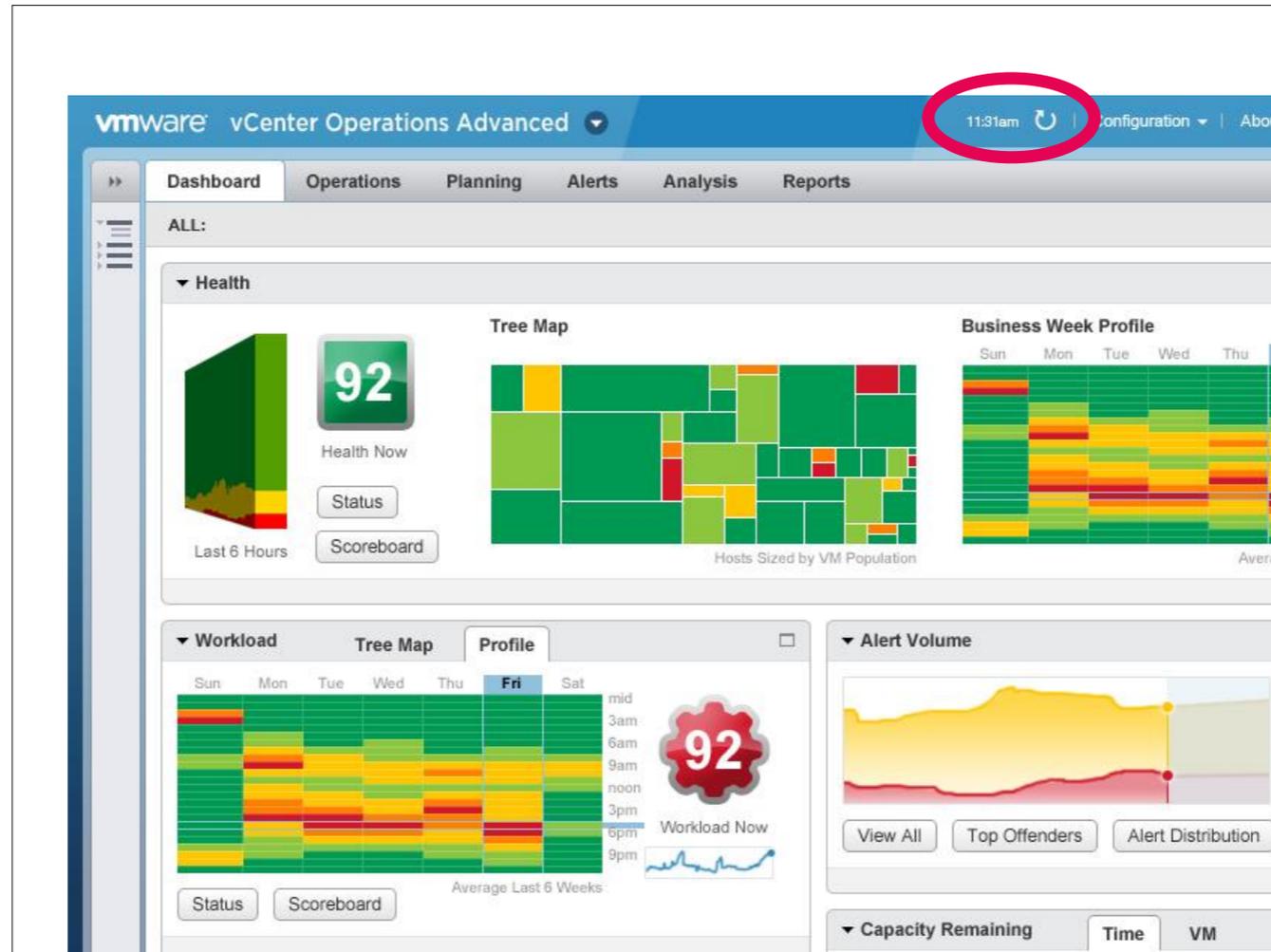
If you have really complex visuals, **start with some layers off**. That way, users can process what they are looking at as they turn them on. This reduces the **cognitive load** on users.



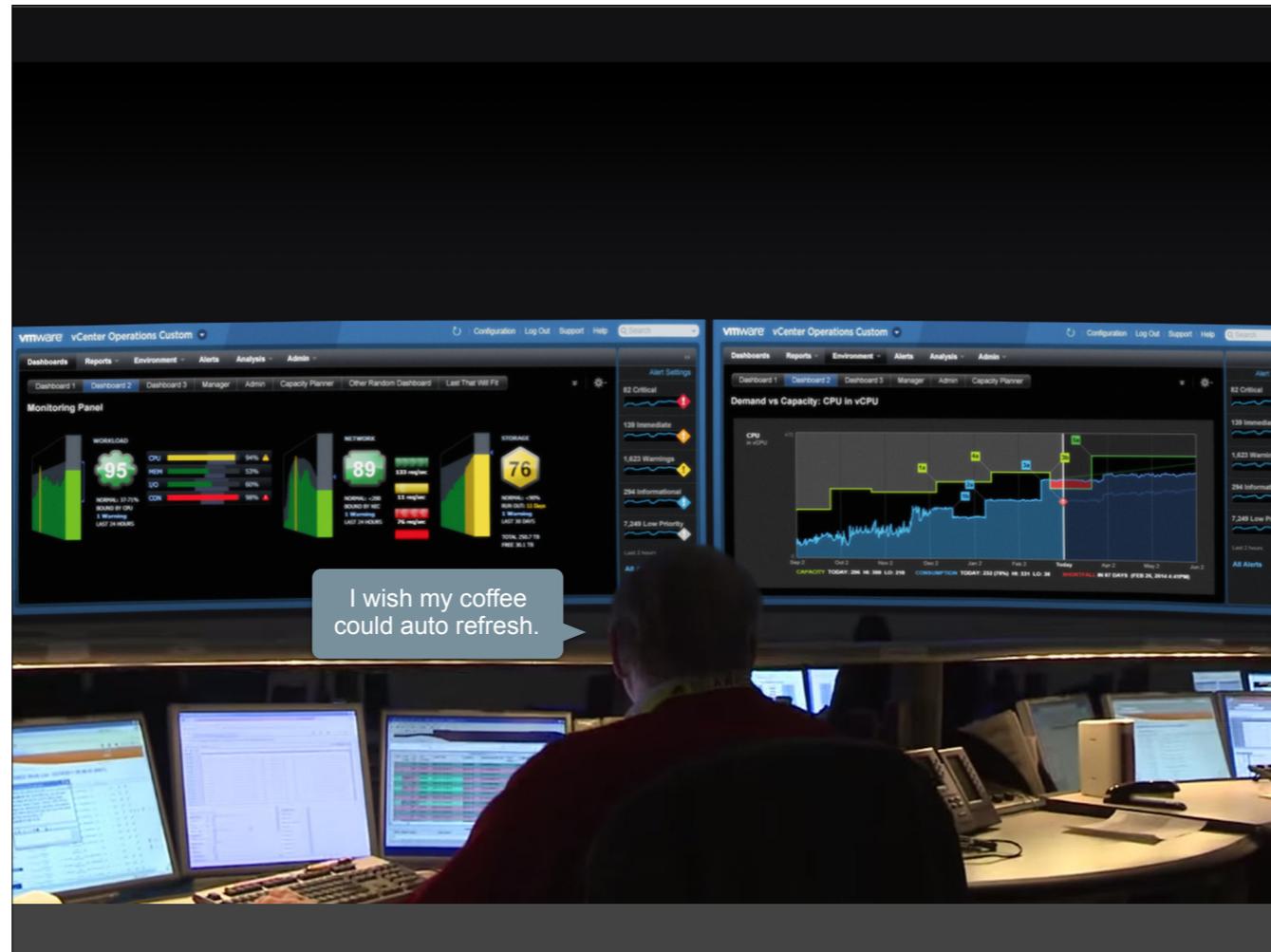
Tabs are another strategy to make secondary content available **without clutter**. Your first tab should be the most important stuff. And **be minimal with the number of tabs**. Not more than three!



We'll also need to think about **what filters or controls** might affect the **content** on our dashboard.

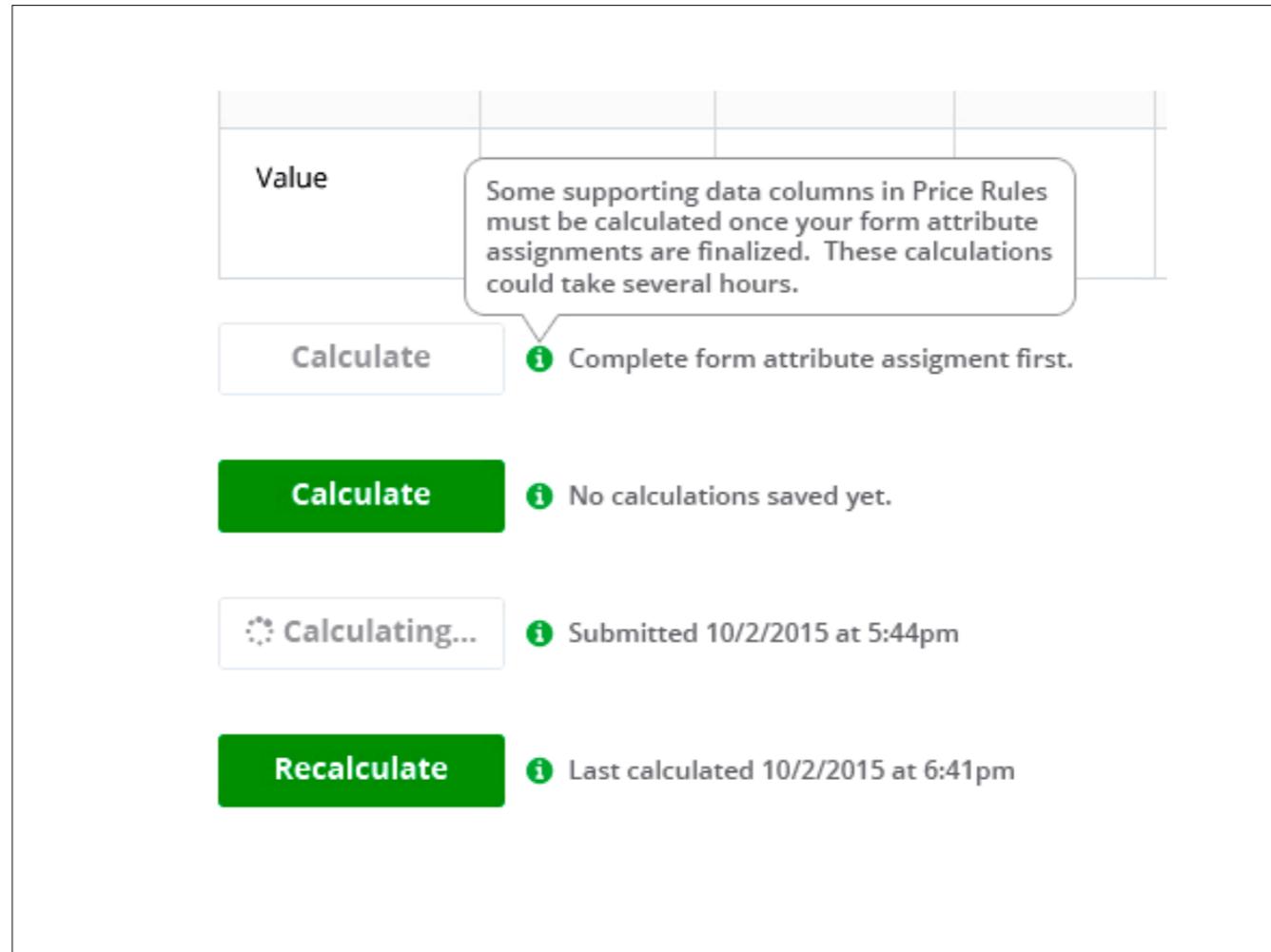


Dashboards never truly show data in “real time,” and it’s expensive to get close. However, when seconds matter, it’s important to put a **time stamp** on visuals. You may also want to plan how to refresh the data. It might warrant a button that does more than the browser refresh.



Remember our buddy Houston? Those big screens on the wall are **passive displays**. Meaning nobody is interacting with them. They need to **auto refresh to stay current**.

