Seven Principles of **UX Design for Maps**

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#UWCART

Source: Katie Kowalsky

#NLCART

CREDIT: National Oceanic and Atmospheric Administration/Department of Commerce

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The Job Market

The New Cartographers

By Emily Underwood
March 18, 2013

Twenty years ago, a driver lost at night would pull his car over, take out a paper map bought at a gas station, and pore over its folds under a dim light. With luck and some critical thinking, he would eventually get where he was going. Today, he'd be more likely to swipe his finger across a smart phone screen and follow directions using Google Maps.

As maps have changed, so have mapmakers. No longer static images, maps have become active

:ontinuously

o distant satellites and suggesting where we ought to go, says Seth Spielman, a

"[F]uture shortages i
photogrammetry, an
because the number of graduates is too small
(tens to hundreds) to give NGA choices or
means of meeting sudden demand." –Future
U.S. Workforce for Geospatial Intelligence, a
report from the National Research Council

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the "New" **Cartographers**

- **425,000 US jobs!**
- **+35% by 2020**
- **2.4mil US ceiling**

Source: Science Magazine (March 2013)

CAREERS / BEST JOBS / ENGINEERING

MORE

Cartographer Overview

#3 in Best Engineering Jobs | Overall Score 6.6 / 10

the "New" **Cartographers**

Overview | Salary | Reviews and Advice | Job Openings

Job Alerts

What is a Cartographer?

Cartographers draw maps for a living. And maps are used for more than just atlases. You'll find them in newspapers, helping readers make sense of a complicated issue. You'll find them on your smartphone, giving you directions for getting from point A to B.

You might expect to find mapmakers back in the 2nd century, even the 15th and 16th centuries. Ptolemy was a cartographer. Leonardo da Vinci was one too. But you might not expect to find them in 21st century America.

And yet demand for cartographers is high. And it's really no wonder. Tanya Buckingham, assistant director of the Cartography Lab at the University of Wisconsin – Madison, says the field has seen incredible change, even in the last decade. "Since [2001], we have seen the explosion of interactive maps; the democratization of cartographic tools, cloud-based tools and data storage; print on demand; as well as the ever changing trends in screen size," she writes in an email.

For Buckingham, the discipline is the perfect intersection of her interests. There's an analytical part of the job, which involves pouring over data to find trends and patterns. And there's also an artistic part of the job, which involves visualizing that data in a design. "I enjoy the process of making beautiful graphics to explain ideas, which are better understood with visuals."

Best Engineering Jobs

#1 Environmental Engineer

#2 Mechanical Engineer

#3 Cartographer

#4 Civil Engineer

#5 Biomedical Engineer

See the full rankings list

+29%
by 2024!

Source: US News & World Report (2017)

Source: LinkedIn (January 2014)

10 hot job titles that barely existed 5 years ago

We examined over **259,000,000** LinkedIn members' profiles to determine the 10 most popular job titles that were barely on the map in 2008. Technology and fitness are the biggest drivers for these fascinating changes.

1

THE IOS DEVELOPER

Apple announced the iPhone in 2007, and 3rd party development for iOS took off in 2008 with the release of iOS 2 and the App Store.

142x growth in 5 years

THE ANDROID DEVELOPER

Google's Android platform was also announced in 2007, with the release of the first Andoid-powered handset in 2008.

199x growth in 5 years

3

THE ZUMBA INSTRUCTOR

Zumba started in the early 2000's and quickly gained traction in 2007 as fitness centers started popping up all over the US.

396x growth in 5 years

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396x growth in 5 years

9

THE CLOUD SERVICES SPECIALIST

Salesforce.com and Amazon were the 2 companies that introduced cloud computing to businesses throughout the early 2000s. The stark contrast in the number of jobs shows how popular and reliable cloud services have become.

7

THE BIG DATA ARCHITECT

Although it's been around for at least 2 decades, the concept of big data took off around 2008. That year, the Computing Community Consortium published a white paper which propelled the term into the limelight.

3,440 x growth in 5 years

5

THE DATA SCIENTIST

Our digital lives have created an overwhelming flood of information. In the last 5 years, data scientists have come to the rescue by trying to make sense of it all.

30x growth in 5 years

THE UI/UX DESIGNER

User interface and user experience designers focus on making our technology pleasant and intuitive to use. Seeing as our lives depend on interacting with technology, it's no small wonder UI/UX designers are in hot demand.

22x growth in 5 years

the "New" **Cartographers**

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Transforming Essential GIS Skills

by Bern Szukalski on August 1, 2013

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Over the years GIS has grown to cover a very broad horizon. It's no longer the domain of specialized departments; instead it has become deeply woven into an organization's fabric and extends to a very public and connected audience. The fact that we think differently today than in the past about how we use–and perhaps more importantly how we *can* use–GIS reminds us that we need to continue to evolve our skills

first job.

A recent e-mail f

me thinking abou

their GIS job pro

realized that whe

usually anticipate

prowess. Even c

mashups, slippy

case where the technology of the day dictates the habits and expectations of consumers of geographic information, and also the corresponding requirements for today's GIS professional. Here's what I've come to understand are sought-after skills.

Design and User Experience

Even the best functionality or information can't be appreciated or effectively used behind a poorly designed website or app. The user experience (UX), and design of compelling apps and websites, is a key factor in reaching a target audience, and how that audience perceives the information presented. It doesn't matter whether it be a long-time resident in a city trying to find the office to pay a late bill, or a community activist looking to push the envelope by hacking with data the city's GIS has provided. What you deliver must be compelling and friendly. Lots of GIS organizations are challenged with a lack of design and UX talent.

Design and User Experience

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Director, Utility Solutions

Helen Thompson
Esri Director of Commercial Marketing

Bern Szukalski
Esri Product Manager and Technical Evangelist

Andrew Turner
CTO, Esri R&D Center, Washington, D.C.

What do you want to discuss next?

Source: Esri Insider (August 2013)

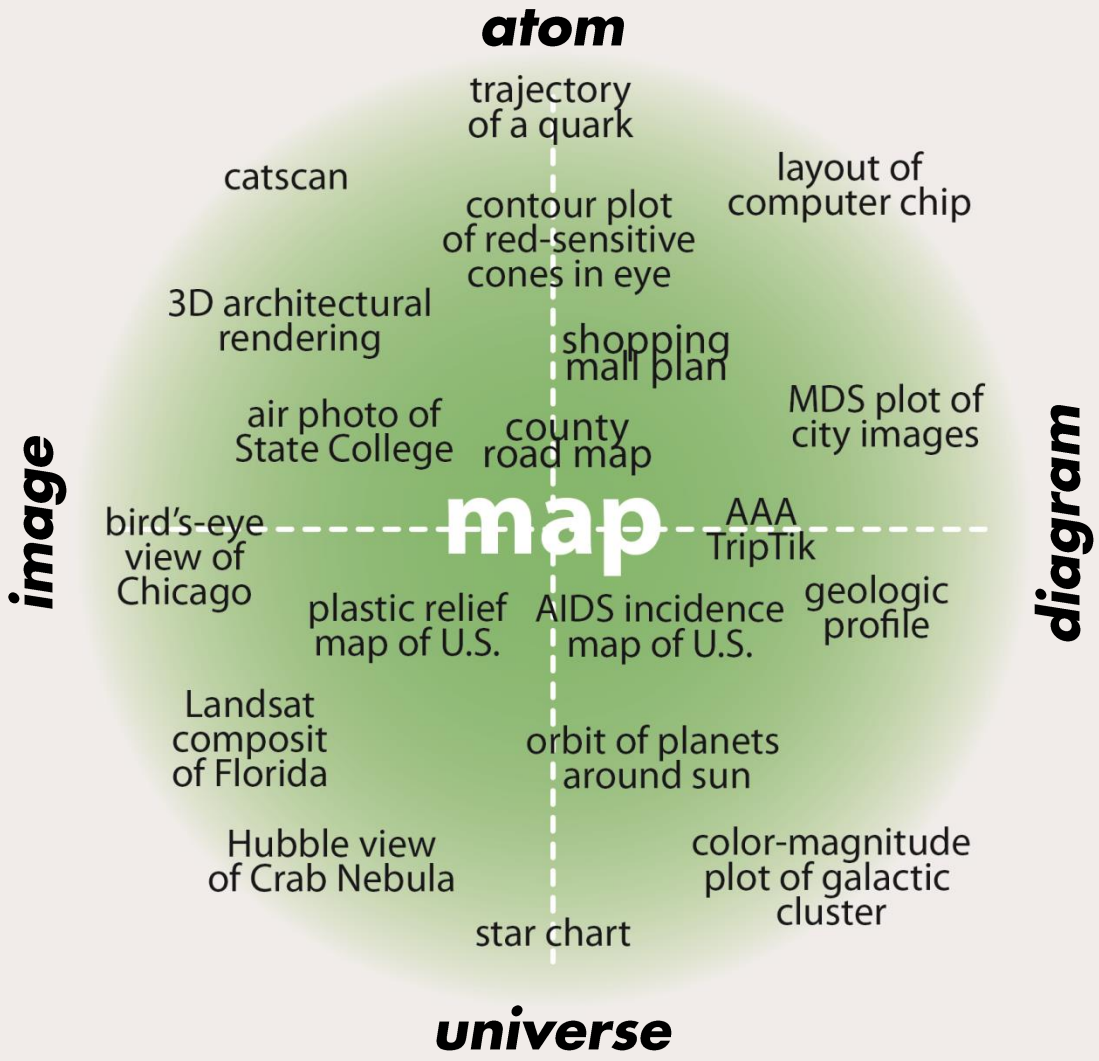
Seven Principles of **UX Design for Maps**

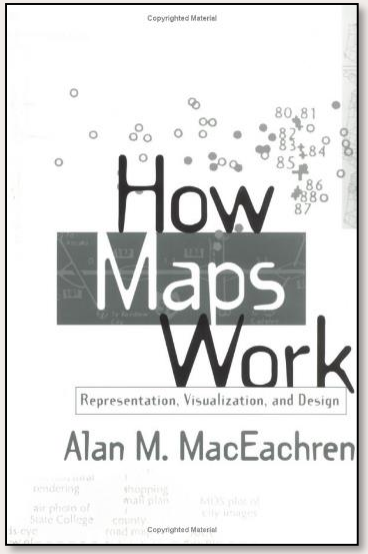
1. Cartography includes both **representation** and **interaction** design!
2. Representation and interaction **design** share design principles, are **synergistic**!
3. We **use** interfaces, but **experience** interactions; it's the **UX** that matters!
4. User **goals** inform **when?** and **how much?** interactivity is needed!
5. User **objectives** translate abstract goals into specific **geographic insights**!
6. **Operator** requirements are determined/evaluated by user **objectives**!
7. Appropriate mapping **technology** is determined by **operator** requirements!

Think of a <u>map</u>!

What was the first map that came to mind?

