



Designing Scientific Systems for Change

Simon Twigger, Ph.D.



About me!

Academia

Biochemistry

Bioinformatics, Genomics

Genome Databases

Ontologies, Semantic Web

Proteomics, Cloud Comp.

Clinical informatics

BioTeam

Cloud Comp.

Software Devel., Dev Ops

Sci. IT Assessments

Data commons, Interoperability

Data sharing, Searchability

Sustainability

Something (always) needs to change!

Our storage is full/broken/old/not backed up, etc.

The scientists aren't happy with IT.
(and probably vice versa!)

We don't have access to enough compute.

We want to move on/off the Cloud!

Moving our data is too slow!

We need our own network to connect all our teams across the entire country!

We want a custom cloud SaaS platform so people can easily use our product!

All the data needs to be FAIR!

The *[insert critical infrastructure here]* is failing and the person who built it just left...

But.... it's complicated

Scene: A typical research lab

HARRY, a bench scientist sits at his desk staring at the computer screen, watching his download progress bar barely moving.

The lab door opens, GRIFFIN, the IT Guy, walks in looking stressed..

GRIFFIN

Why do you have so many USB drives back there? That's a data governance and disaster recovery nightmare!

HARRY

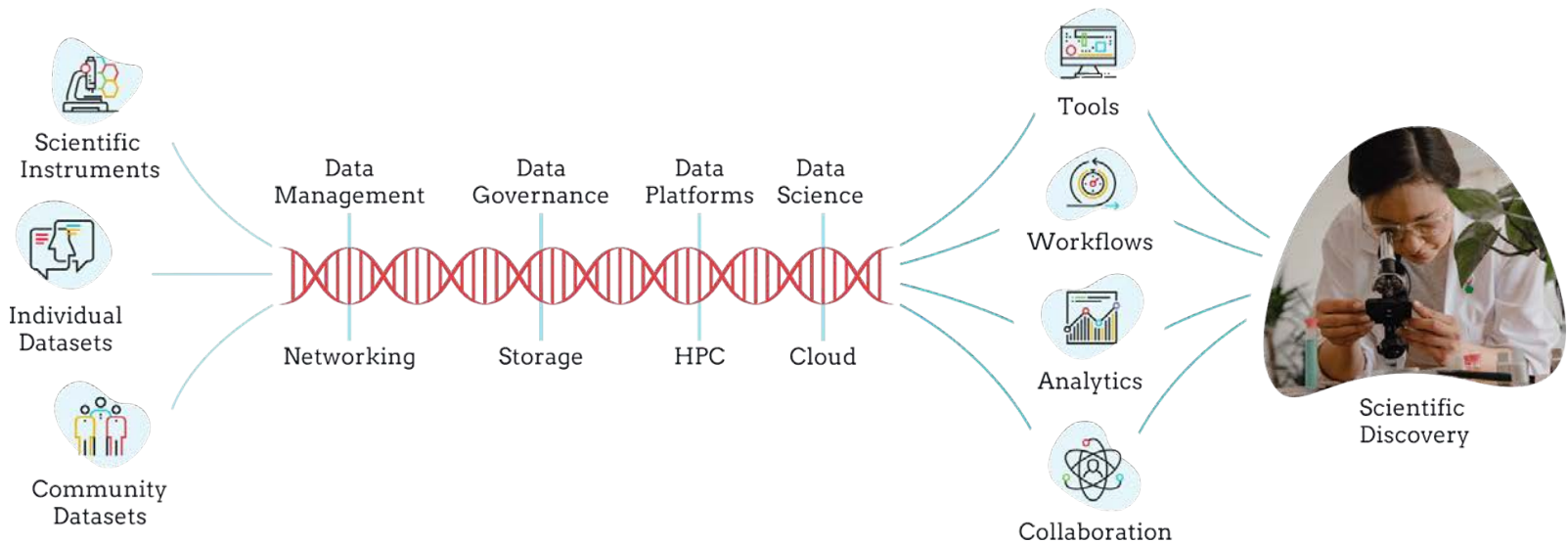
(pauses, looks up from the screen)
It's complicated..