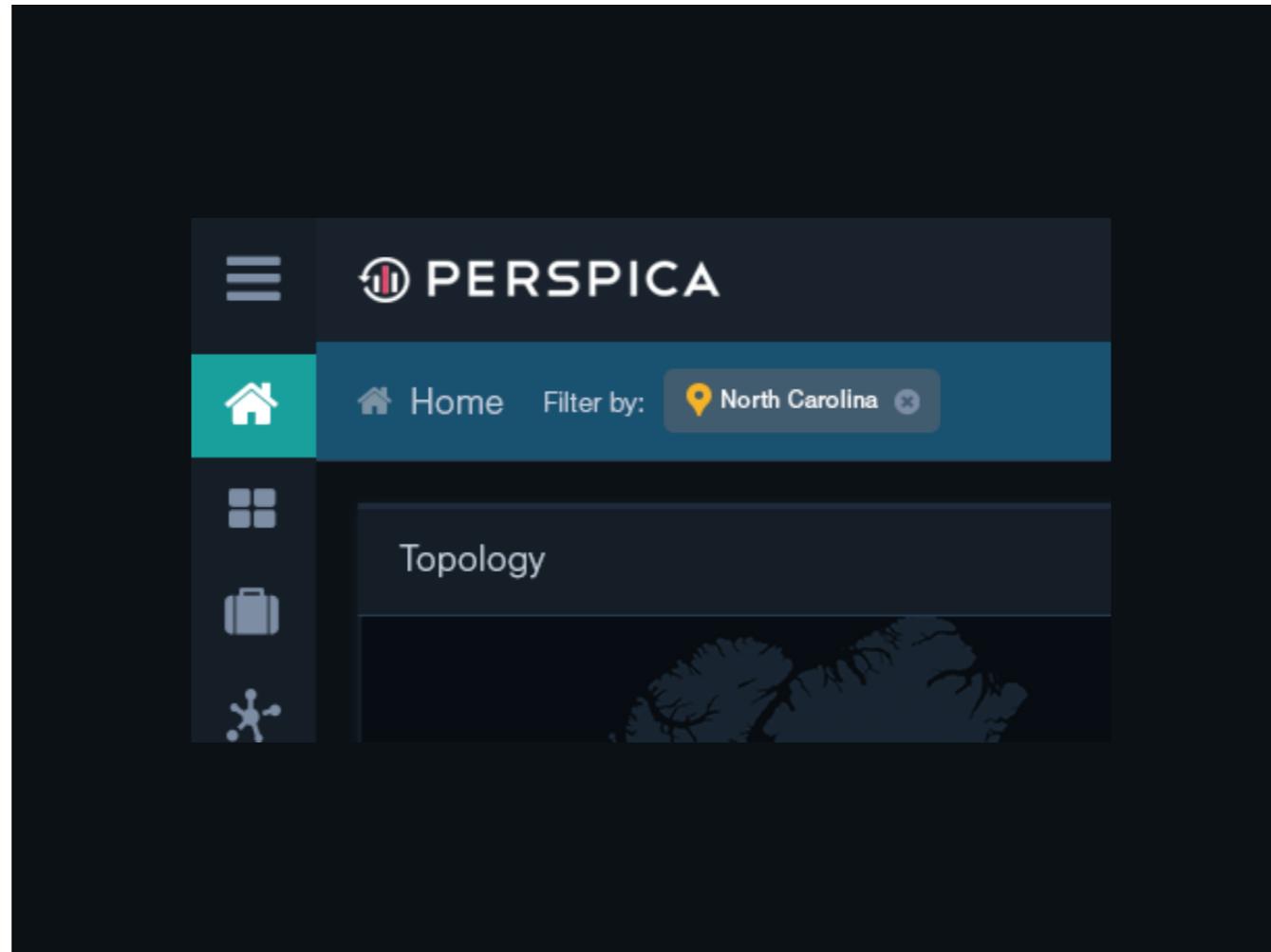
You can design a particular chart on a dashboard to request new data every few seconds, or you can automatically reload the page if all of the content should be updated.



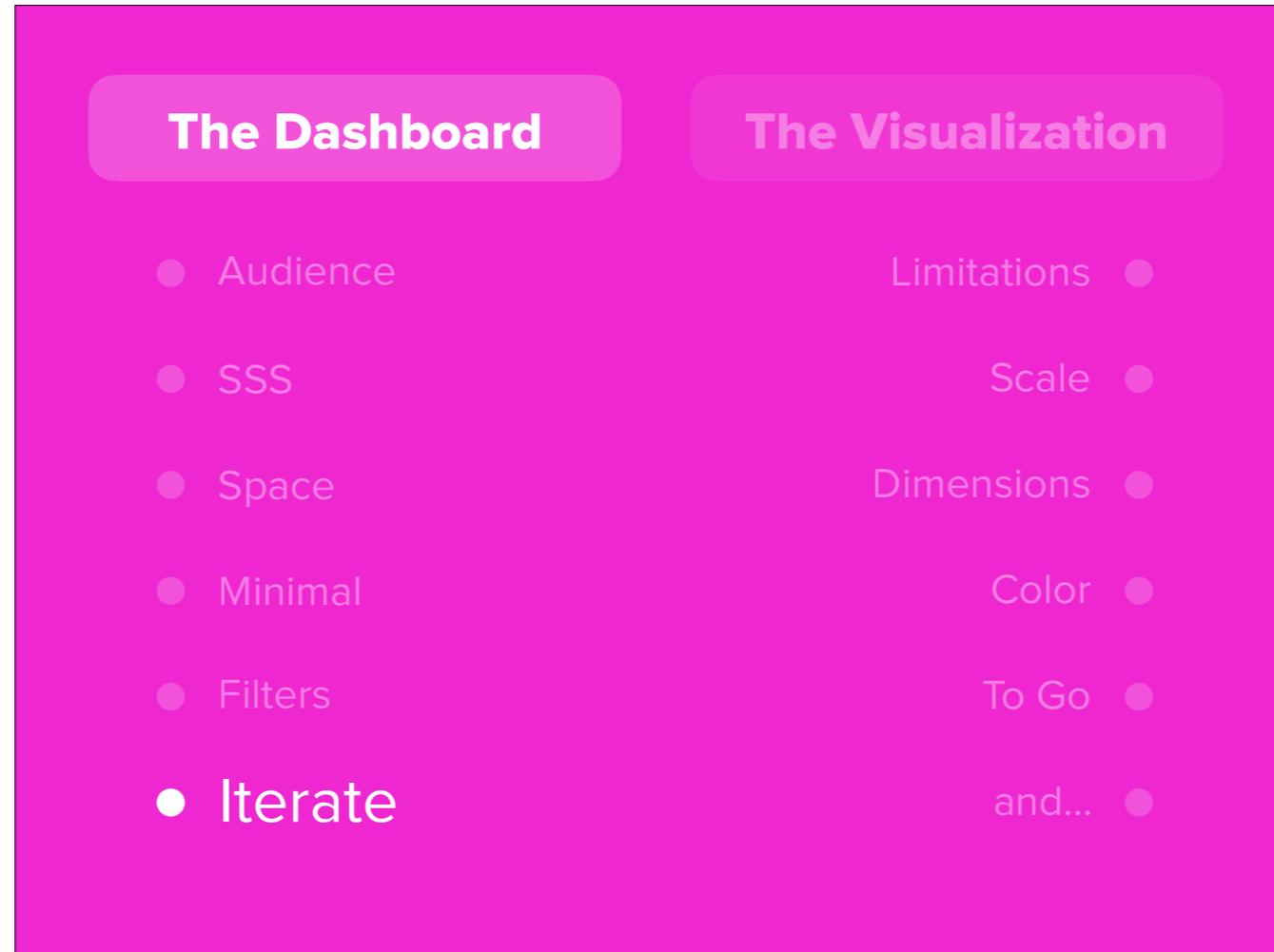
If you deal with data that takes **more than a few seconds** to gather, you will need to **set expectations with the user**. This example shows different states of a calculate button for data that took **about 6 hours to process**.



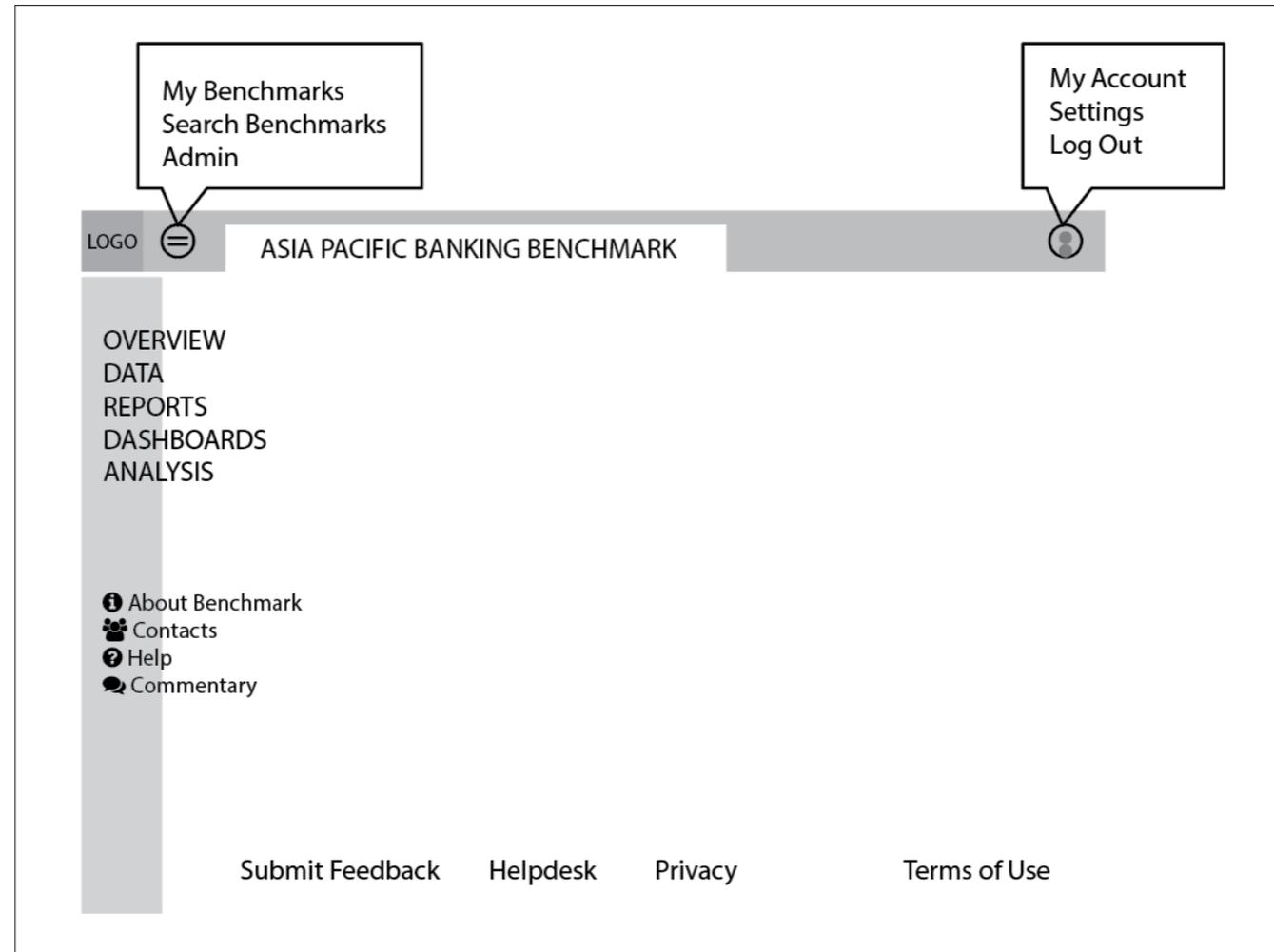
You may also have use cases where a dashboard can be **viewed in the past**. This example has a prominent color change to make sure people realize **this is not right now**. This app's time range selection was global, meaning it persisted across other screens. That makes the visual reminder **extra important**.



You may also have the ability to filter dashboard content **by a topic or tag**. Think through how this might affect your content, and **whether the filter should persist** for this or other screens. And **be careful of filter overload**. Be minimal, and progressively disclose them if you're going to put a lot in there.

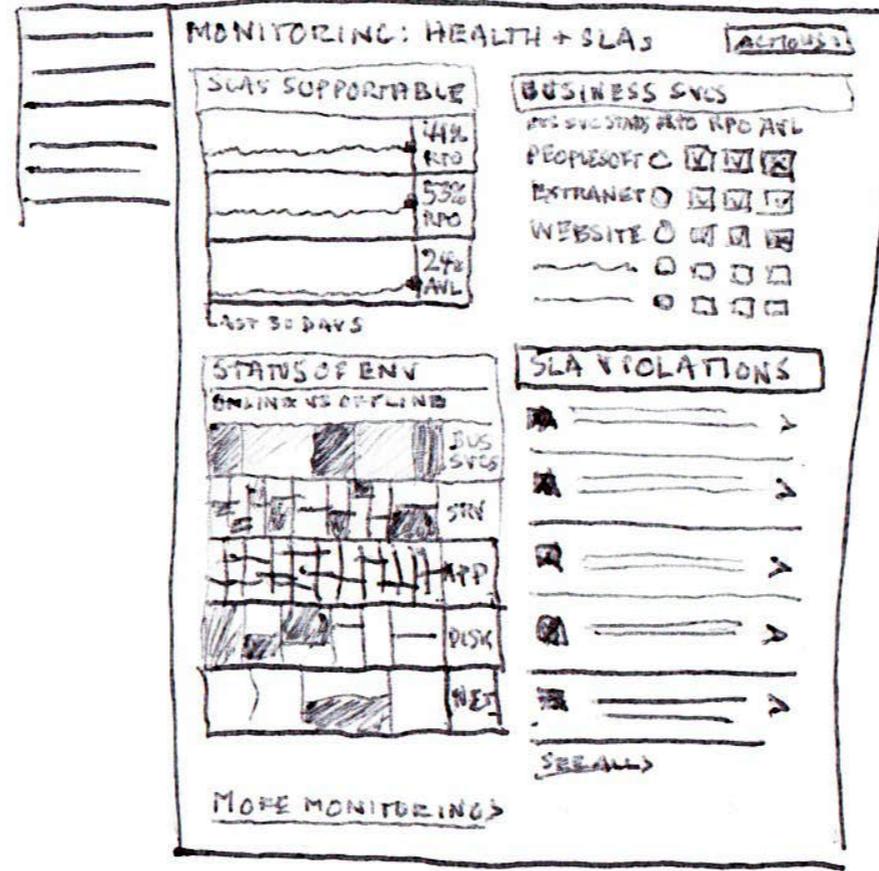


Testing with users is key, as early and often as is practical.
It's not very expensive to do and doesn't have to be elaborate.
If you have to change everything in your sketch, it's a lot more affordable than scrapping something that's been developed.



One of the first things you can test is **nomenclature and navigation**, even before you have your first wireframe. We'll often show a navigation to people to see if they can tell us where they would find something.