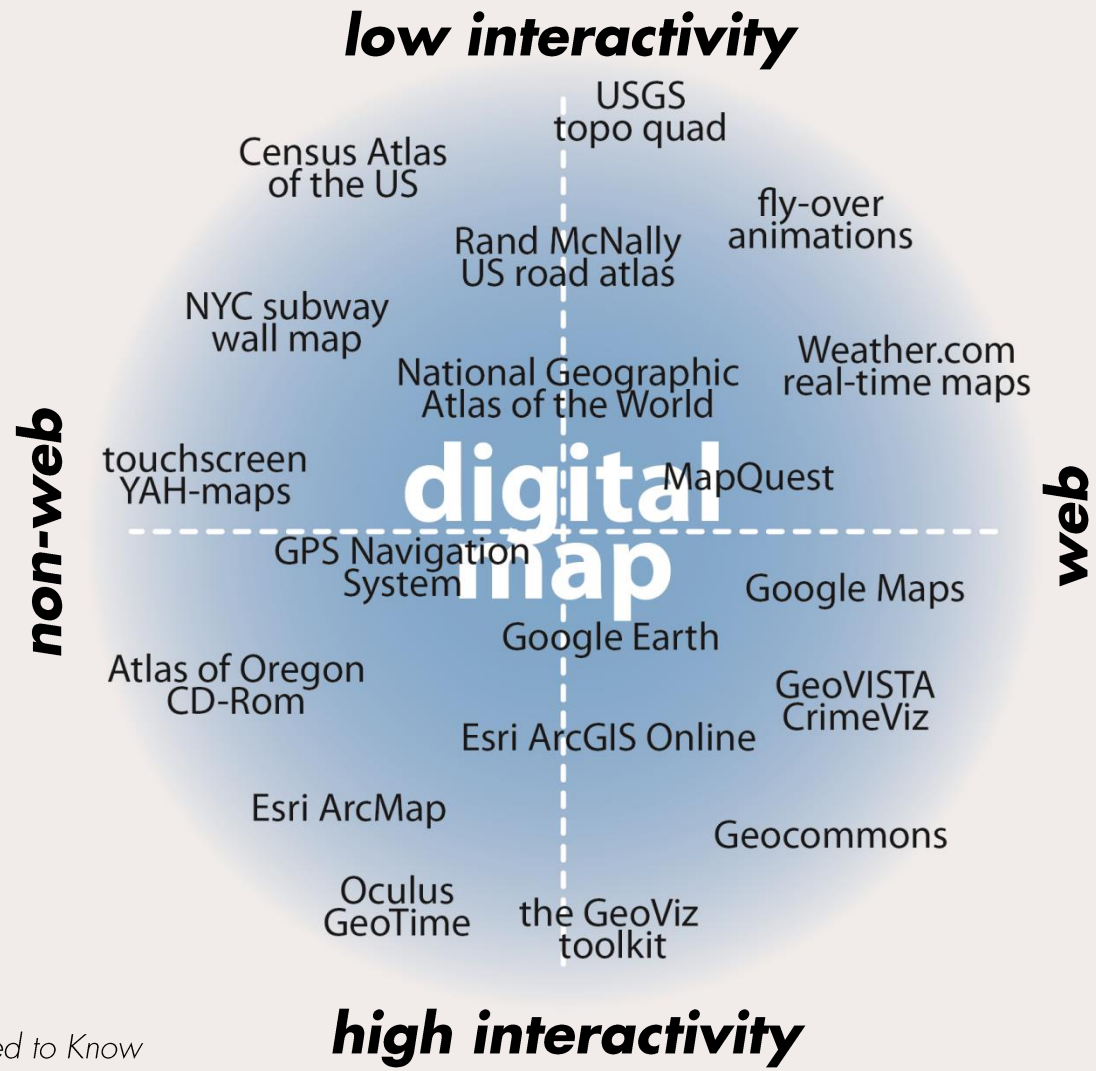
Scale vs. Abstraction





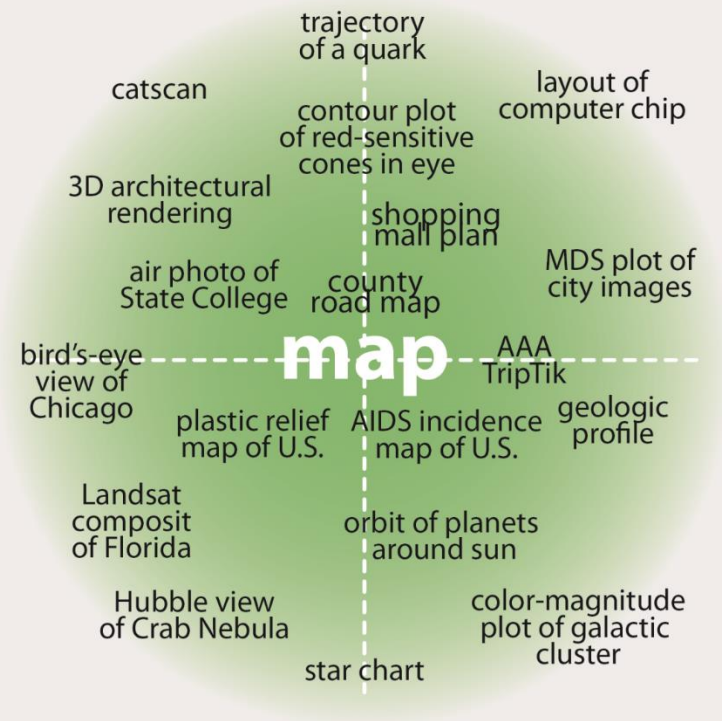
Source: MacEachren (1995) *How Maps Work*

Web vs. Interactive



Source: Roth (2013)
Interactive Maps: What We Know & What We Need to Know

1. Cartography includes both **representation** and **interaction** design!



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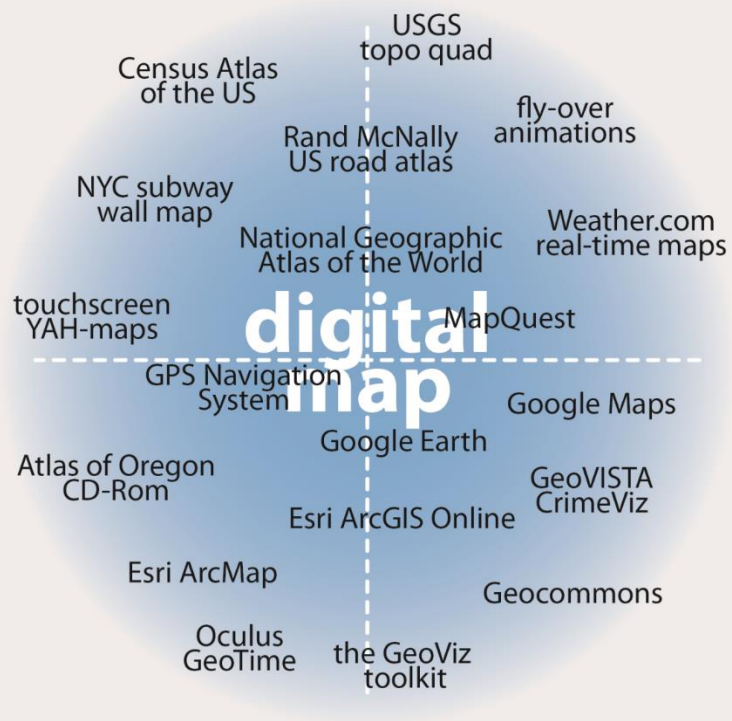

2. Representation & interaction **design** share design principles, are **synergistic**!

"promote communication clarity"

"promote transparent usability"

"maximize information density"

"optimize system utility"

"develop a strong visual hierarchy"

"develop strong affordances & feedback"

"properly manipulate the visual variables"

"properly implement the interaction primitives"

Source: Roth & Harrower (2008); https://lakeshorepreserve.wisc.edu/imap/LakeshoreNaturePreserve.html

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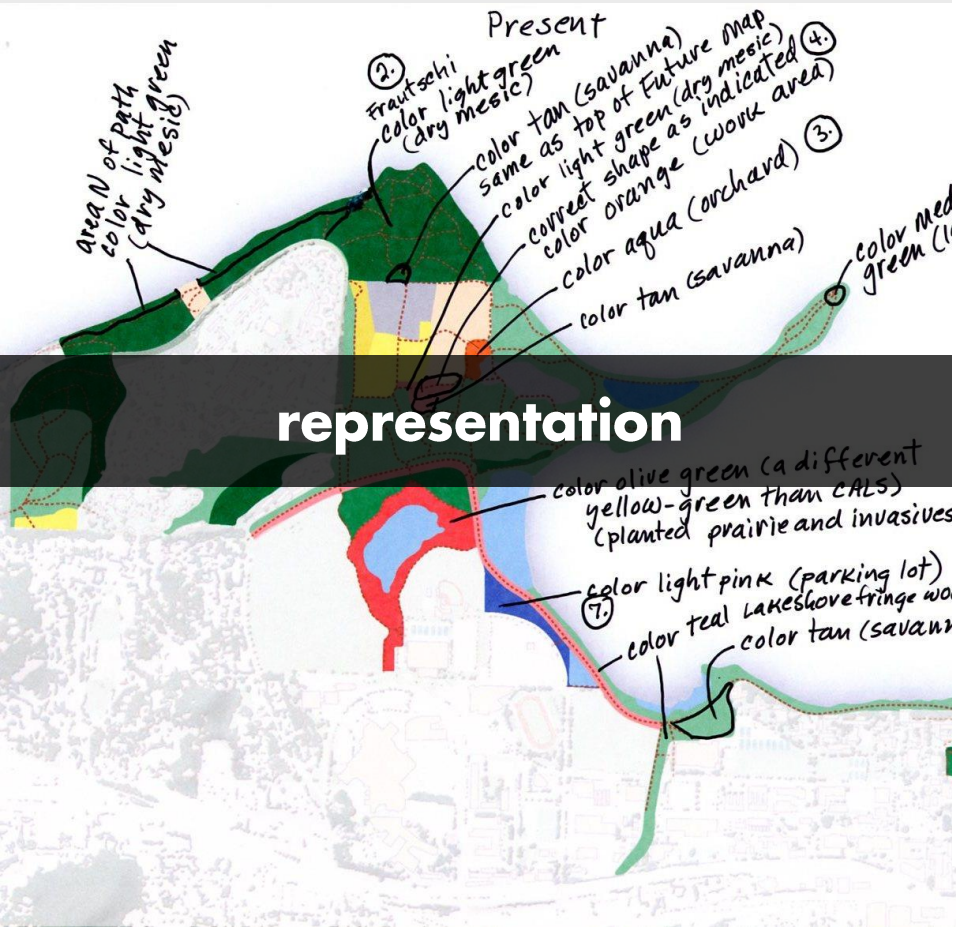
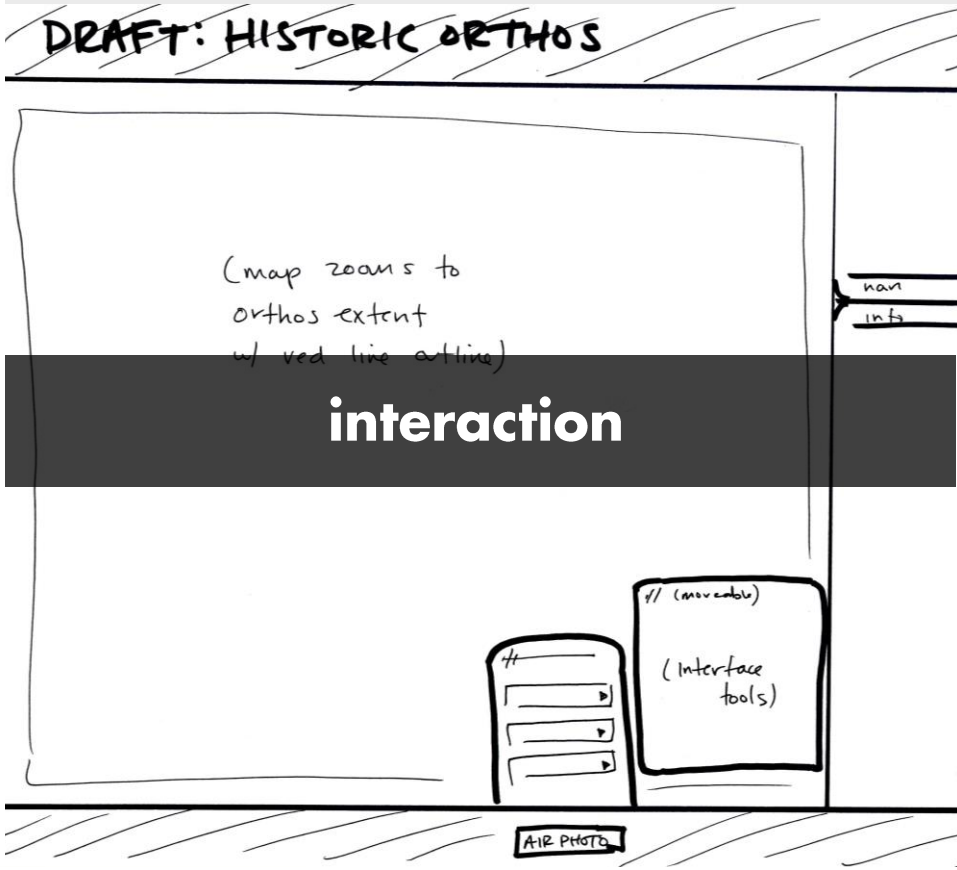


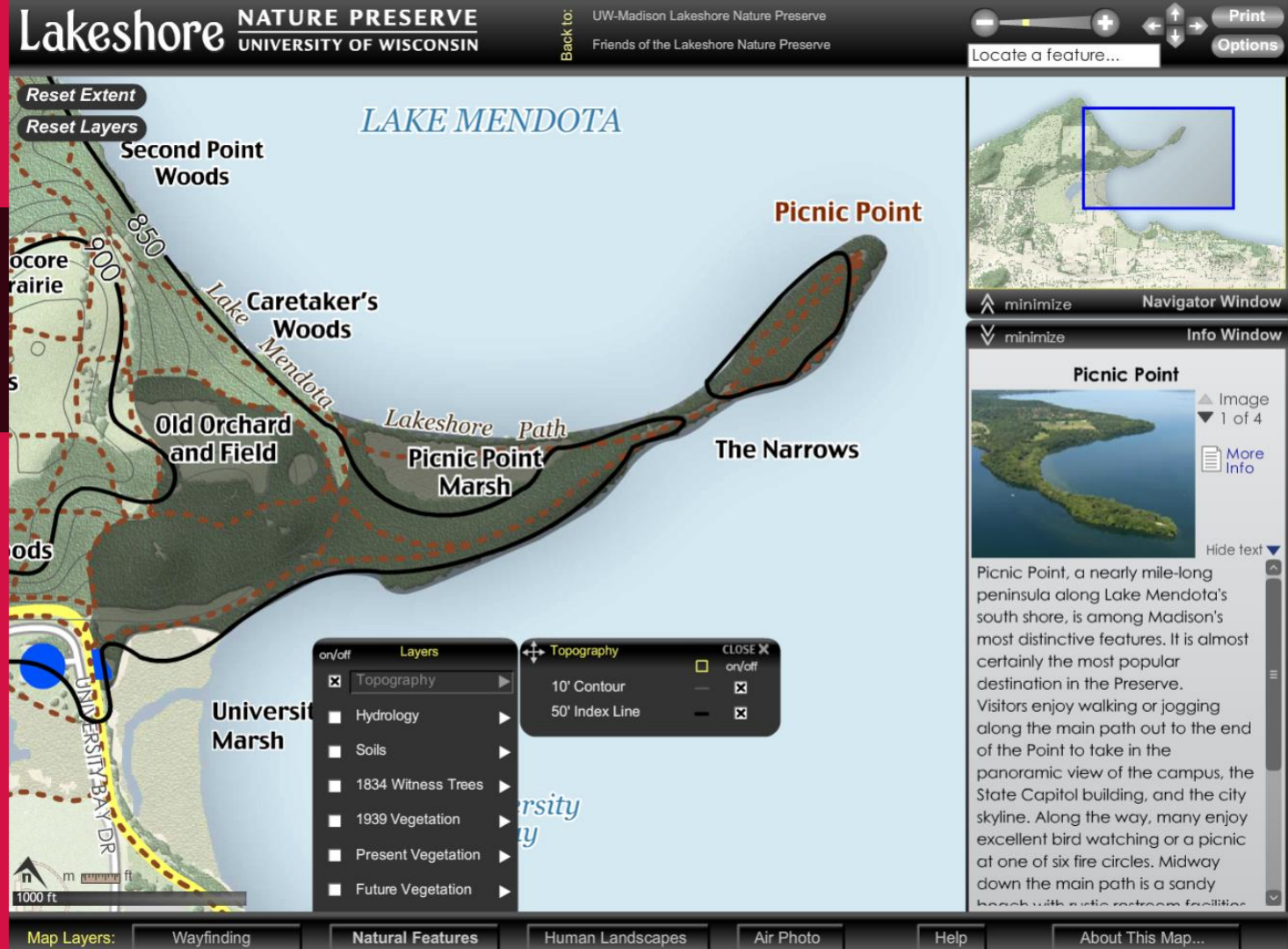
representation



interaction

Source: Roth & Harrower (2008) *Addressing Map Interface Usability*

#protip
avoid lorem ipsum map design!