Griffin - Why is our lab internet so slow? I can barely do any science at all!

GRIFFIN

(pauses, his eyes narrow)
It's complicated..

Why is it complicated?



There are a lot of interconnected pieces, each of which is complex in its own right, all of which are created, managed, and used by people...

Ask ChatGPT - working with people (part 1)



write a short paragraph on why working with people is difficult



Working with people can be difficult for a variety of reasons. One of the main challenges is that people have different personalities, communication styles, and work habits. This can lead to misunderstandings, conflicts, and miscommunication. Additionally, people have different goals, values, and motivations, which can make it hard to align everyone's efforts and achieve a common objective. Additionally, people have different backgrounds, experiences, and perspectives, which can make it difficult to understand one another and find common ground. Finally, people can be unpredictable, and their behavior can change based on a variety of factors, such as their mood, stress levels, and personal life. All of these factors can make it difficult to work effectively with others.



Ask ChatGPT - working with people (part 2)



write a short paragraph on why working with people is easy



Working with people can also be easy for a variety of reasons. One of the main benefits is that people bring diverse skills, experiences, and perspectives to the table. This diversity can lead to new ideas and innovative solutions to problems. Additionally, people can provide emotional support and encouragement, which can make the work environment more enjoyable and motivating. When people work together and communicate effectively, they can achieve great results. Furthermore, when people have common goals, values, and motivations, it can make it easy to align everyone's efforts and achieve a common objective. And finally, people can learn from each other, which can help them to grow and develop professionally. All of these factors can make working with people an easy and enjoyable experience.





Working with people - to recap...

Different personalities, communication styles, motivations, experiences, and perspectives **can be hard to communicate and find common ground.**

Different personalities, communication styles, motivations, experiences, and perspectives **can do great things when they have common goals, work together, and communicate effectively.**



Given the complexities of tech, people, etc.

How do you:

- Find out about common goals?
- Identify common ground?
- Understand the complexities?
- Help people work together?
- Communicate effectively?
- Figure out what's really going on?
- Know what to change?



Design



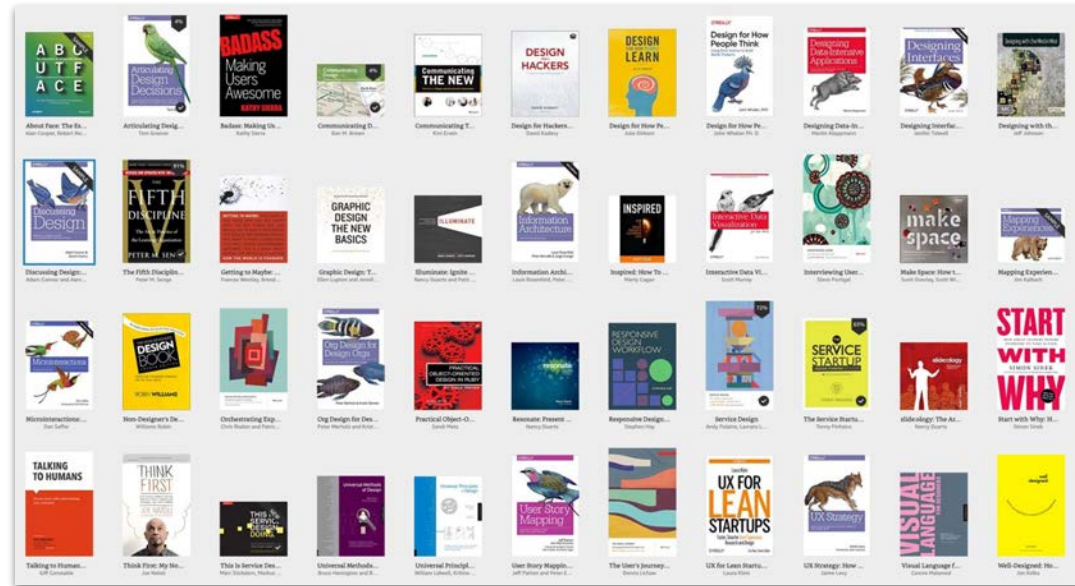
“Everyone designs who devises
courses of action aimed at
changing existing situations into
desired ones.”