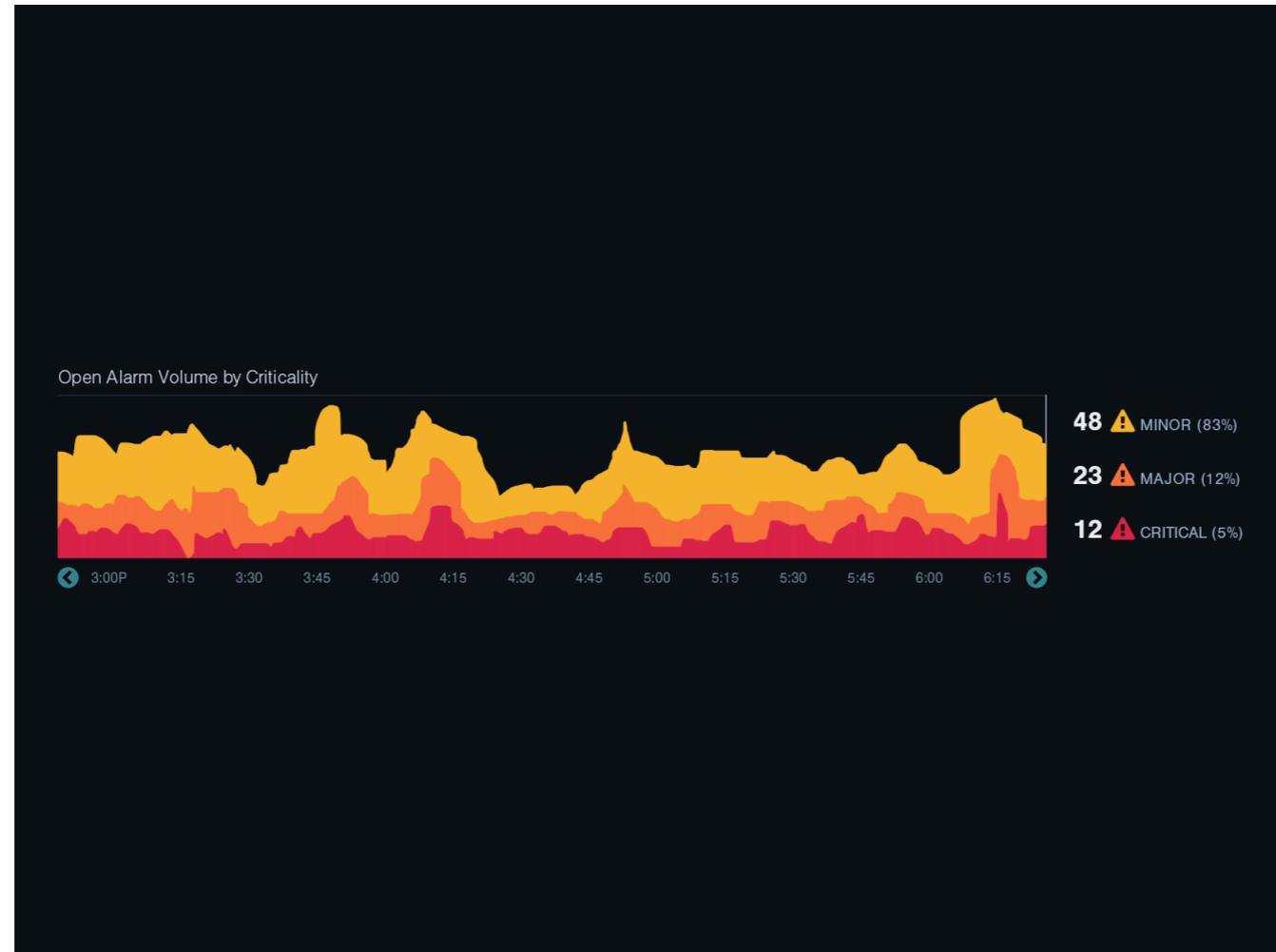
Icons are useful to test as well, to see if people can identify them without seeing a label.



Can we have \$ figures attached to this?



If you're like us, and you make detailed and highly functional wires, it helps to **share sketches of your dashboard** with people to see if you're on the right track. We've even made new sketches **with users in the room**.



The ultimate test is **the real world**. So testing after release is important too. For one project we designed this lovely graph of alert volume over time. Looks like a campfire doesn't it?



But in actual practice it ended up looking like this.
The minor alarms in yellow **vastly outnumbered** the critical alarms almost all of the time.
This makes it hard to see any nuance in the critical trend.

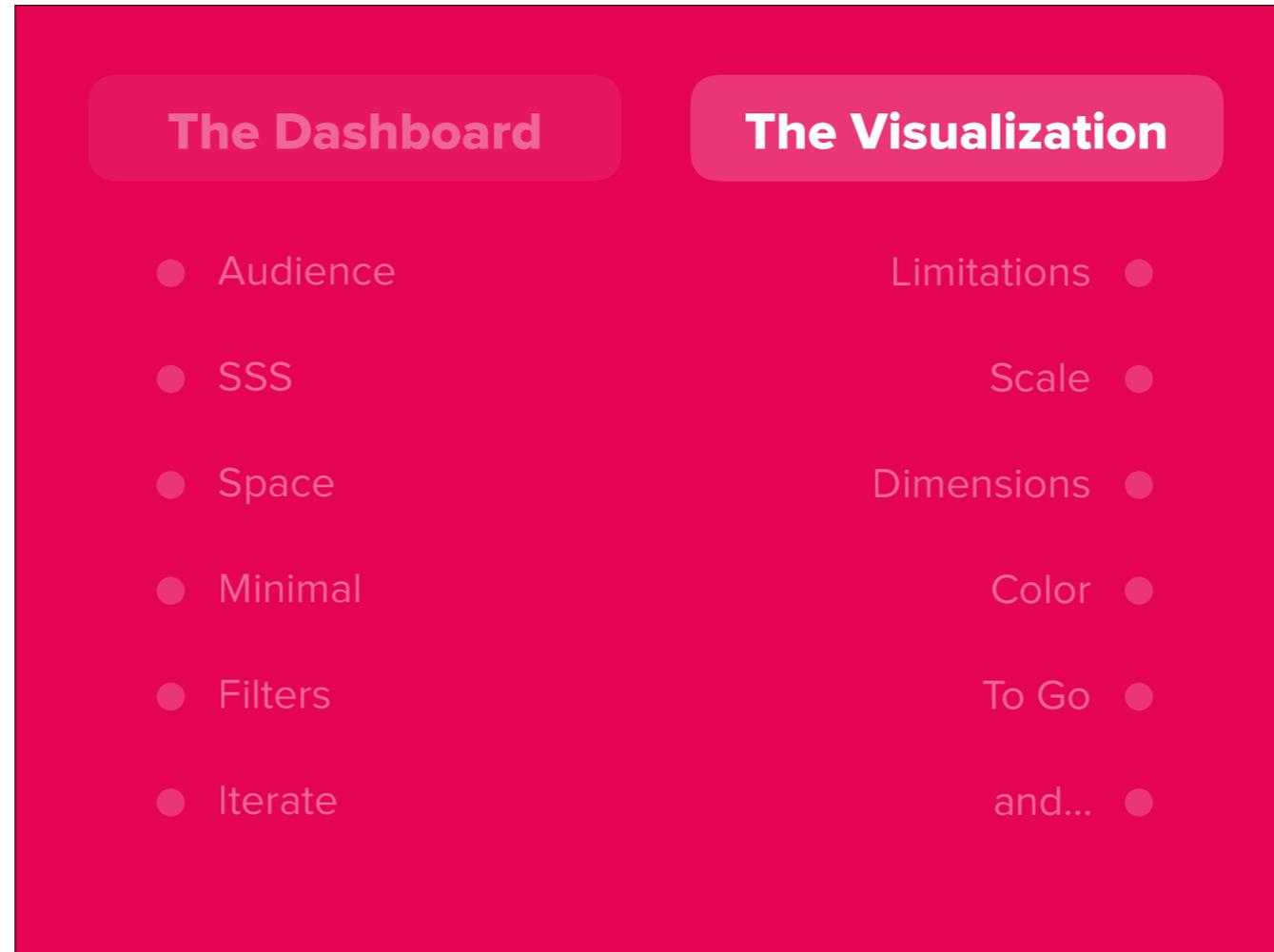


The solution we ended up with was to separate the different levels of alerts. Maybe not as pretty, but **more usable in real world situations.**

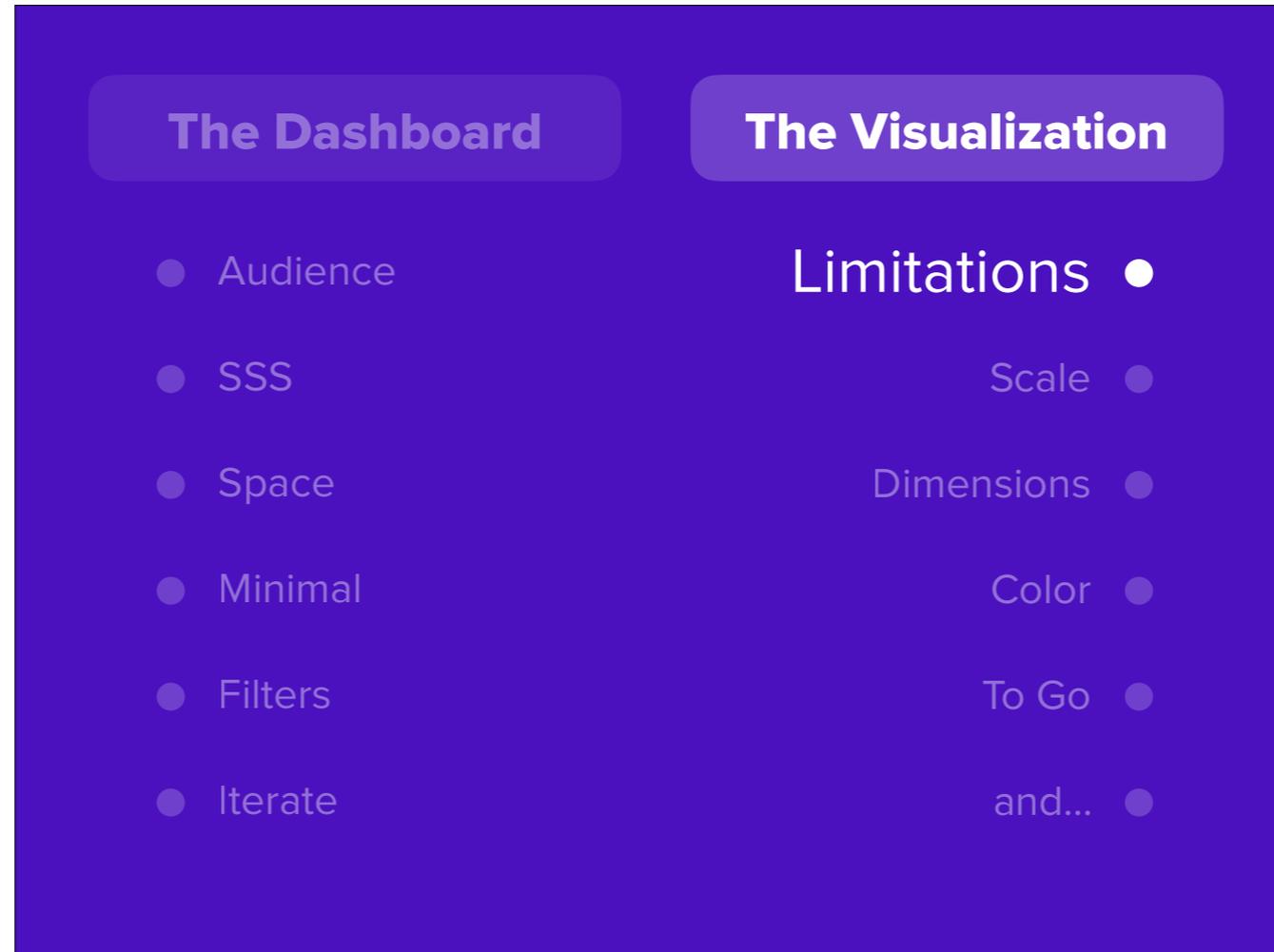
Some natural user test spots

What:	When:
Nomenclature & navigation	Application Mapping
Priority and concept	Screen sketches
Usability and screen flow	Detailed Wireframes
Look and feel	Visual Design
Real world	Beta test, soft launch, or live

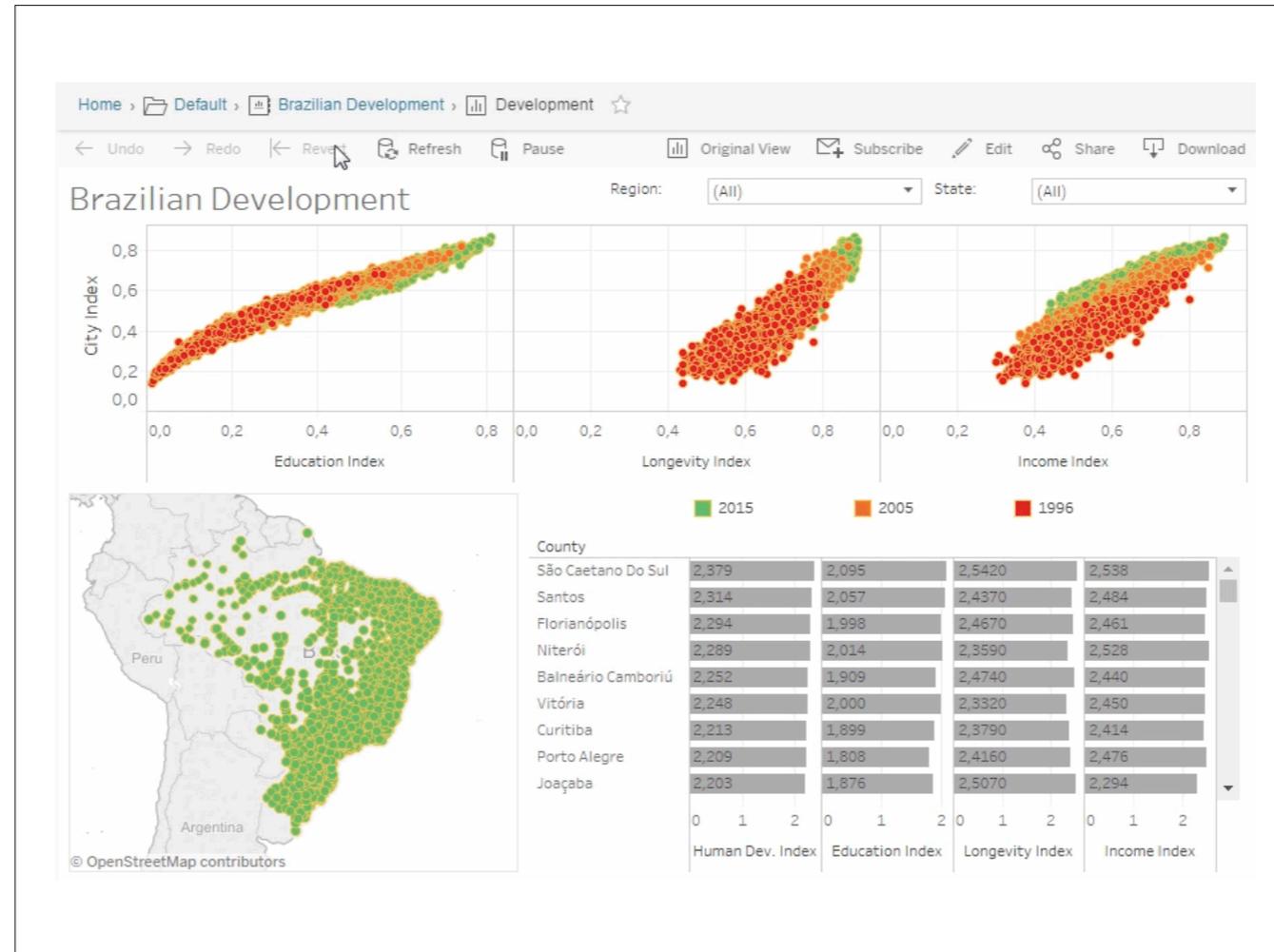
Here are some points in the process **when we often test** with users.
Look and feel: **test what you changed from wireframes**



Now it's time **to fill in those boxes**. Let's dig in to planning a visualization. You might be putting several small ones on your dashboard. Or you might be putting a larger, more detailed one on a report or drilldown screen. **We're going to cover some strategies** for thinking through each one.