Source:
Roth & Harrower (2008)

UI = user interface

UX = user experience

Designer = sketcher + tinkerer + evaluator

UI = user interface

UX = user experience

Designer = decider of how it “works”

3. We **use** interfaces, but **experience** interactions

Maps

Source: Roth (2012) *Cartographic Interaction Primitives: Framework & Synthesis*

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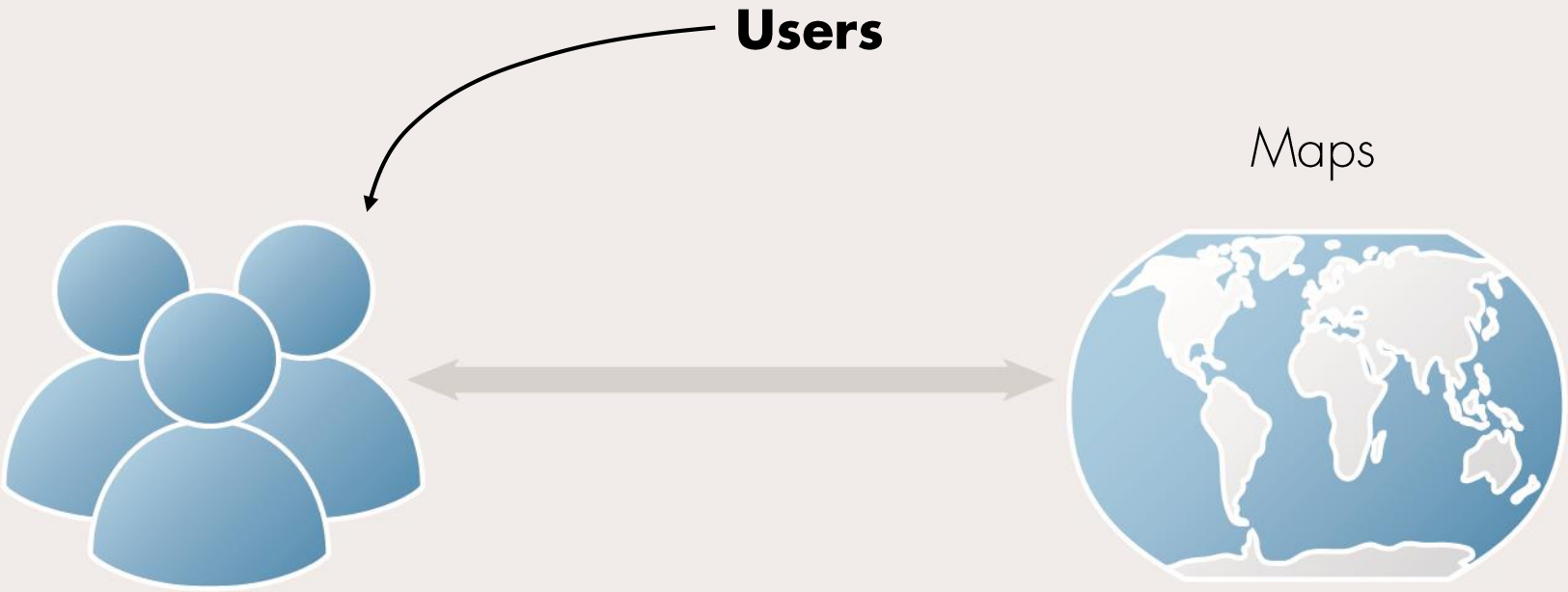

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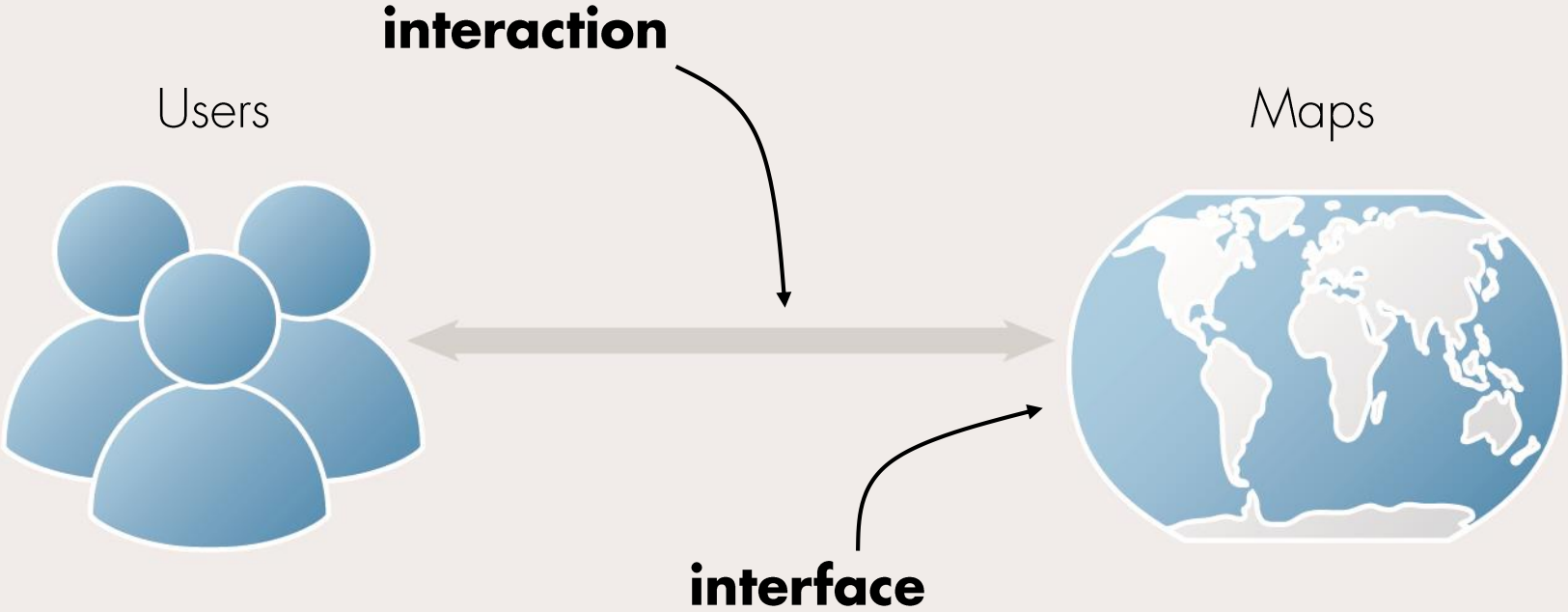
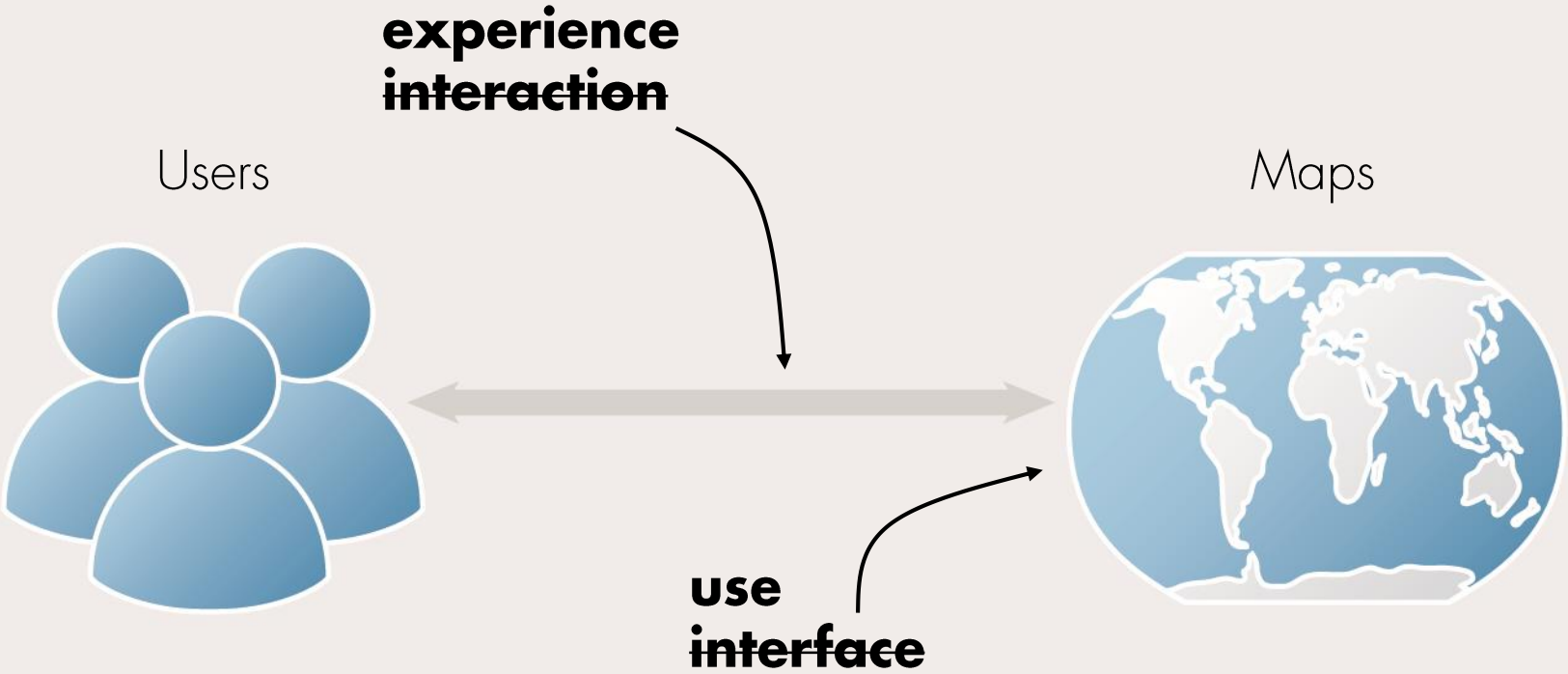


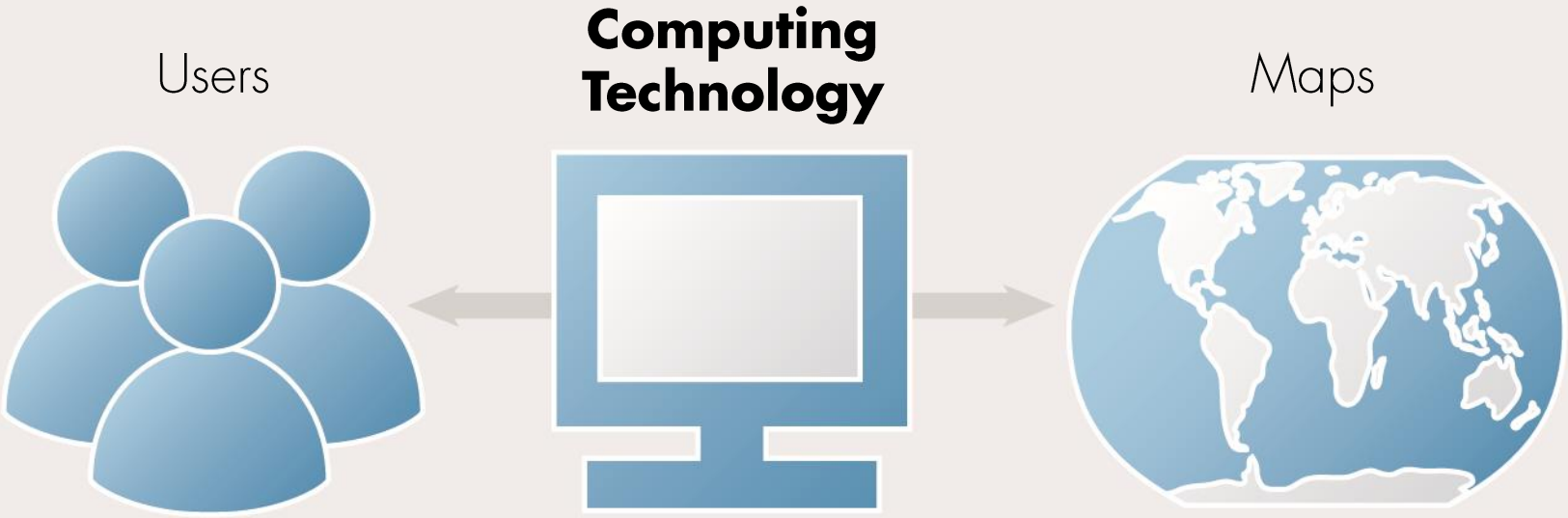
Source: Roth (2012) *Cartographic Interaction Primitives: Framework & Synthesis*

3. We **use** interfaces, but **experience** interactions; it's the **UX** that matters!



Source: Roth (2012) *Cartographic Interaction Primitives: Framework & Synthesis*

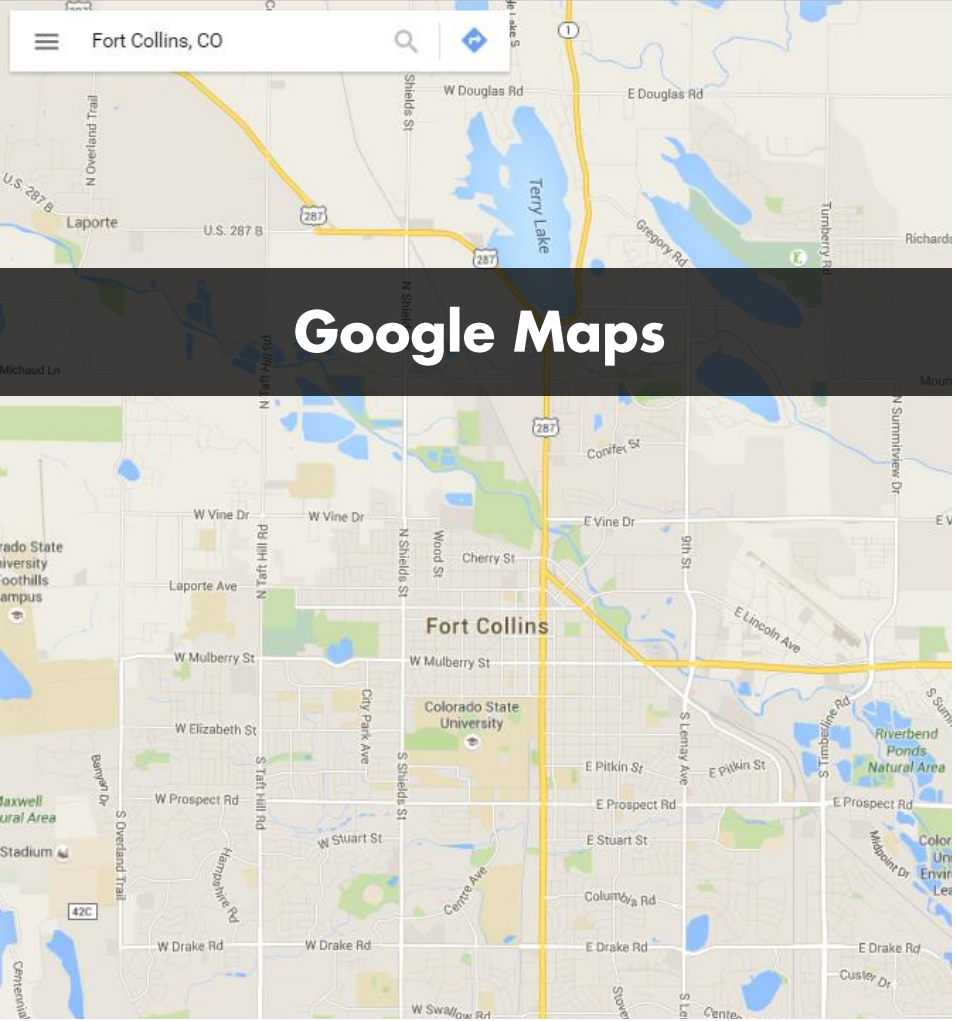
#protip (most) users don't care about the technology; they just want it to **work**!

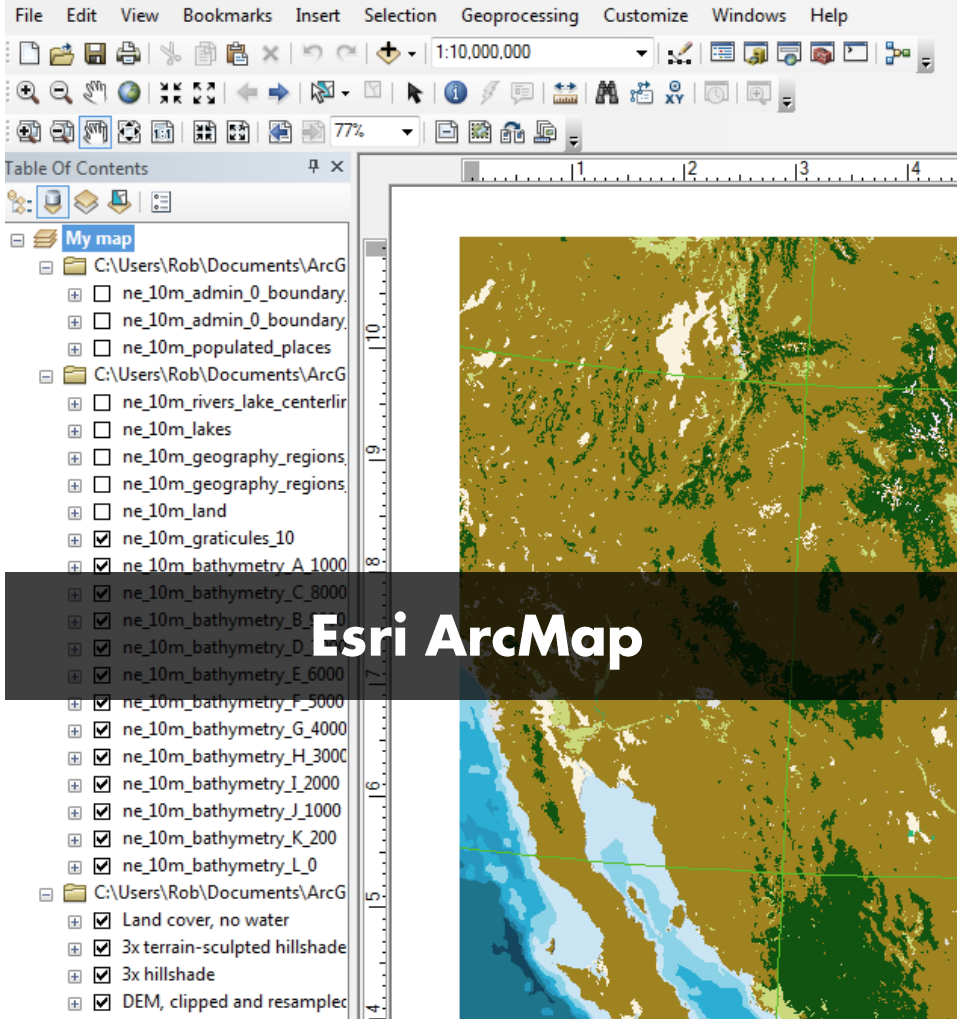


Source: Roth (2012) *Cartographic Interaction Primitives: Framework & Synthesis*

User Goals

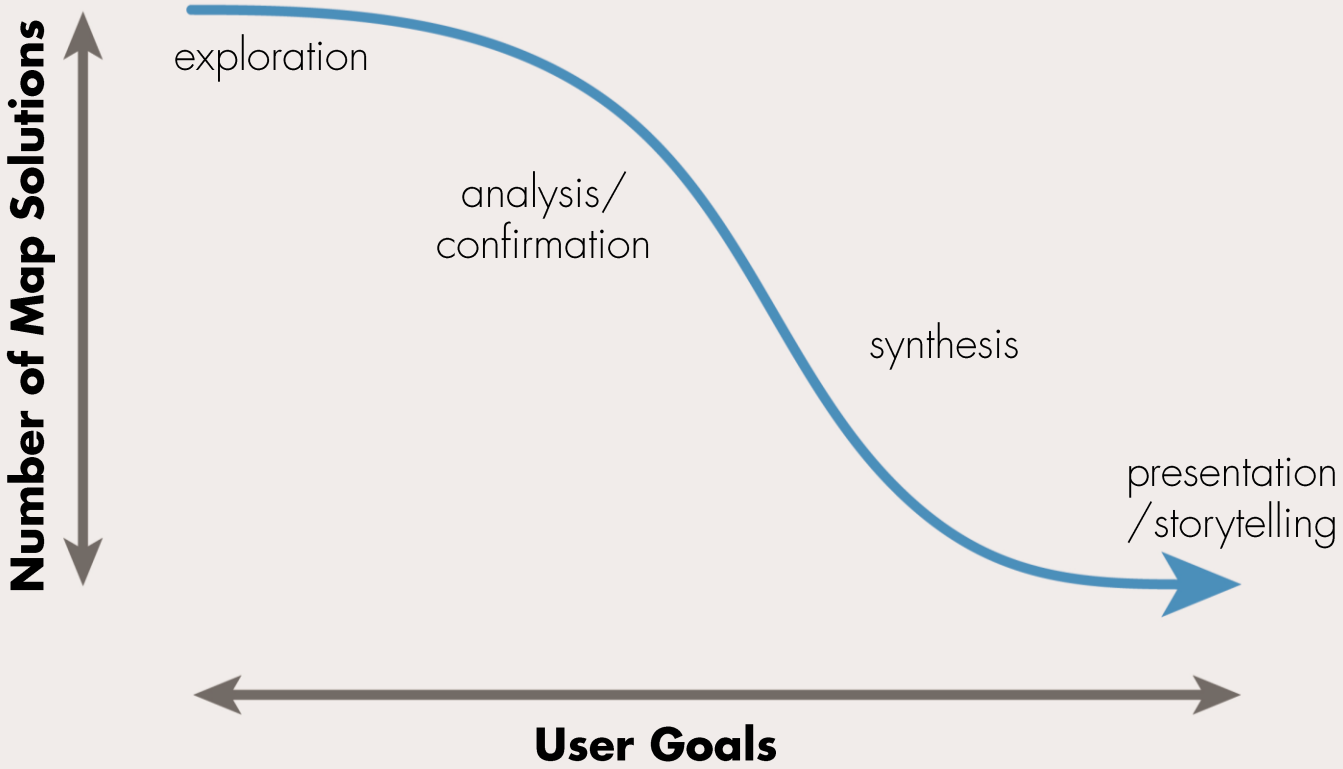
broad, ill-defined needs motivating design and use of the interactive map





Source: Roth et al. (2015) *User-centered design for interactive maps*

4. User **goals** inform **when?** and **how much?** interactivity is needed!



Source: DiBiase (1990) *Visualization in the Earth Sciences*

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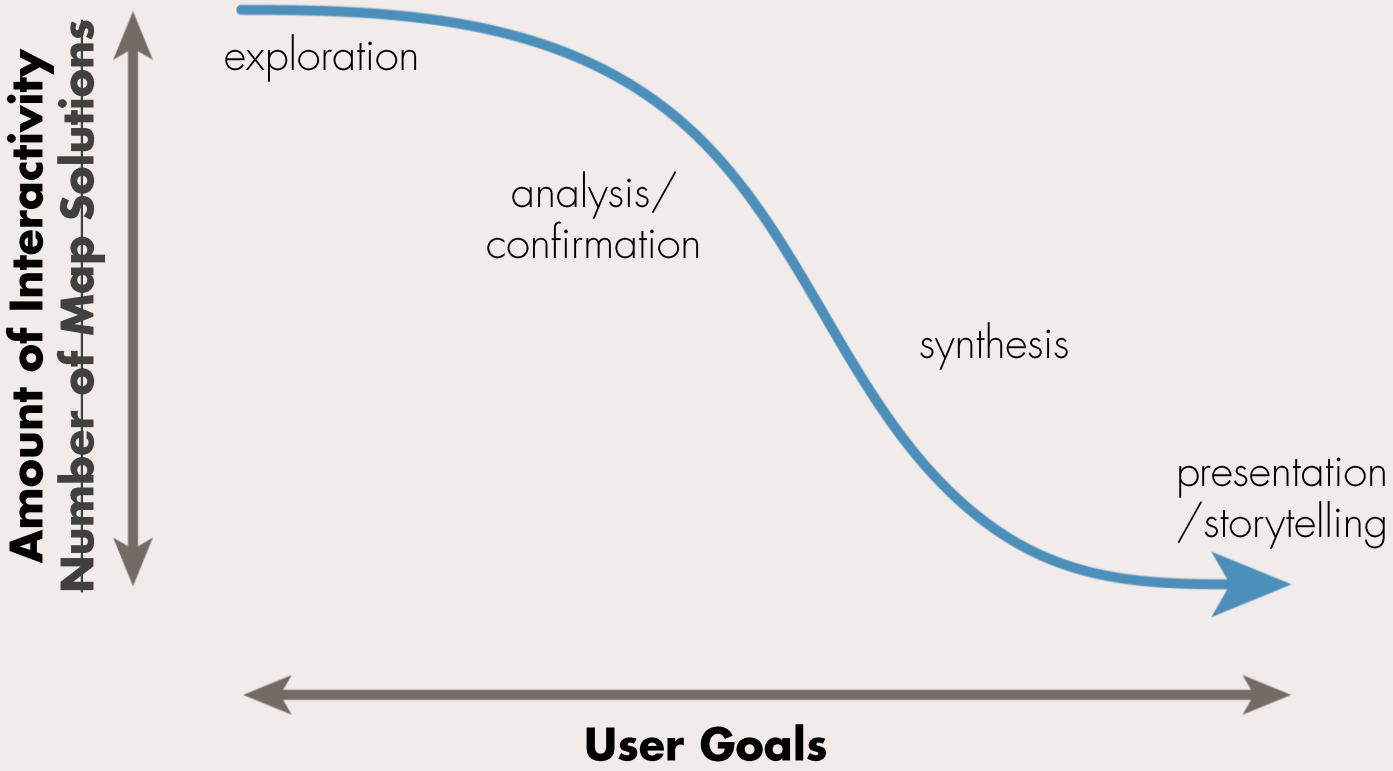