Limitations are your friend. But they can be your enemy if you don't know them going in. Make sure you know what data is available. Ask your development team if there are any **technical** considerations you should know about. And ask your client if there are any **legal or business** considerations.



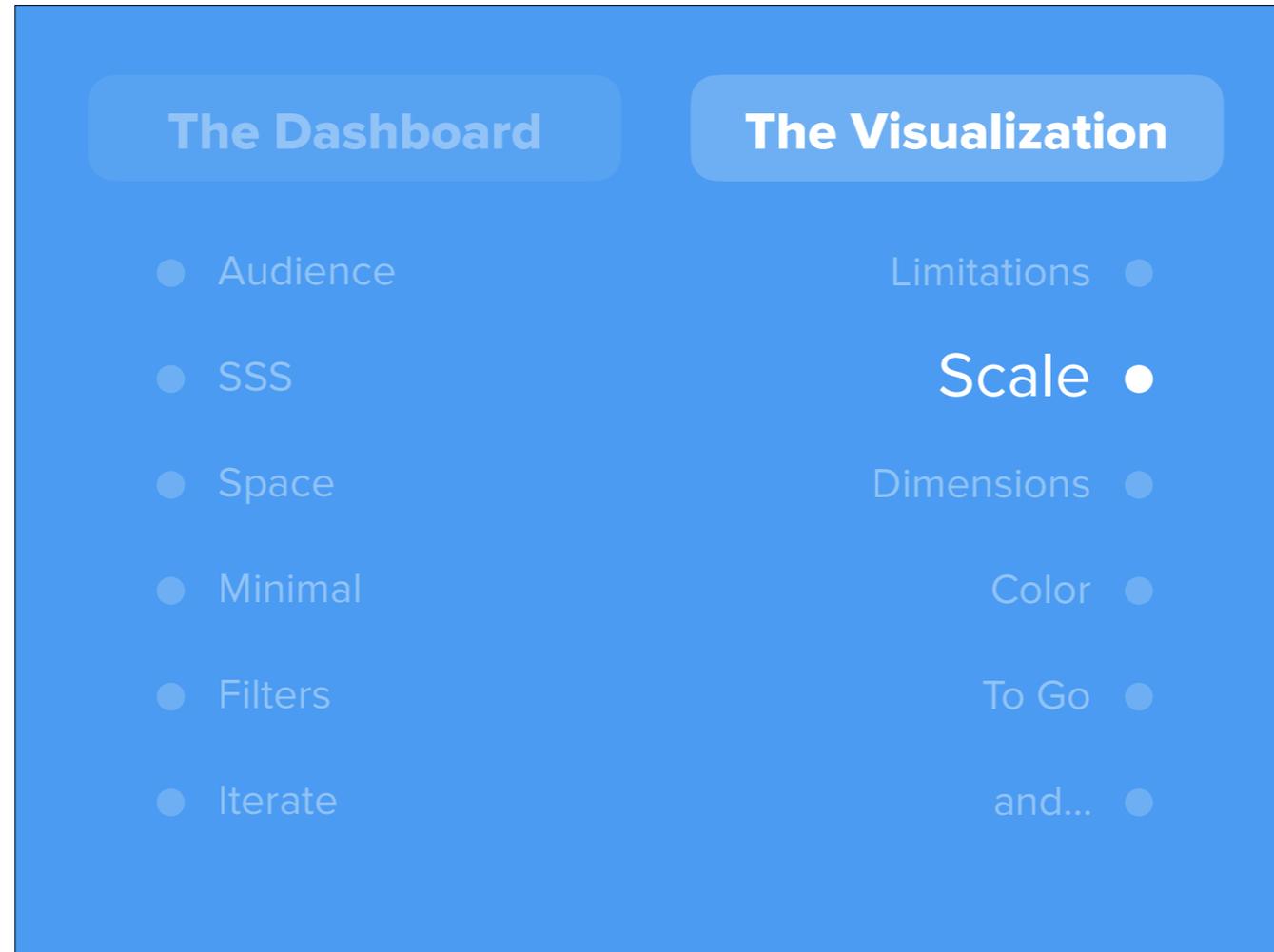
Before you get beyond a sketch, **find out what graphing package** will be used for the project. Graphing package such as Tableau, Qlik, Domo, Highcharts, etc.

Study the examples to see what the default interaction patterns are: how filters work, what legend options are, how it can be themed, what chart types they have out of the box. **Align your designs with these patterns when possible.**

And by all means, get adventurous and non-standard, just know what extra work you'll be creating.

The screenshot displays the Highcharts website interface. At the top, there is a navigation bar with links for 'HIGHCHARTS', 'DEMO', 'DOCS', 'SUPPORT', 'PRODUCTS', 'BLOG', 'COMMUNITY', 'ABOUT US', 'PLUGINS', and 'SHOP'. Below this, the page title is 'Highcharts Demos > Scatter plot'. A sidebar on the left lists various chart types: 'LINE CHARTS', 'AREA CHARTS', 'COLUMN AND BAR CHARTS', 'PIE CHARTS', 'SCATTER AND BUBBLE CHARTS', 'COMBINATIONS', 'DYNAMIC CHARTS', '3D CHARTS', 'GAUGES', 'HEAT AND TREE MAPS', and 'MORE CHART TYPES'. The 'Scatter plot' option is highlighted. The main content area shows a scatter plot titled 'Height Versus Weight of 507 Individuals by Gender' with the source 'Source: Heinz 2003'. The plot has 'Height (cm)' on the x-axis (ranging from 145 to 200) and 'Weight (kg)' on the y-axis (ranging from 20 to 140). Data points are colored by gender: red for 'Female' and blue for 'Male'. Below the plot are two buttons: 'VIEW OPTIONS >' and 'EDIT IN JSFIDDLE >'. At the bottom of the page, there is a copyright notice '© 2017 Highcharts. All rights reserved.' and social media icons for Facebook, Twitter, LinkedIn, and YouTube.

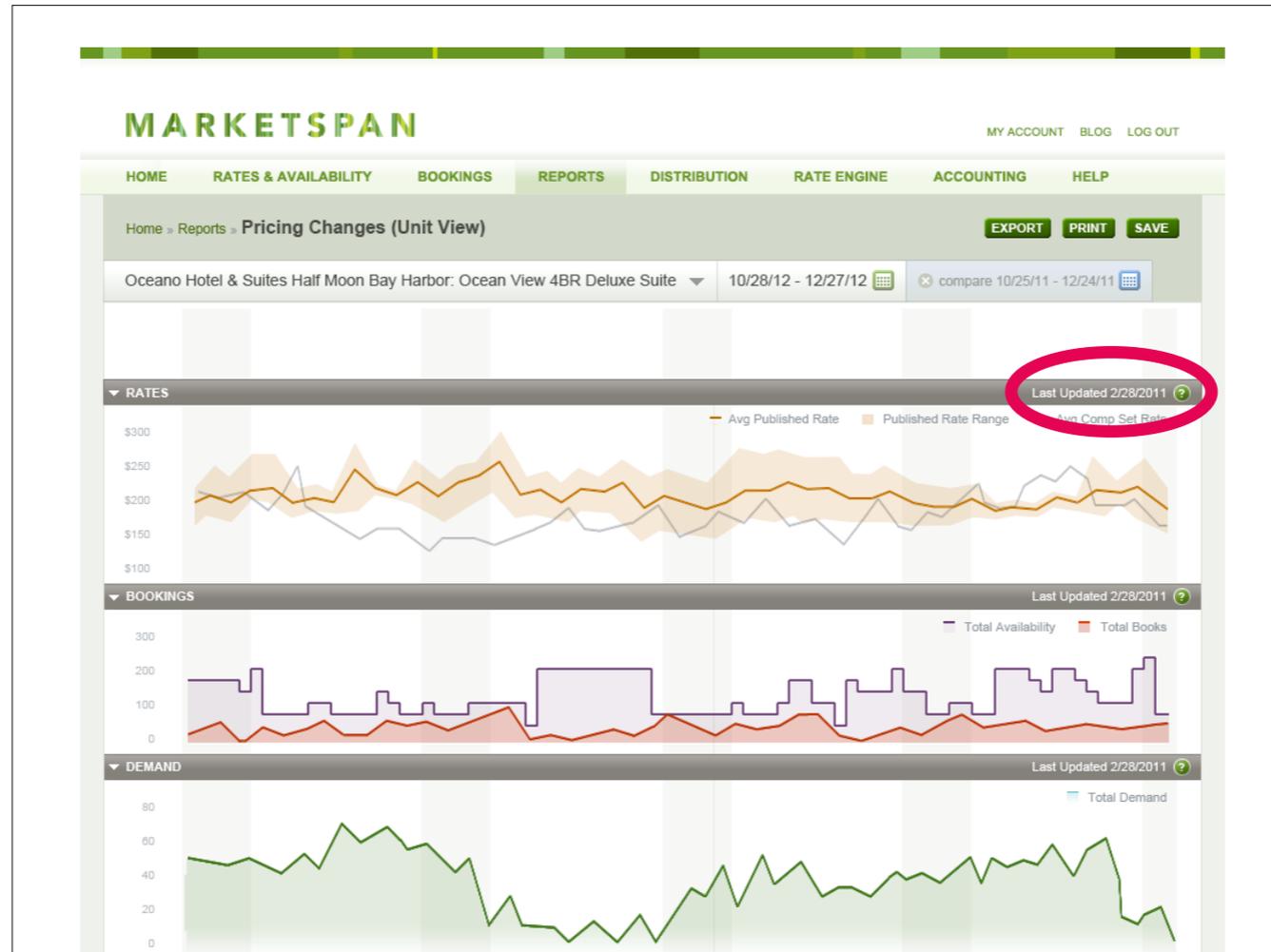
Highcharts, for example, has a lot of demo examples. You can even use JSFiddle if you know some basic coding to see what can be tweaked. **Work with your developers** to make sure you're not mocking something that will **create unnecessary work downstream**.



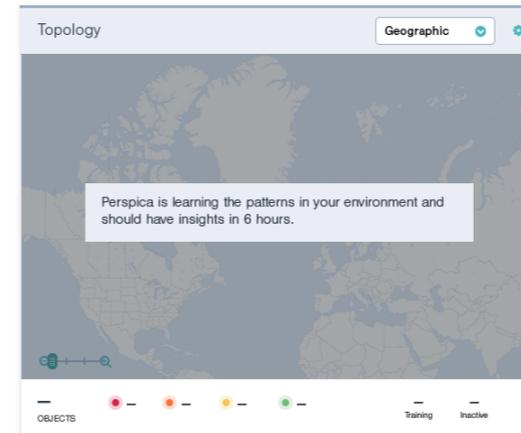
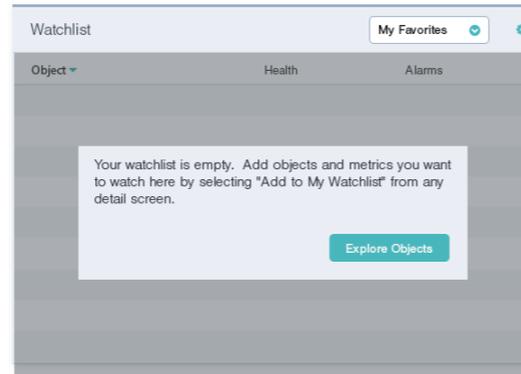
It's important to understand the possible **scale or range of data** across **as many use cases as you can identify**.