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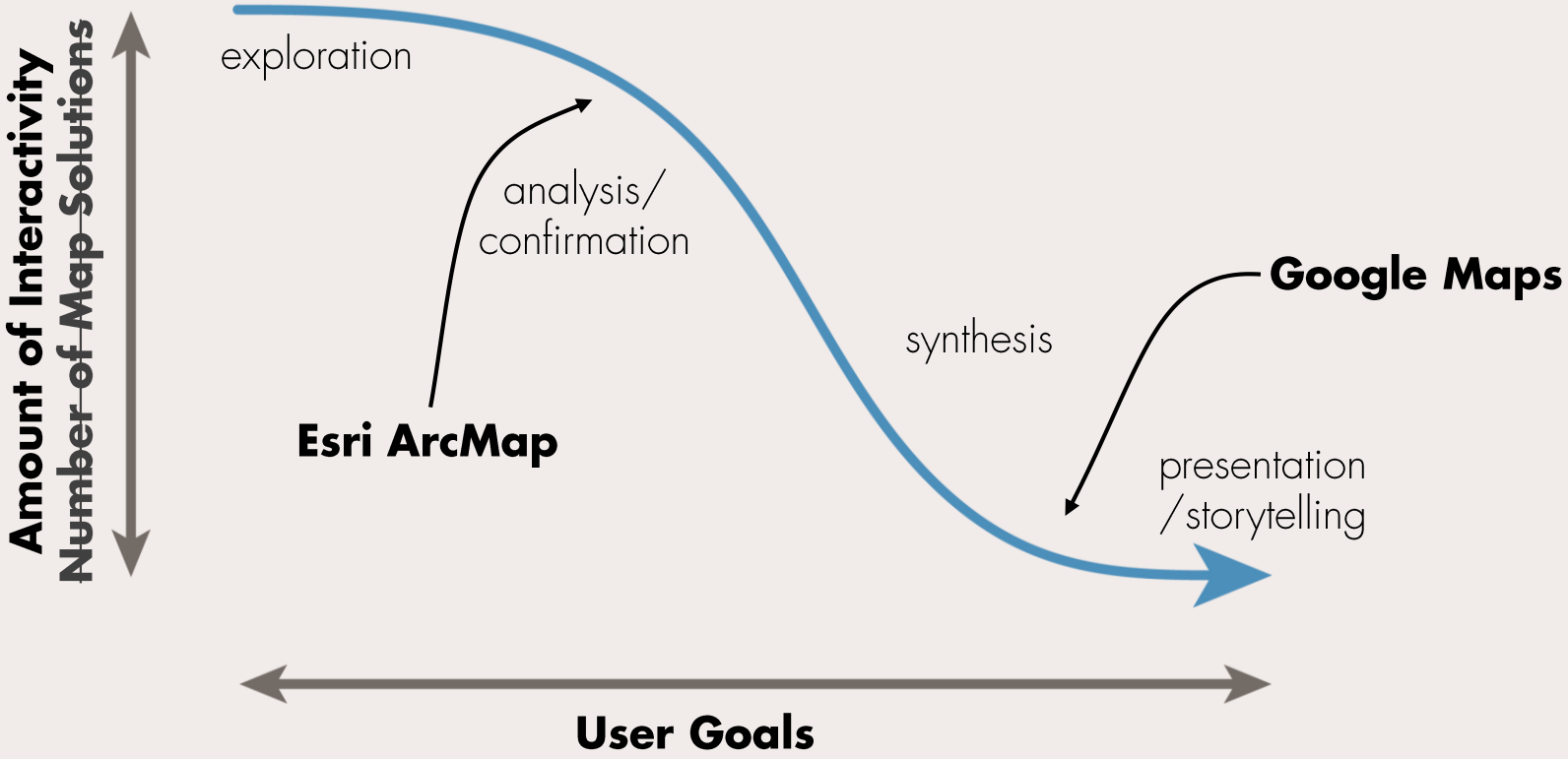
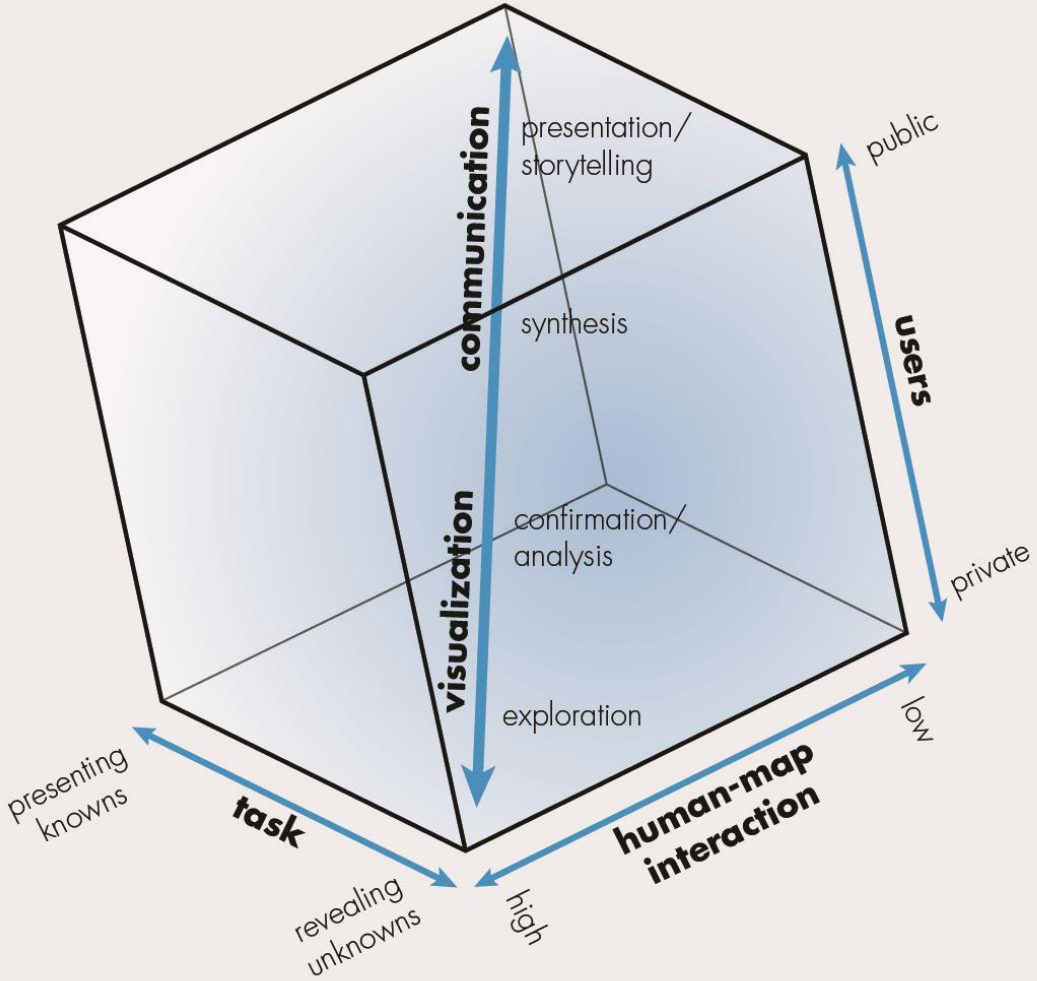


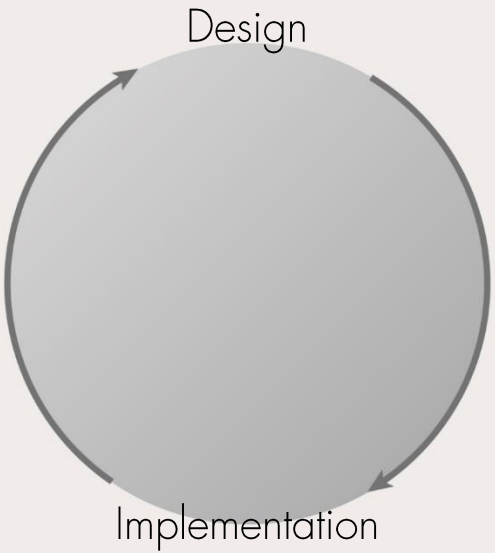
Source: DiBiase (1990) *Visualization in the Earth Sciences*

#protip
interaction follows user & use context

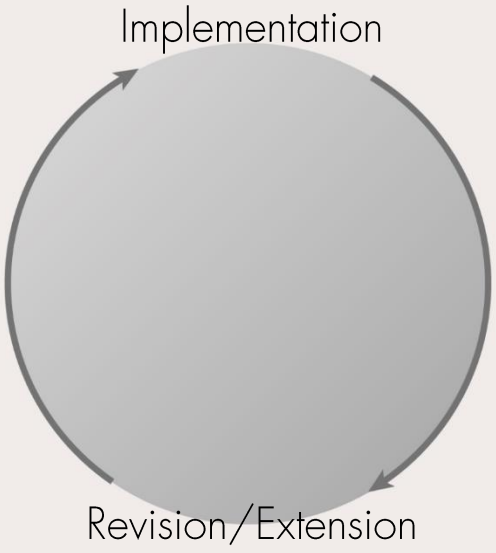


Source: MacEachren & Kraak (1997) *Exploratory Cartographic Visualization*

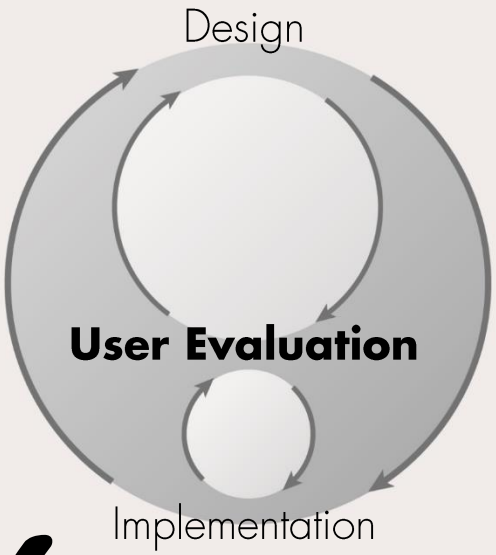
#protip follow user-centered dev cycle to seek user input early and often



X **Ideal Dev Cycle**



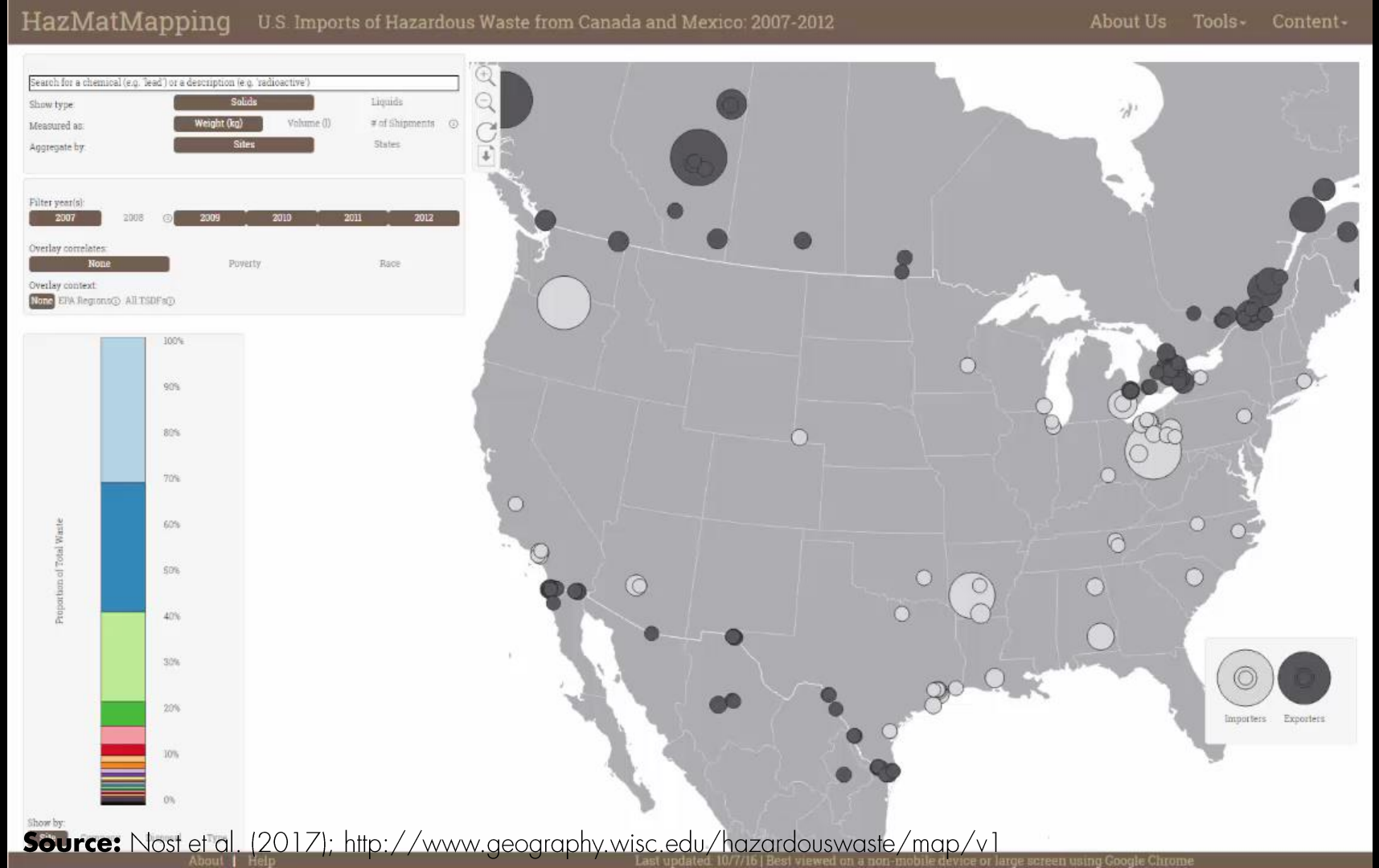
X **Standard Dev Cycle**



✓ **User-Centered Dev Cycle**

User Objectives

specific, well-defined questions that generate geographic insights



Source: Nost et al. (2017); http://www.geography.wisc.edu/hazardouswaste/map/v1

Think of a question you can answer with this map.

5. User **objectives** translate abstract goals into specific **geographic insights**!

Identify
examine a single map feature

Compare
determine similarities/differences between two map features

Rank
determine the order or relative position of 3+ map features

Associate
determine the relationship between two or more features

Delineate
organize map features into a logical structure

increasing difficulty

5. User **objectives** translate abstract goals into specific **geographic insights**!

Identify	ID, locate	find in space (where?)	find attribute (what? or who?)	find in time (when?)
Compare	change, difference, similarity	distance between bearings, distances, extents, or shapes	difference between values (numerical); same or different type (categorical)	difference in time lengths, composites, or resolutions; change
Rank	anomaly, outlier	order by nearer/farther	order by most/least, best/worst	order by first/last
Associate	cause-effect, correlation, trend	strength of connectedness; routing/topology	correlation between variables	trend across time; cause/effect
Delineate	cluster, hotspot, spike	division into distinct regions; clustered/disperse	division into distinct categories according to attribute values	division into distinct periods; spikes/troughs

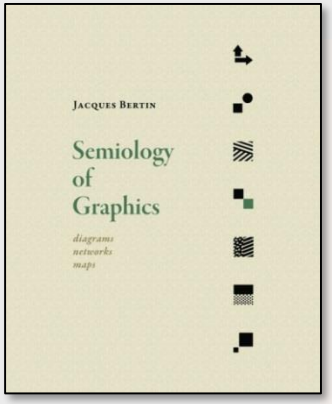
pro tip!
use objectives for personas & scenarios