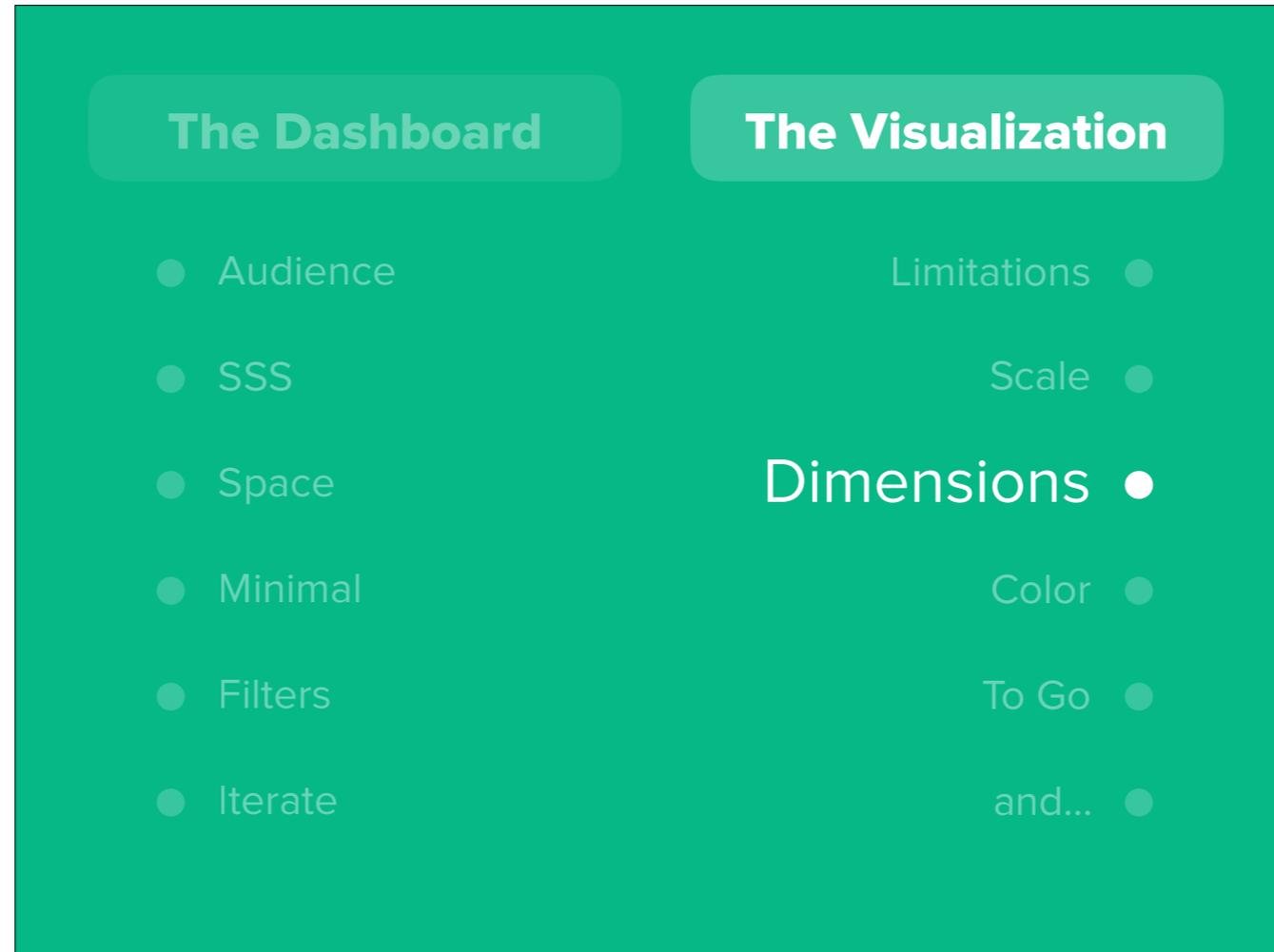
One of our clients collects **millions of metrics** across thousands of items. This status mix visual can show the proportion of healthy and unhealthy items, **even if there are millions**. The side wall shows how it is trending over 30 days. The health overall score can be a rollup of any number of items. **This is a highly flexible visual and needed to be.**



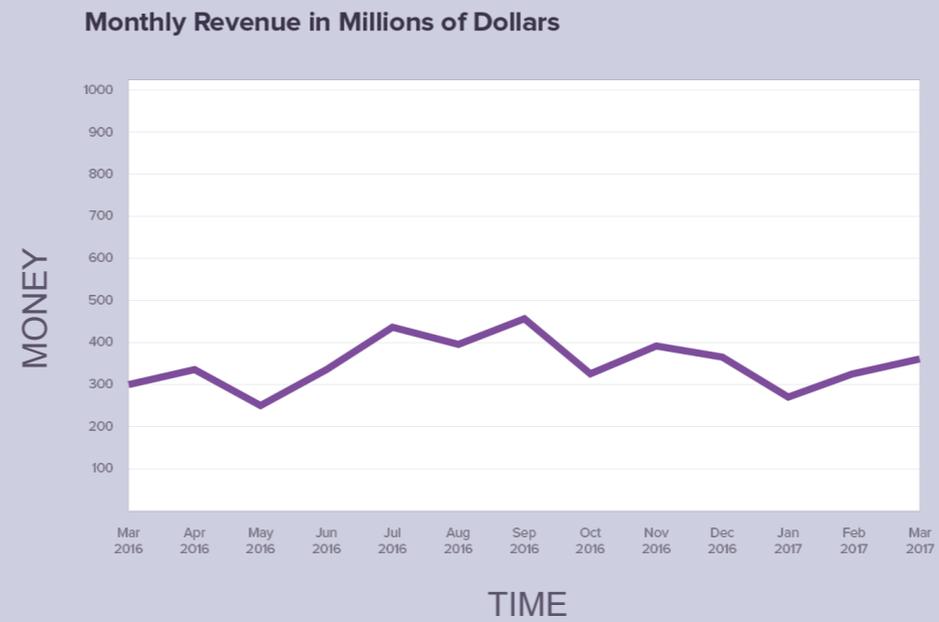
Understand how often the data changes, and how close to real time it needs to be. It should line up with how often you'd like users to return.
So if it updates every six weeks, **don't expect daily visits!**



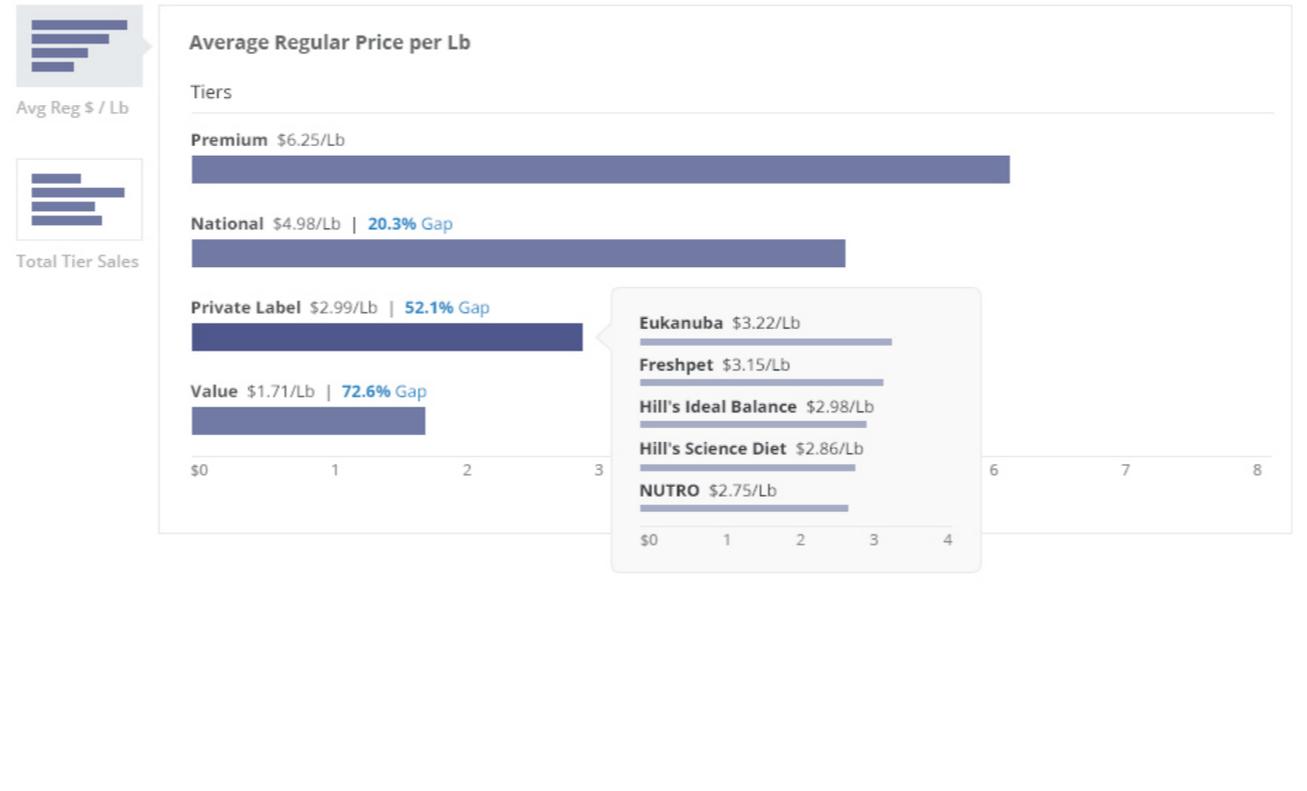
This one is an easy one to overlook:
What does it look like **if there is NO data?**
Consider if there are use cases where data is unavailable or hasn't been set up.



Your visualization will have one or more **data dimensions**. There are **different types of visuals** for showing patterns for different numbers of dimensions.



Each **type of data point collected** is a dimension.
If you think of a line graph, each axis represents a dimension: say **money over time**. Each dimension might have **hierarchy** to it, so you may have to consider **aggregation**. In this example, you might have to add up daily revenues into months.
Aggregation is helpful to get to a **reasonable number of points to plot**.



If you do have aggregated dimensions, you may want to have a **drilldown**. In this case, all the private label brands are averaged. The callout shows each brand's average within private label. A drilldown might be a hover state like this or take over the whole graph space, with a means to get back up a level.

Megan Butler, Client CEO

Age: 63

Family: Married

Location: New York City, NY

Devices: iPad, PC, Paper

Education: MBA

Main Role

- Hires company for a change management project
- Receives status reports on program from PMO
- Communicates with company leadership
- Sets strategic vision for company
- Regularly checks project progress



Challenges and Pain Points

- Dashboard (high level info)
- Current tools too time intensive
- Security (data destruction & permissions)
- Lack of mobile
- Tool hard and time-consuming for her people to use
- Doesn't provide right level of info for course correction
- Info not customized enough
- Tool and especially Reports don't seem state-of-the-art

Goals and Needs

- Tool must be easy to implement, easy to train
- Maintain data security
- See company's branding
- Must get quick customized/targeted updates on progress to make decisions
- Mobile interactive dashboard reports

Favorite Features

- Consistency of numbers
- Data security, data destruction & Permissions
- Configurable dash boards based on standard reports
- Report drilldowns to help course correction
- Customized reporting
- Real-time data on mobile
- Intuitive UI so employees spend less time training and more time roadmapping
- Client branding
- Automatic alerts

Application Usage: Low to none



Tech Savvy: Lower



Change Mgmt Experience: High



Seniority: Highest stakeholder



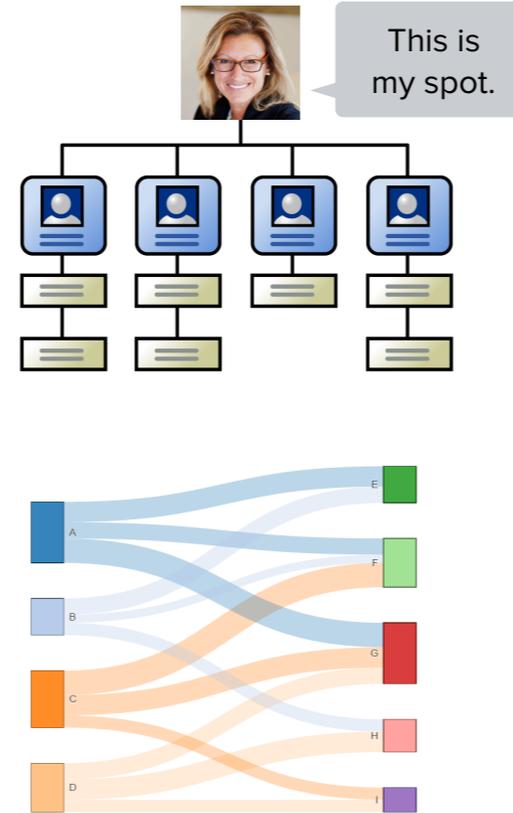
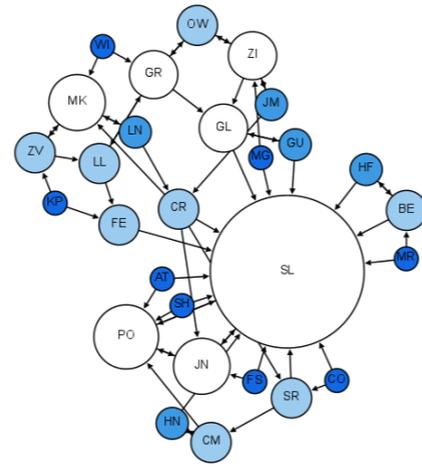
PRIMITIVE SPARK 

Combining these dimensions in different ways can **answer different kinds of questions:**

- Snapshot: what is the status right now?
- Trend: how is it changing over time?
- Distribution: what is the breakdown?
- Comparison: how does x compare to y?

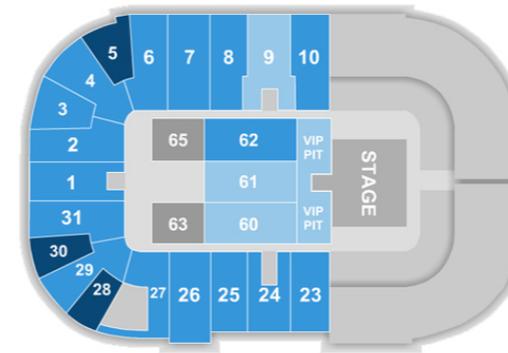
Refer to your persona to figure out what questions you want to answer. Google **“types of visualizations”** and you’ll get plenty of references on what kinds of visuals work for different goals.