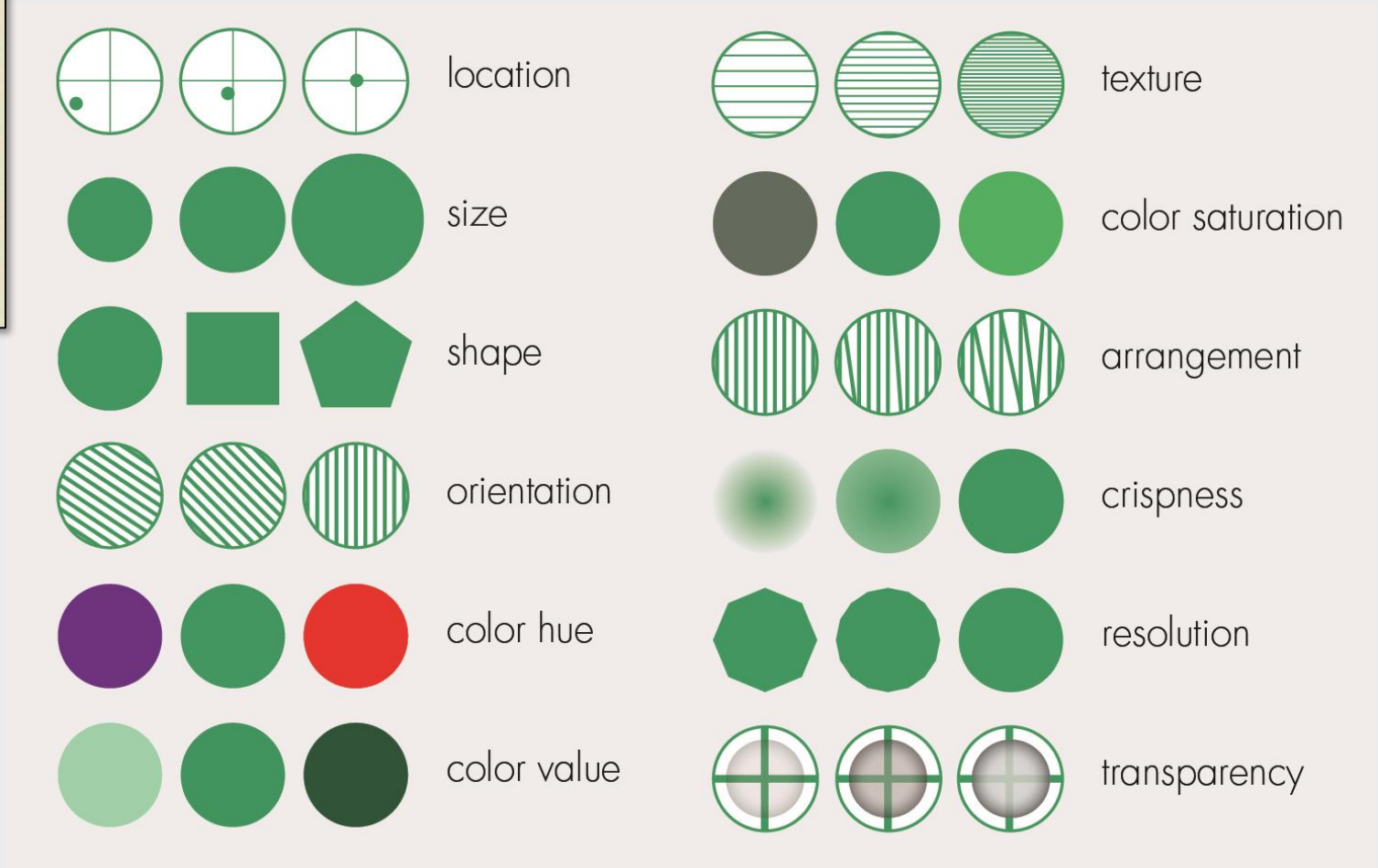
Use Case Scenario #1: US EPA Permit Manager

Upon arriving at HazMatMapper, the permit manager is greeted with a site-level overview using proportional symbols to depict the import volume of solid waste at each site in the United States. She begins visual analysis by looking for regional level **anomalies** of solid waste imports and **ranking** Region 6 against other EPA regions. From the proportional symbol map, she assesses that Region 6 **ranks** second largest by concentration of solid hazardous waste imports after Region 5 (covering the Great Lakes). She then zooms into her region by double-clicking the map. Looking at the map, she can see that there is one site in Arkansas that is an **outlier** of solid hazardous waste importing across the country. The permit manager hovers over this site to identify it by name: Alcoa Reynolds Metal Co., Gum Spring Plant. She then clicks on the proportional symbol to view the flows of waste to this site. The resulting flow lines show heavy trade with the Arkansas site and several export sites in Quebec, Canada. This **anomaly** surprises the permit manager: given her jurisdiction in the south-central US, she expected most of the waste to come across the US-Mexico border

Interface Operators

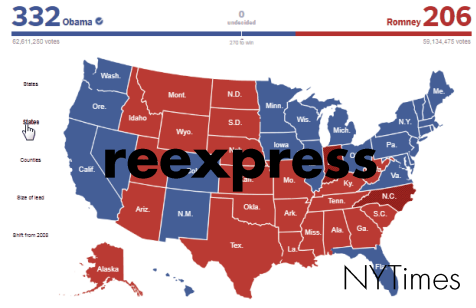
generic building blocks of a user interface; functional map requirements

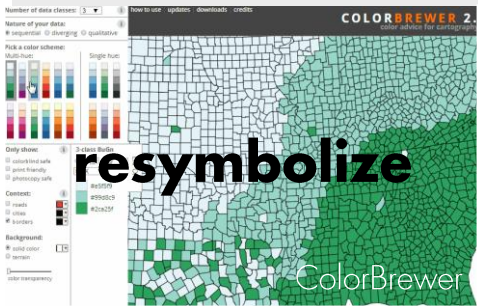


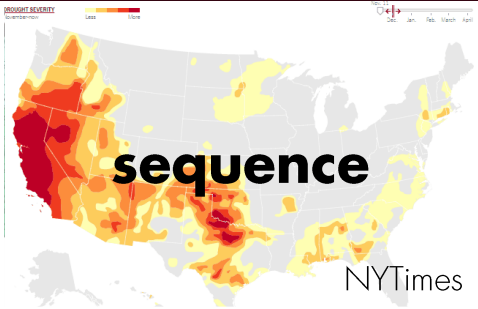


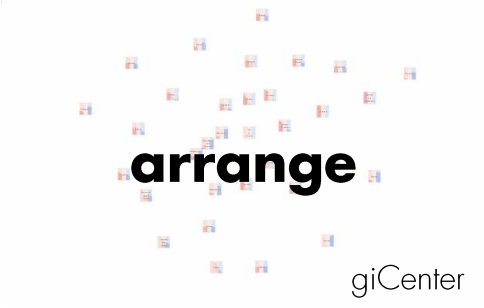
Source: Bertin (1967) *Semiology of Graphics*

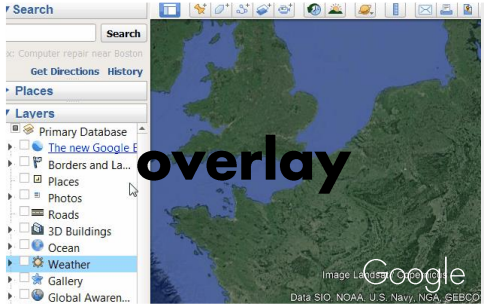
6. **Operator** requirements are determined/evaluated by user **objectives**!

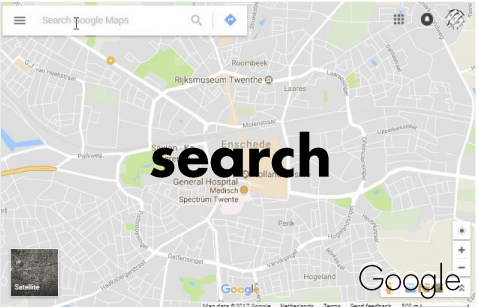


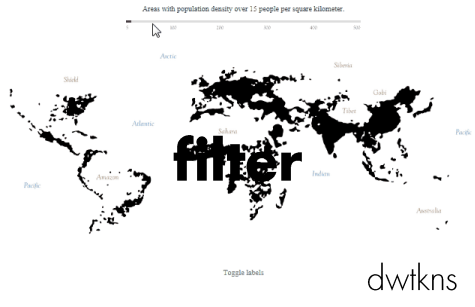


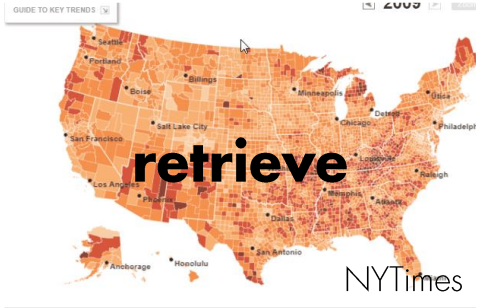








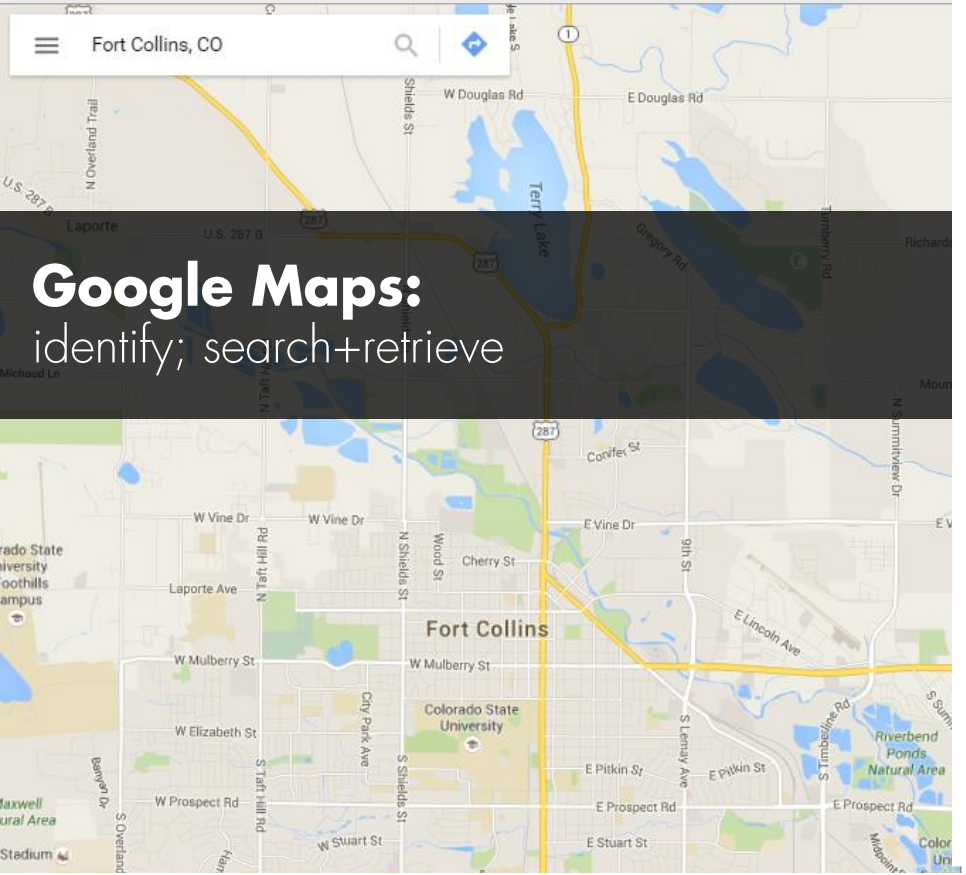




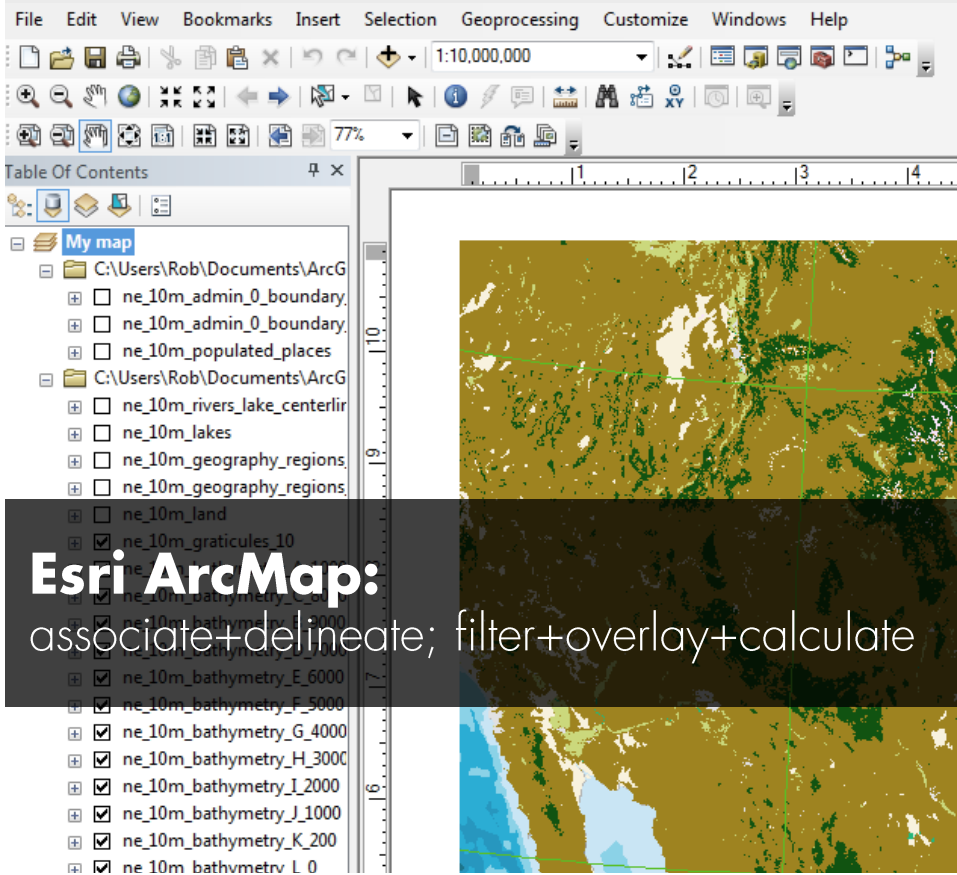
GeoFort!

velocity
variety
volume
new insights
Overvallen voorkomen...
HINDUISM
JUDAISM
BUDDHISM
CHRISTIANITY
ISLAM
BUSINESS INSIDER
1920
Als ons water stijgt
Ga je weg of blijf je?
NORSE

6. **Operator** requirements are determined/evaluated by user **objectives**!



Google Maps:
identify; search+retrieve



Esri ArcMap:
associate+delineate; filter+overlay+calculate

Source: Roth et al. (2015) *User-centered design for interactive maps*

Your Body, (Not) Your Choice

Map Analysis About

Since the landmark Supreme Court decision Roe v. Wade in 1973, which legalized abortion throughout in the U.S., states across the country have slowly chipped away at this federally protected right. We are here to tell this story.

Report Card

Prohibited At

Mandated Counseling

Waiting Period

Parental Consent

Mandatory Ultrasound

Show: Crisis Pregnancy Centers

Show: Abortion Providers

Grading Scale:

F

D

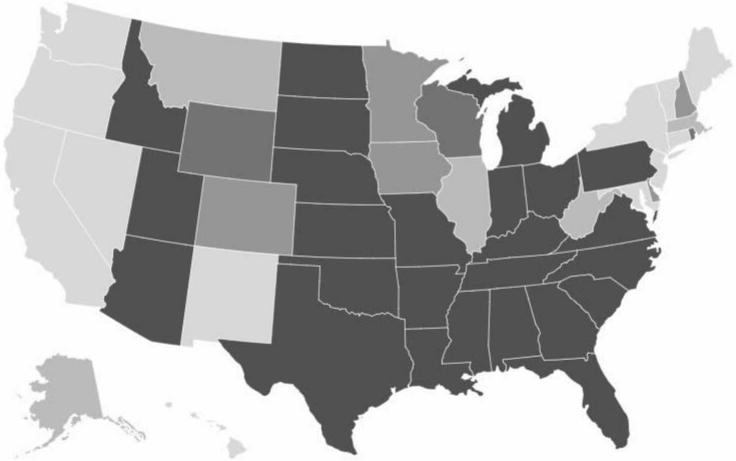
C

B

A

The report card grade, created by NARAL, given to each state based on their policies regarding a woman's choice and access to abortions. We provide an overview of these policies here.

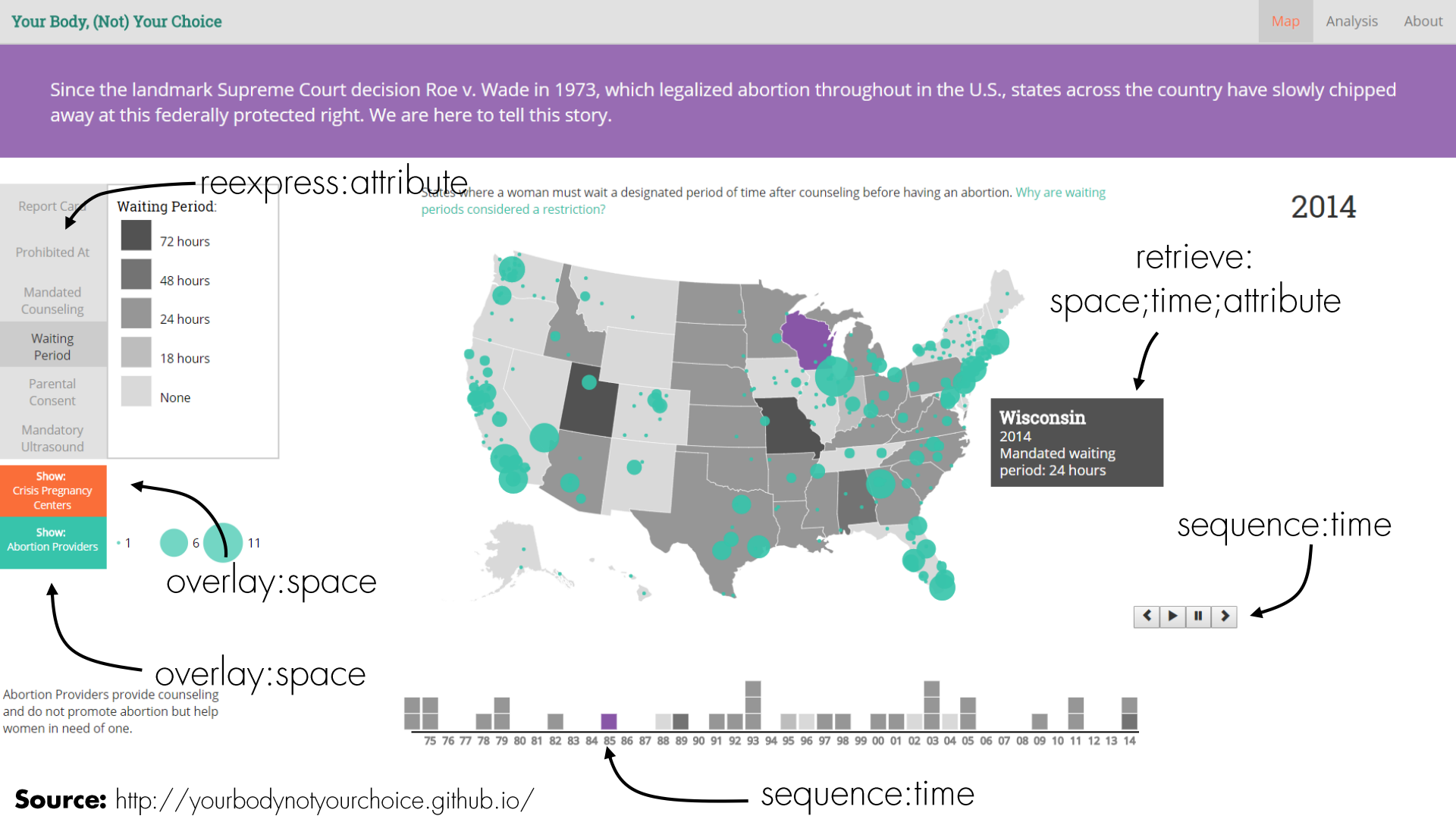
2014



Due to complex laws, political jargon, and emotional fervor, abortion policy is a contentious topic. There is a wealth of information and misinformation. The combination of vague terminology and lack of uniformity among state laws makes it difficult to interpret the true national status of abortion rights.

This is a challenging subject to talk about, but we believe it is important to make the information that we have collected available. We do not believe that all people who consider themselves pro-life intend to cause harm or restrict women's rights. Regardless, that is what we think these laws do.

Source: http://yourbodynotyourchoice.github.io/



Source: http://yourbodynotyourchoice.github.io/

Your Body, (Not) Your Choice

Map Analysis About

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Report Card
Prohibited At
Mandated Counseling
Waiting Period
Parental Consent
Mandatory Ultrasound

Waiting Period:
72 hours
48 hours
24 hours
18 hours
None

Show: Crisis Pregnancy Centers
Show: Abortion Providers

1 6 11

compare:difference

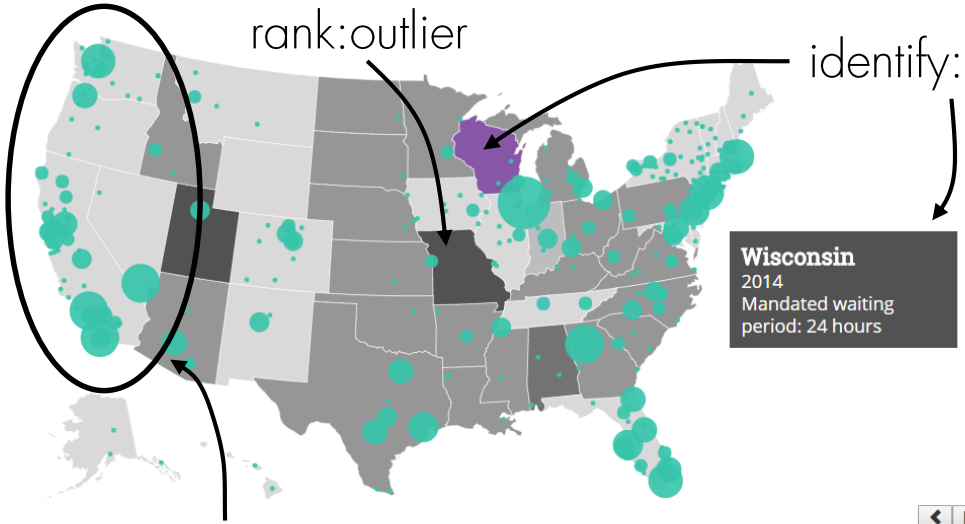
associate:correlation

States where a woman must wait a designated period of time after counseling before having an abortion. Why are waiting periods considered a restriction?

2014

rank:outlier

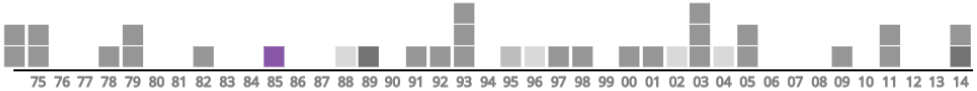
identify:location



Wisconsin
2014
Mandated waiting period: 24 hours

delineate:cluster

Abortion Providers provide counseling and do not promote abortion but help women in need of one.



associate:trend

Source: http://yourbodynotyourchoice.github.io/

Your Body, (Not) Your Choice

Map Analysis About

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1 6 11

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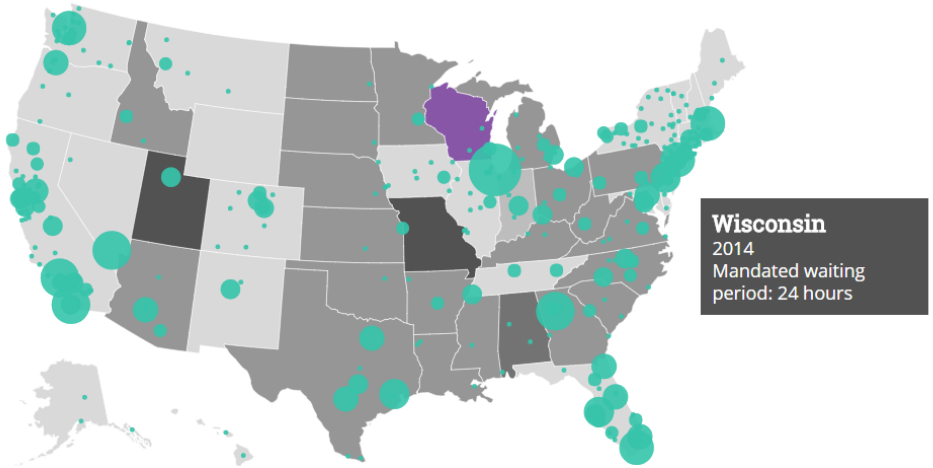

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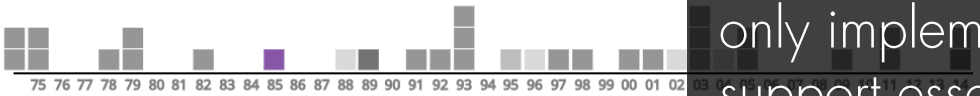
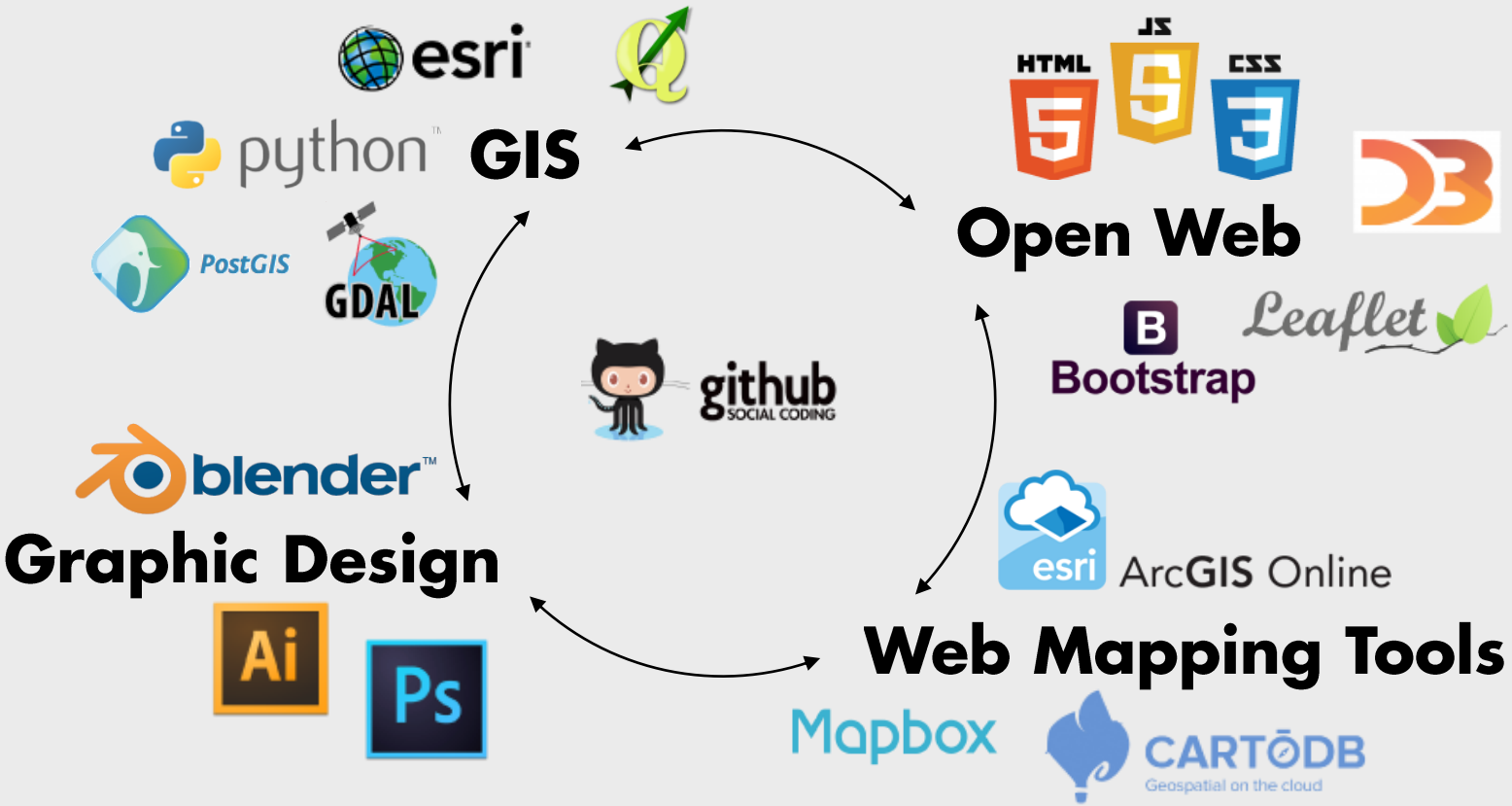