Relationships



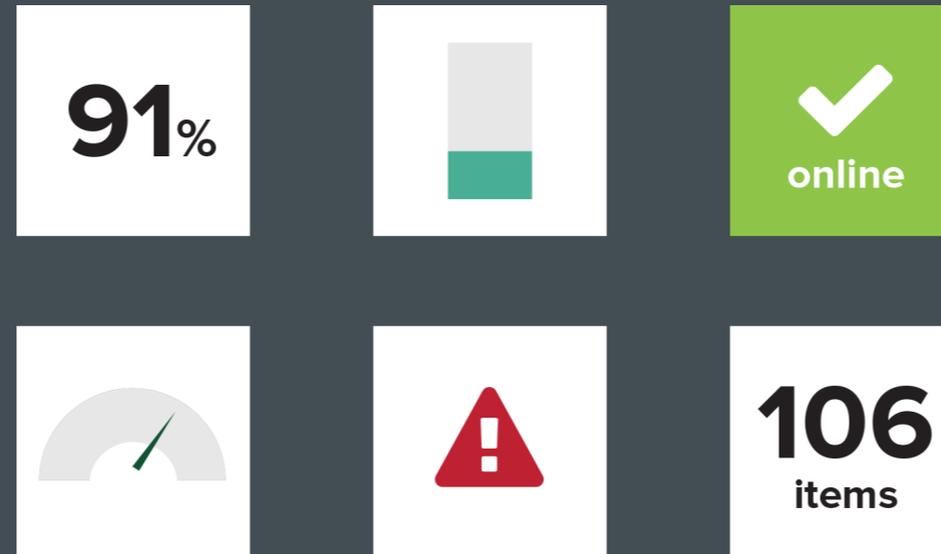
You can also visualize **relationships** for things like hierarchy, interdependency and similarity. Tree, Flowchart, Treemap, Node Link, Sankey, Matrix, Arc, Dependency

Geospatial



Geospatial visuals can map things in physical or ideological space. Geo Map (with regions, dots, connections, flows, colors), Seating Chart
You can **combine these strategies**. In this map's case, to show a snapshot of status AND geographic relation.

One Dimension



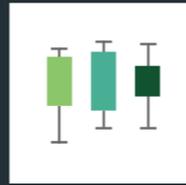
Here are some examples of **single dimension visuals**. These are typically stats that give you a **snapshot**.

Two Dimensions

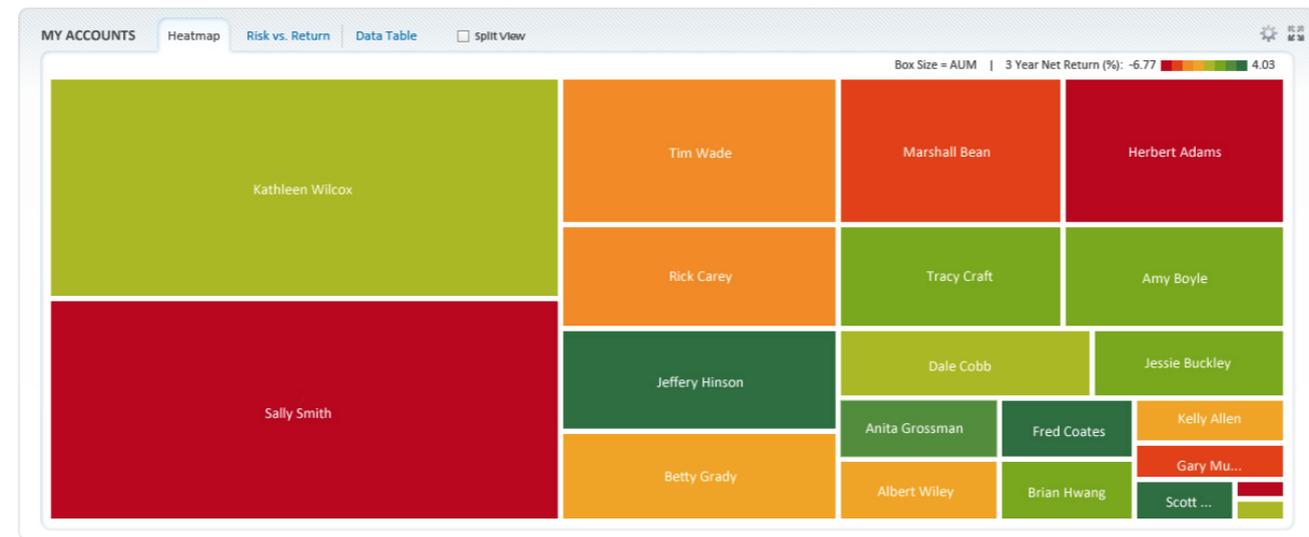


When you have two dimensions, it's like a **series of snapshots**.
That might be **time series** for a trend line, or it could be a **distribution of values**.

Three or More Dimensions



Three dimensions or more is useful for **comparison** and other analysis. **The more dimensions you have, the more you are asking of your users.** So you might need to explain what's going on more. And maybe reserve these for power users.



I'd like you to turn to your neighbor. **Say hello!**

Take a look at this chart and see if you can identify TOGETHER how many dimensions it has.

Answer is 3: Box size is one (assets under management), color is two (return) and by person is three.

The Dashboard

- Audience
- SSS
- Space
- Minimal
- Filters
- Iterate

The Visualization

- Limitations ●
- Scale ●
- Dimensions ●
- Color ●**
- To Go ●
- and... ●

Let's talk about how to think through **color** with visualizations.

		HONEYMOON SUITE																				
		Days Before Arrival (DBA)																				
		0-7	8-14	15-21	22-28	29-35	36-42	43-49	50-56	57-63	64-70	71-77	78-84	85-91	92-98	99-105	106-112	106-112	106-112	106-112	106-11	
		ALL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	
% Availability	0-10	ROW	+0%	+0%	+0%	+0%	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+20%	+20%	+30%	+30%	+40%	+50%	+50%
	11-20	ROW	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+10%	+10%	+10%	+10%	+20%	+20%	+30%	+30%	+40%	+50%	+50%
	21-30	ROW	-10%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+20%	+20%	+30%	+30%	+40%
	31-40	ROW	-20%	-20%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+20%	+20%	+30%	+30%	+30%
	41-50	ROW	-25%	-20%	-20%	-10%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+20%	+20%	+30%	+30%
	51-60	ROW	-25%	-25%	-20%	-20%	-15%	-15%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+20%	+20%	+20%
	61-70	ROW	-30%	-25%	-25%	-25%	-20%	-20%	-15%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%	+20%	+20%
	71-80	ROW	-35%	-30%	-25%	-25%	-25%	-20%	-20%	-20%	-10%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+0%	+0%	+10%	+10%
	81-90	ROW	-40%	-35%	-30%	-25%	-25%	-25%	-20%	-20%	-20%	-20%	-10%	-10%	-10%	+0%	+0%	+0%	+0%	+0%	+10%	+10%
	91-100	ROW	-40%	-40%	-35%	-30%	-25%	-25%	-20%	-20%	-20%	-20%	-20%	-20%	-10%	-10%	+0%	+0%	+0%	+0%	+10%	+10%

Did I mention I don't do Excel?



The right use of color can help us see the big picture much faster than from reading words or numbers. In this visual if you took out the color, you might as well be using Excel!

Promo Calendar

Save

SEASON: STS'16 SCENARIO: Long Term Profit BASELINE QUARTER: STS'15 RETAILER: Retailer 1 DEPTH GUIDELINE: Broken Guardrails (red) / No Promo (grey)

SKU	Product Name	Cat	Strategic Prod. Grp	Street Price	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Wk13
SKU1	Product 1	IPS	Home	399	20		20	30	30	20	20	30		20	30		20
SKU2	Product 2	IPS	Home	449	30	30	40	30	30	40		30	30	30	30	30	30
SKU3	Product 3	IPS	Home	499	30	30	30	50	30	30							
SKU4	Product 4	IPS	Home	429		50			50	50	50		50	50		50	50
SKU5	Product 5	IPS	Home	299	20	20		20		20							
SKU6	Product 6	IPS	Home	499								20	20	20	20	20	20
SKU7	Product 7	LES	Home	529		30	30	30	30	30	30	30	30	50	30	30	50
SKU8	Product 8	LES	SMB	629	60	60			60			60	60	80	60	60	80
SKU9	Product 9	LES	SMB	679													
SKU10	Product 10	LES	SMB	299													
SKU11	Product 11	LES	SMB	199	120	120				120	120	120	120		120	120	
SKU12	Product 12	LES	SMB	279	100	70						70	70		70	70	
SKU13	Product 13	LES	SMB	329	70				50	70							
SKU14	Product 14	LES	SMB	249	100												
SKU15	Product 15	LES	SMB	319			30			20	20		30			30	

< 1 2 3 4 >

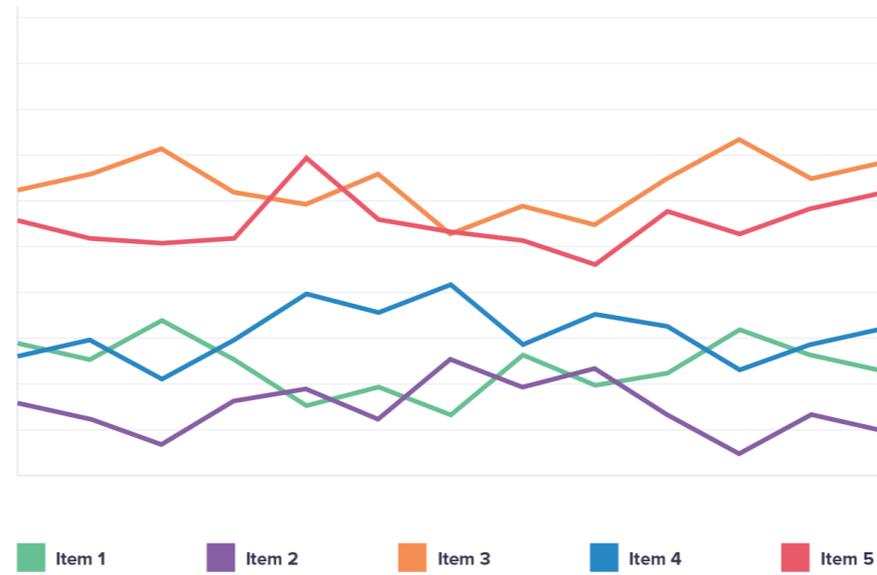
You can also draw attention to the urgent or important things with color. I wonder where the problems are on this page?



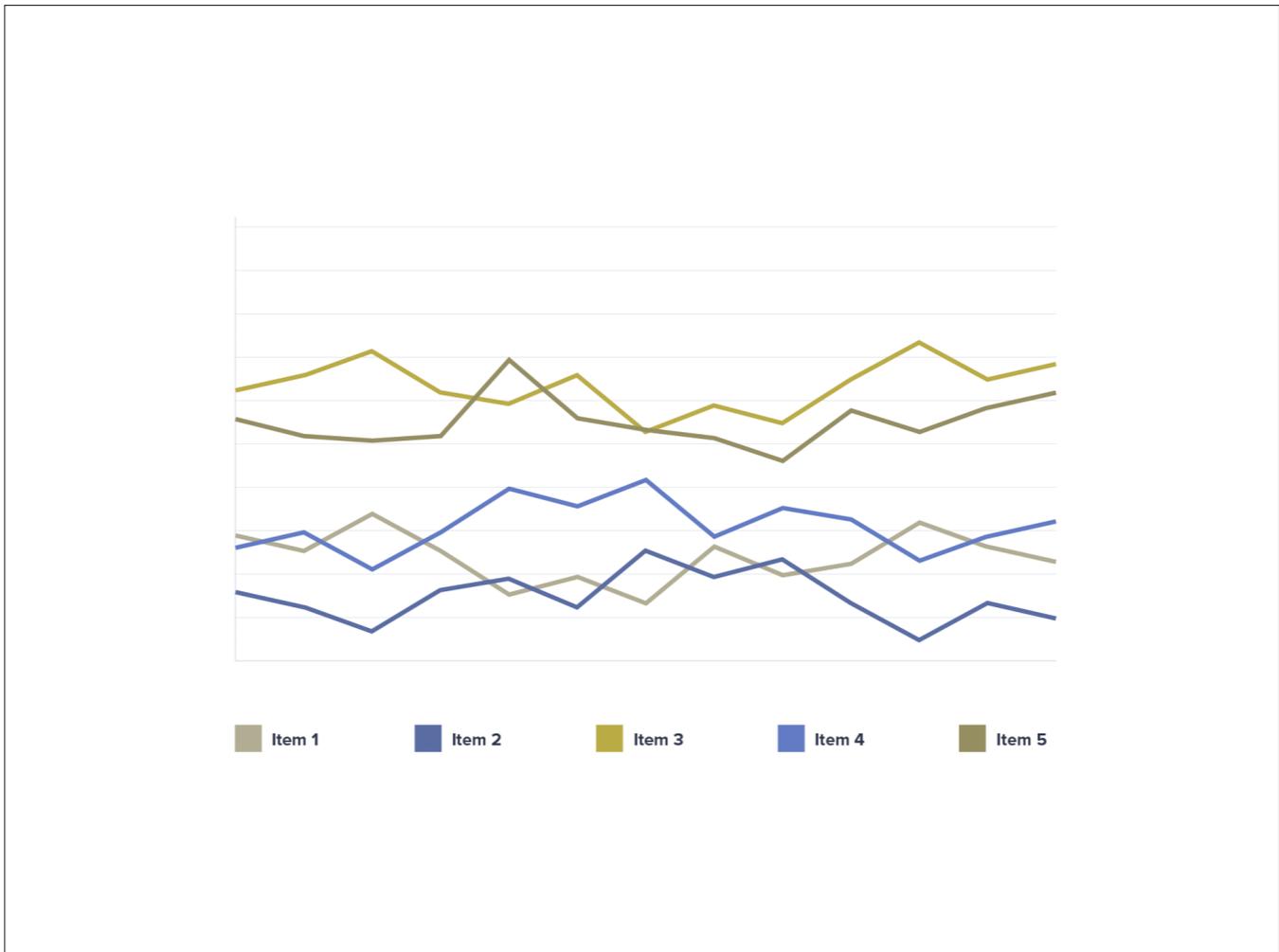
Imagine yourself in a restaurant and there's a huge TV in every sight line. I become **the worst conversationalist** in the world. **The wrong visual design** can have this same effect on your dashboard.



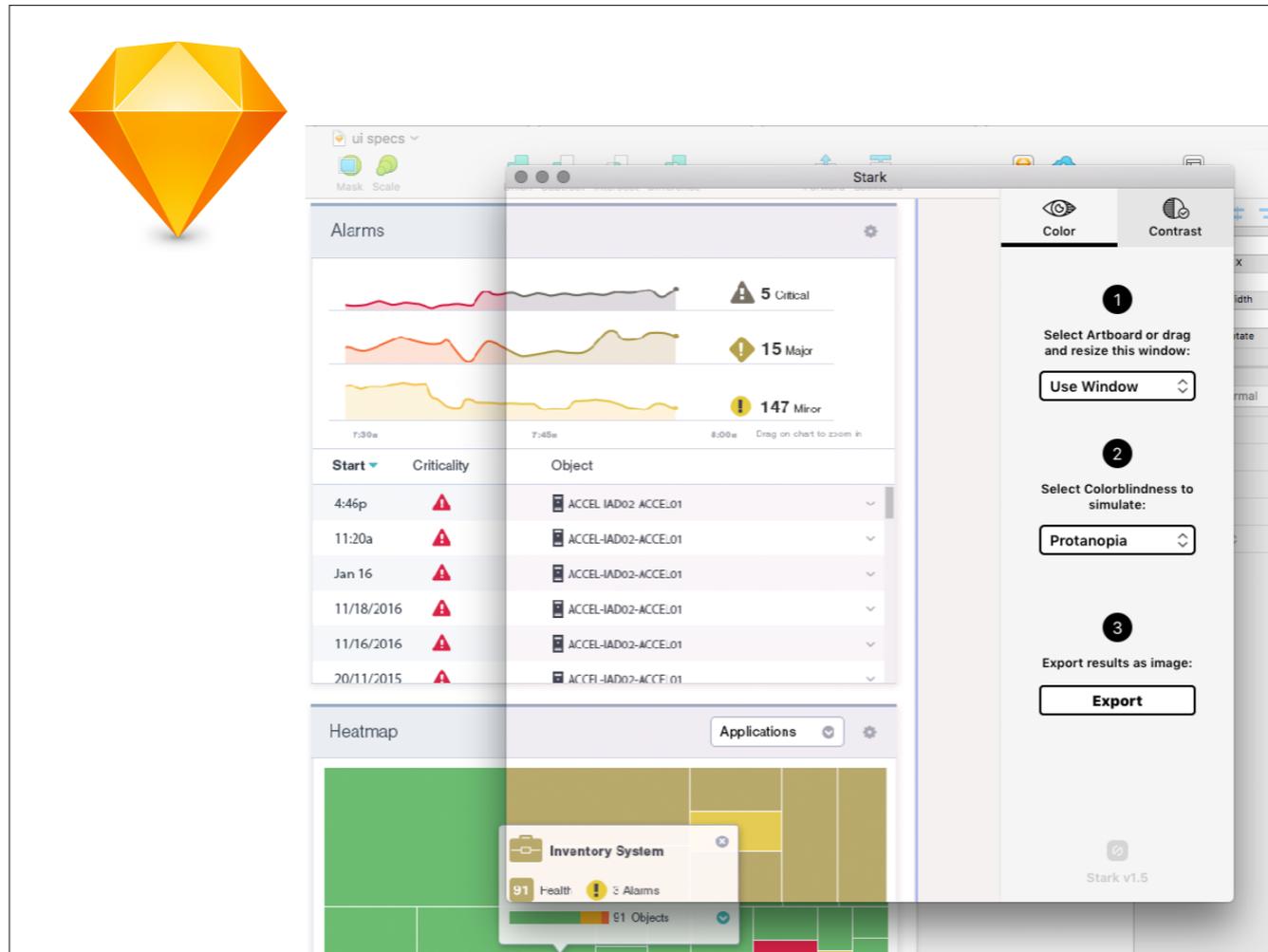
One thing I've found that is tremendously helpful:
 Plan to let your visualizations **stand out** from the rest of the page.
 Work with your visual team to establish a look **that doesn't get in the way**. For the
 elements around the visuals, neutrals with less contrast can help.



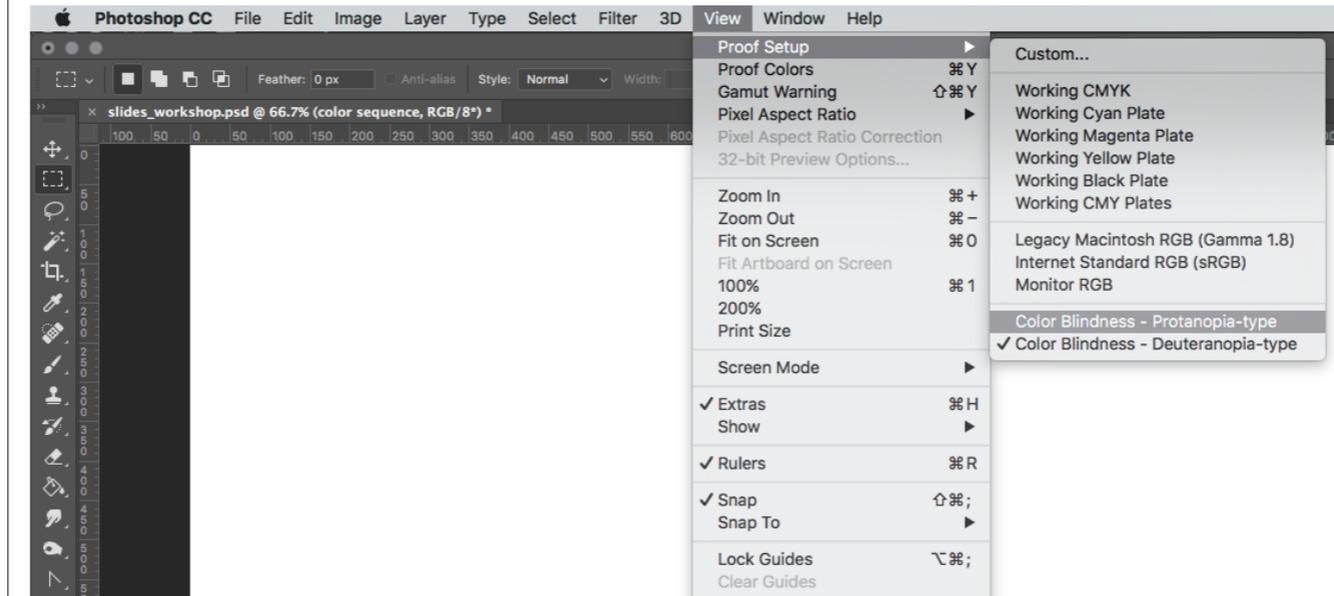
For graphs with multiple layers, you'll need a **palette of colors** that are distinguished from each other.



You'll want to look at your colors and contrast from the perspective of someone with **colorblindness**. This applies to about 10% of the population, the majority of which are males.



It's pretty easy to test it out. **If you use Sketch**, make sure you download the free Stark plug-in. It allows you to **simulate** what your design looks like to people with **many different types** of color perception issues. It also has a slick contrast check in it as well.



In Photoshop, there is a **built-in preview** for the 2 most common types of colorblindness.



Critical

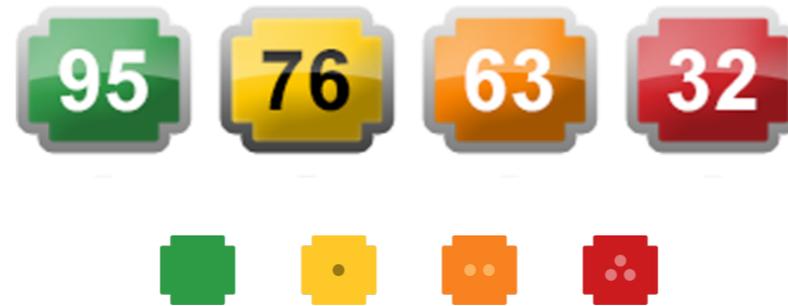


Major

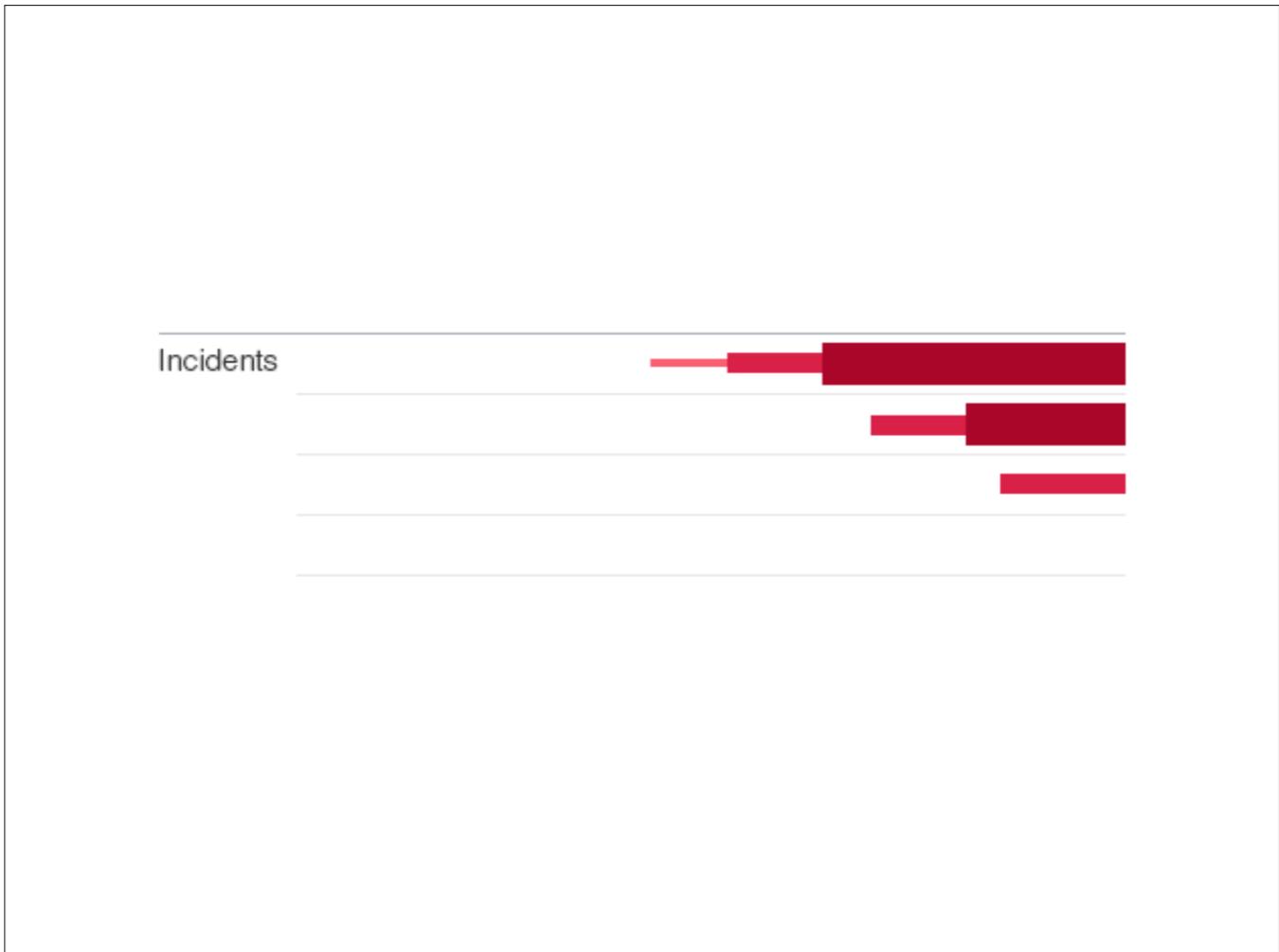


Minor

Colorblind people adapt in most cases, but one trouble spot is **status and alert color**. If you can introduce a **secondary distinction** to your icons it can make it easier to adapt for them. This is called “multiple visual encodings” if you want to get technical. In this example, **shape** also differentiates the levels of alert.