#protip use constraint; only implement operators that support essential objectives

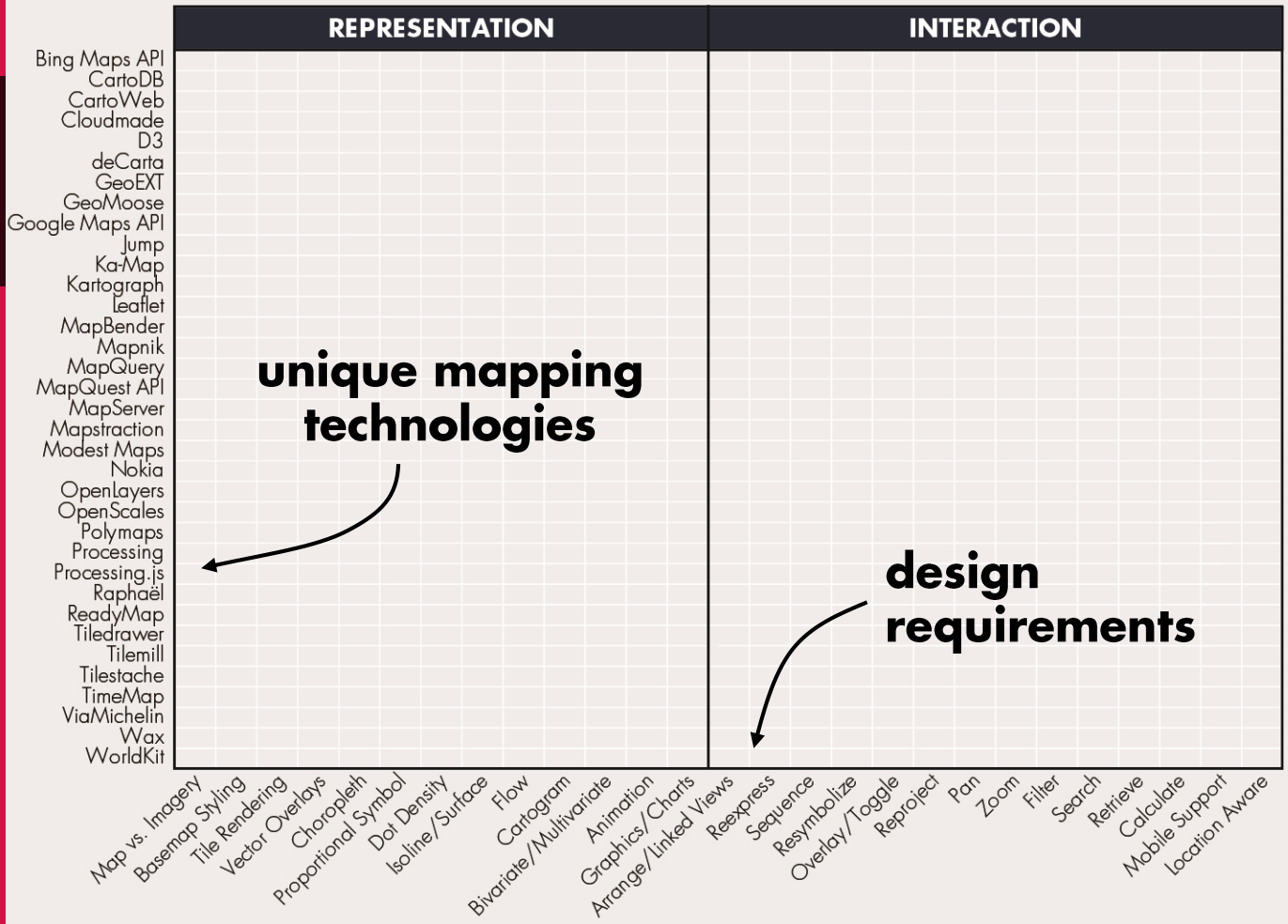
Source: http://yourbodynotyourchoice.github.io/

7. Appropriate mapping **technology** is determined by **operator** requirements!



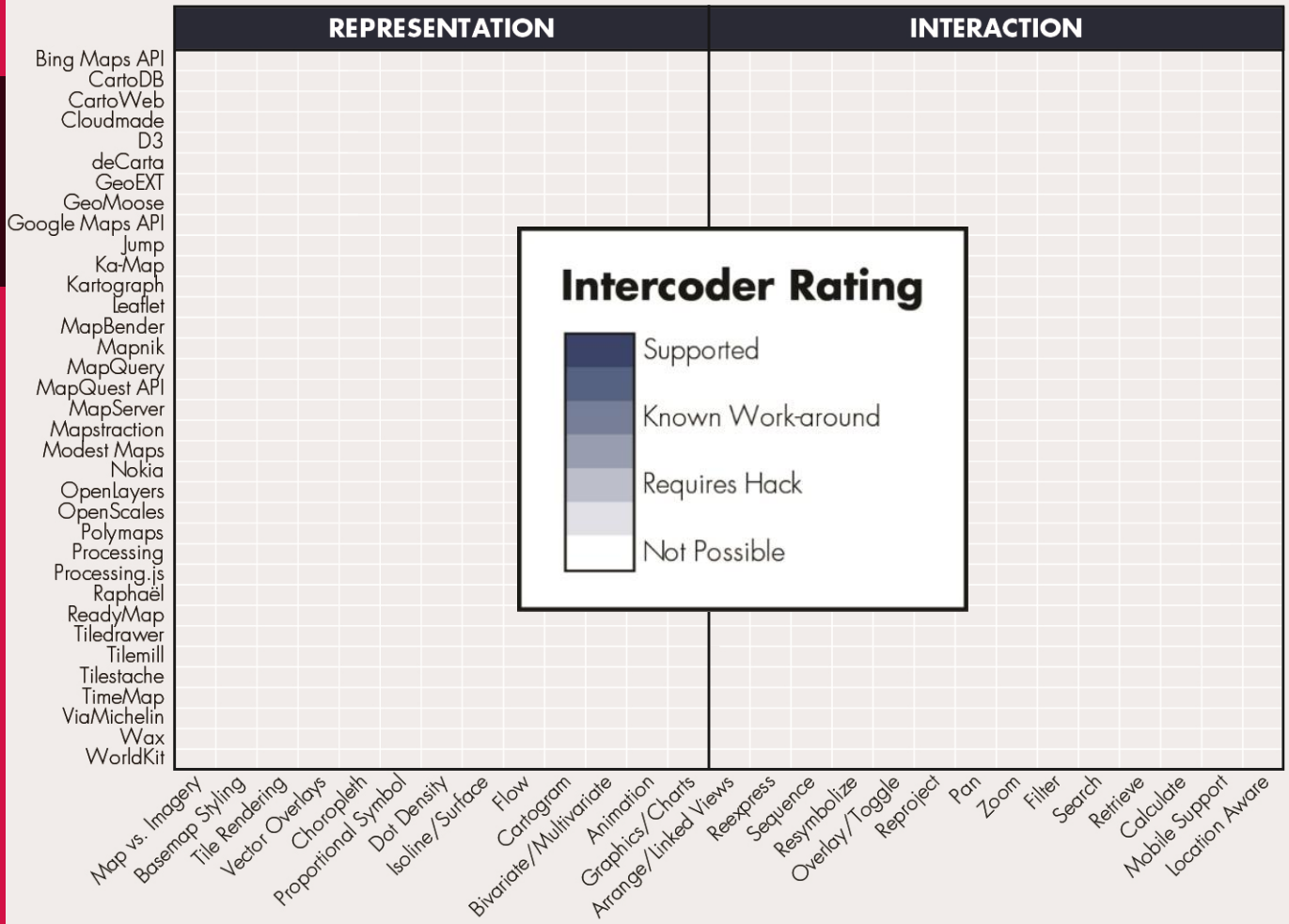
Source: Roth (2016) *Rethinking Cartography curriculum to train the contemporary cartographer*

#protip evaluate technology by rep+int requirements



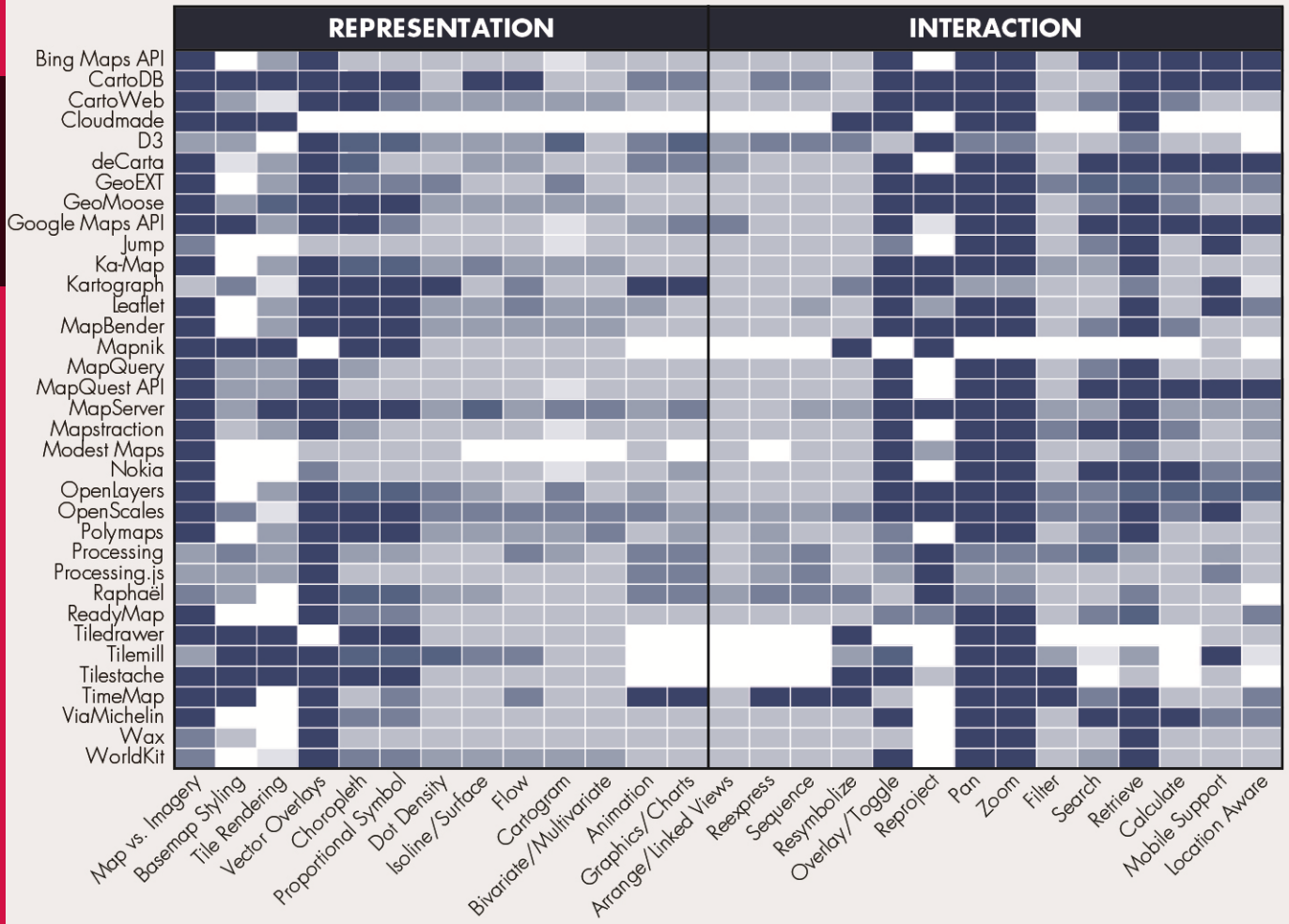
Source: Roth et al. (2014) *A Process for Keeping Pace with Evolving Web Mapping Technologies*

#protip evaluate technology by rep+int requirements



Source: Roth et al. (2014) *A Process for Keeping Pace with Evolving Web Mapping Technologies*

#protip reevaluate technology to avoid path dependency



Source: Roth et al. (2014) *A Process for Keeping Pace with Evolving Web Mapping Technologies*

Seven Principles of **UX Design for Maps**

1. Cartography includes both **representation** and **interaction** design!
2. Representation and interaction **design** share design principles, are **synergistic**!
3. We **use** interfaces, but **experience** interactions; it's the **UX** that matters!
4. User **goals** inform **when?** and **how much?** interactivity is needed!
5. User **objectives** translate abstract goals into specific **geographic insights**!
6. **Operator** requirements are determined/evaluated by user **objectives**!
7. Appropriate mapping **technology** is determined by **operator** requirements!

University Consortium for GEOGRAPHIC INFORMATION SCIENCE GIS&T Body of Knowledge

Free online! http://doi.org/10.22224/gistbok/2017.2.5

- Topic Description
- References
- Author and citation info
- Instructional Resources
- Additional Resources
- Related Topics
- Keywords

CV-13 - User Interface and User Experience (UI/UX) Design

Advances in personal computing and information technologies have fundamentally transformed how maps are produced and consumed, as many maps today are highly interactive and delivered online or through mobile devices. Accordingly, we need to consider interaction as a fundamental complement to representation in cartography and visualization. *UI* (user interface) / *UX* (user experience) describes a set of concepts, guidelines, and workflows for critically thinking about the design and use of an interactive product, map or otherwise. This entry introduces core concepts from UI/UX design important to cartography and visualization, focusing on issues related to visual design. First, a fundamental distinction is made between the use of an interface as a tool and the broader experience of an interaction, a distinction that separates UI design and UX design. Norman's stages of interaction framework then is summarized as a guiding model for understanding the user experience with interactive maps, noting how different UX design solutions can be applied to breakdowns at different stages of the interaction. Finally, three dimensions of UI design are described: the fundamental interaction operators that form the basic building blocks of an interface, interface styles that implement these operator primitives, and recommendations for visual design of an interface.

Author and Citation Info:

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Topic Description:

1. Definitions
2. Introducing UI/UX
3. Designing the User Experience

Source: Roth (2017) *UI/UX Design*

Dankjewel!

Seven Principles of **UX Design for Maps**

slideshare.net/reroth

doi.org/10.22224/gistbok/2017.2.5

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