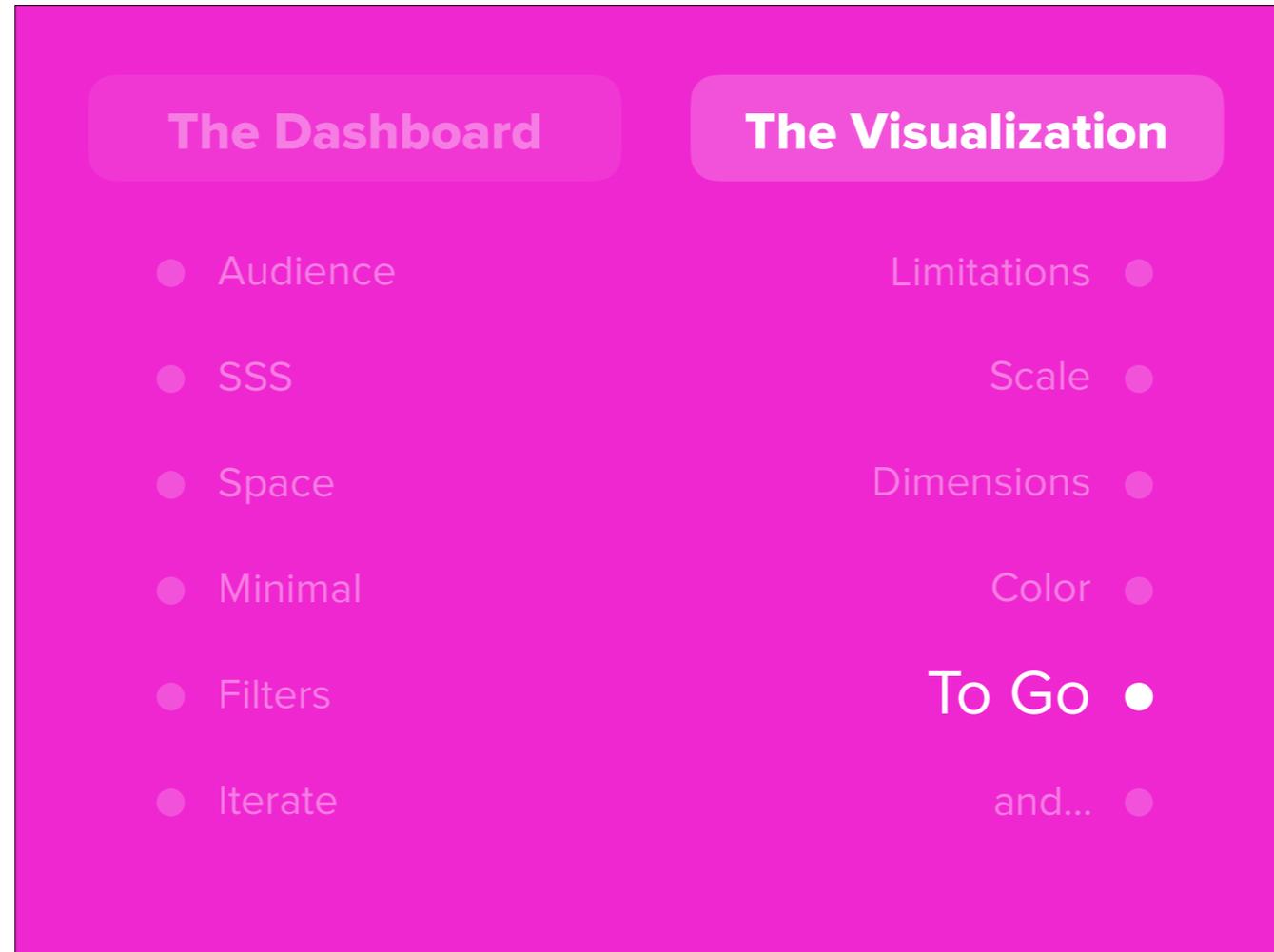
Here, **numbers** help discern what is bad and good.
And when there isn't sufficient space, **a system of dots** reinforces.



Here, these issues get progressively **darker and thicker** to indicate severity.



Another trouble spot is with heatmaps. It is common for people to have trouble discerning **red from green**. My business partner Wendy came up with a modified alternative that fares **much better** than traditional colors.



Allow users to get **value to go** from your applications.
As all of us know, there are **a zillion things** vying for our attention these days. And people are often working on the go, using all kinds of mobile devices.



I've heard more than my share of entrepreneurs wax poetic about a “**single pane of glass**”... Where all my concerns are on one screen, and users are going to look at it all day, every day. **Can you make that happen for me?**

96.7%

fail*

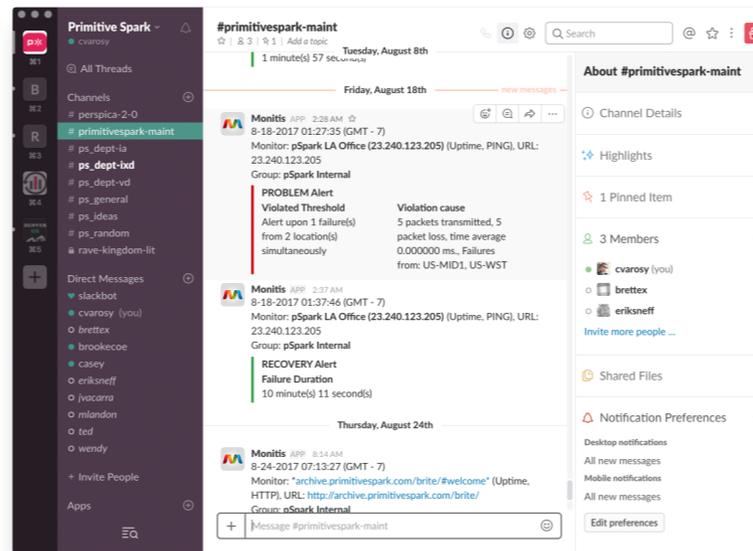
You **know where I got my research.*



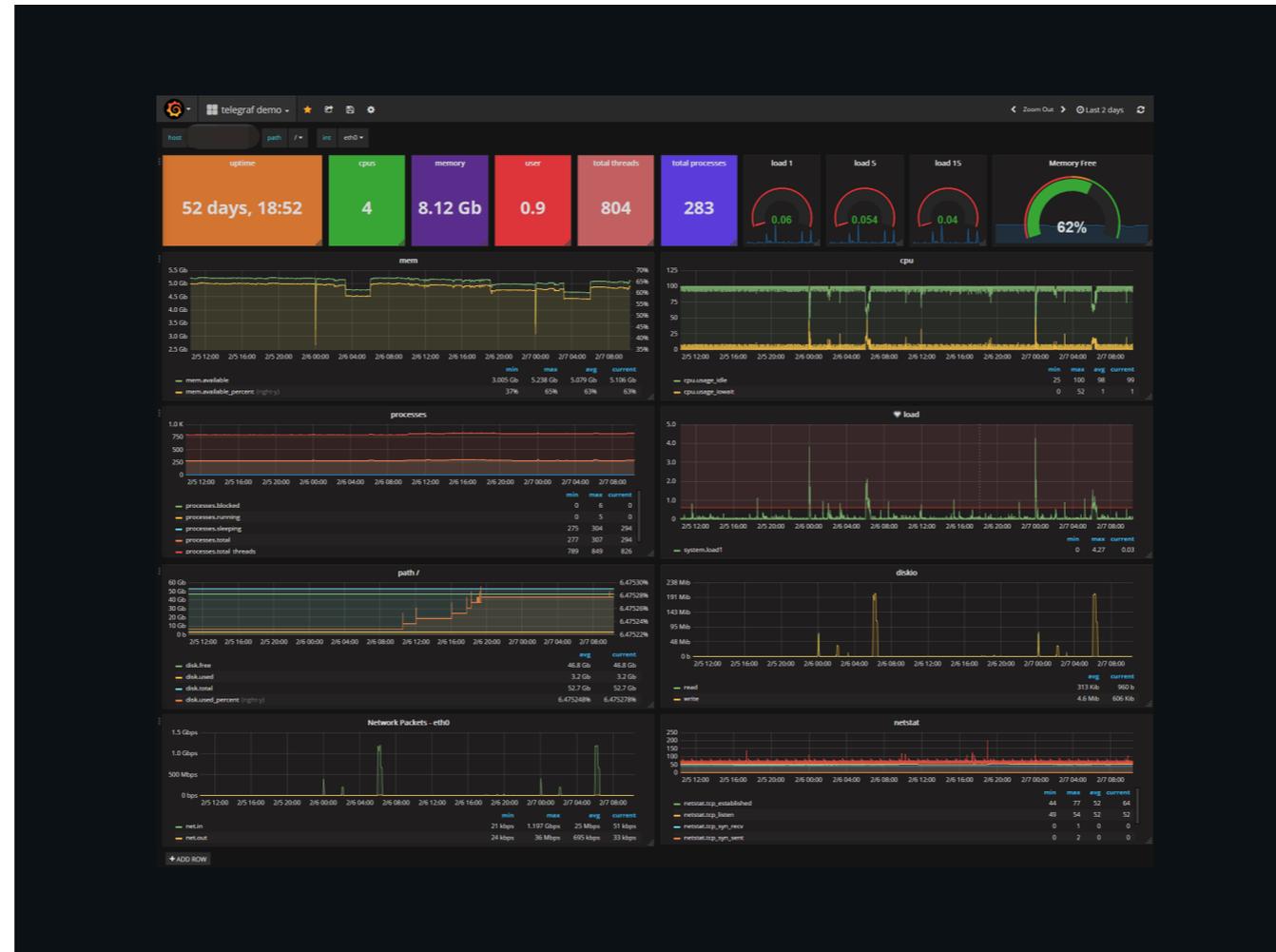
HELL no!

Studies show that 96.7% of single pane of glass projects fail to be the center of the universe. So what are we supposed to **do about it?**

I say we **take the insight on the road!**



We need to **send the value** of our dashboards and visualizations out to where users **already are**. Places like **Slack** are a great place to send alerts and in-app communication.



If there is a single pane of glass, it's probably hand-curated by your users with tools like **Grafana**. Probably has valuable information from a bunch of tools they use. So give users ways to integrate your insights into **their process**.



Email
Wearables
Social Media
Tablets
Video
Phones
News Aggregators

Tickers
SMS
Passive Displays
File Sharing
Alerting Consoles
Monitoring Apps
Calendar

Remember Ms Butler? Find out what **channels of communication** she's already consuming. Consider **infiltrating** all of them with either the insight itself or a **good reason** to click into your application for it. Make sure your hard work will be remembered and put to its intended use.

The Dashboard

- Audience
- SSS
- Space
- Minimal
- Filters
- Iterate

The Visualization

- Limitations
- Scale
- Dimensions
- Color
- To Go
- and...

♪ Don't you...
forget about me! ♪



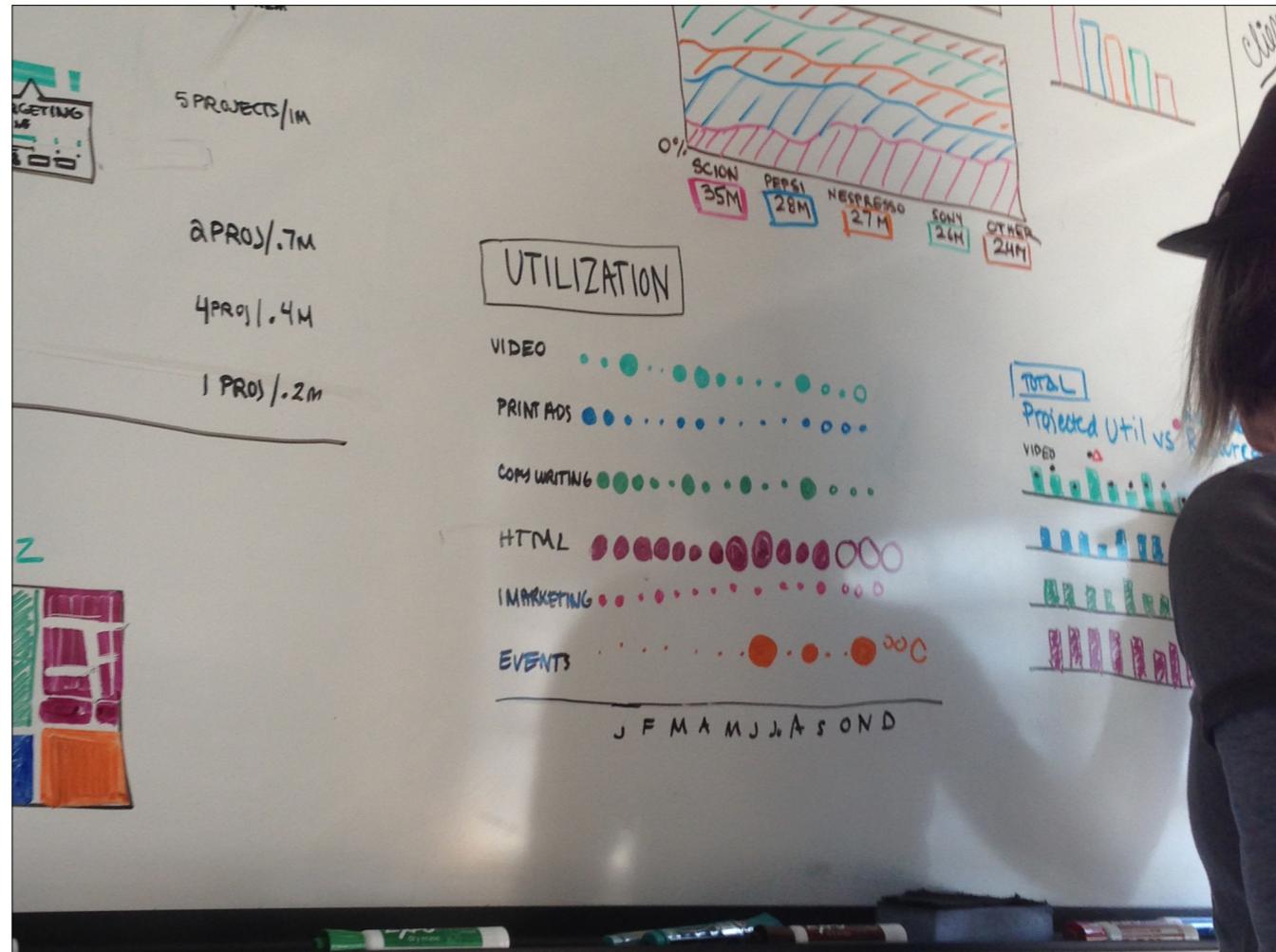
We've covered a lot of ground today. I'd like to leave you with a final thought...

Break Rules Together

You gotta break the rules if you're truly going to innovate.
People are resistant to change, but it's up to us to push the envelope.
If you **work together with your team**, you've got a much better chance for your
breakthrough **to break through**.



Data visualization is interdisciplinary! Get your team together! Your team is **across disciplines**, and includes the **client and the user**.



Partner with front end developer, do experiments early.
Gauge the extra work it will take, **know** what you're getting into. Be prepared to **justify it to the client**. Share the credit, make it a team effort.

Besides, it's more fun when you do it together!

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I'd like to thank our **sponsors** for making this conference possible. And also to the organizers of **PRDC Deliver** for inviting me to participate.

THANK YOU!

chris@primitivespark.com

 @cvarosy

Slides: bit.ly/prdc-v4a

and all of you: thank you for your time today. I'm sure there is much I can learn from you too... So I'd love to hear from you.