Herbert A. Simon

Nobel prize winner for economics, 1978

What sort of 'design' is needed in BioIT?

- Software design
 - Interface design - for web sites and tools
 - Responsive design - for web sites and tools
 - Object-oriented design - for software
- Information design (Information architecture) - documents, websites, etc.
- Graphic design - for ppts, documents, posters, graphics, etc.
- System design - networks, compute, storage, etc.
- Organizational design - hiring, org charts, reporting structures
- Service design - for ourselves, for our clients
- Learning design - for training, educating
- Human-centered design - as an overall theme
 - User experience, UX
- Articulating/communicating design - to explain why *this* rather than *that*...?



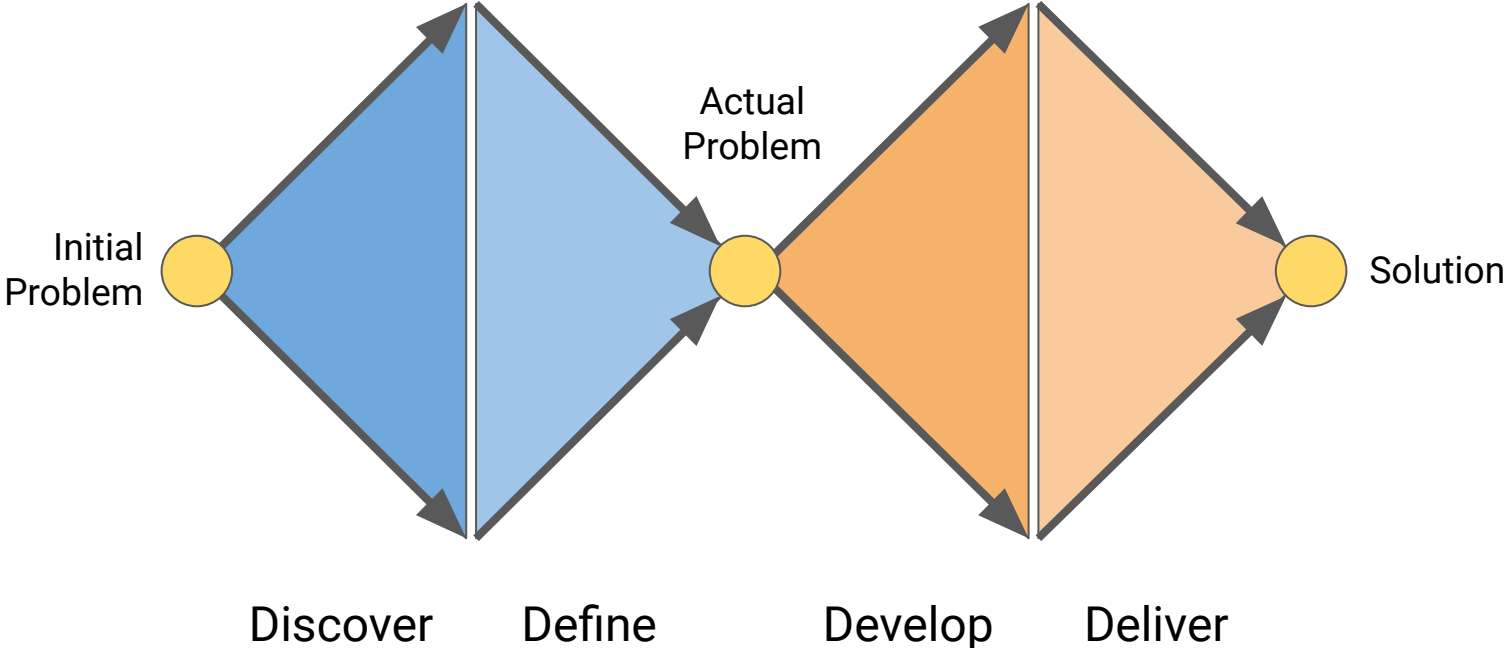


How can design help us?

Design has a rich body of knowledge, established tools to help us understand what is going on, and established processes that we can follow to figure out how to solve the problems we find.

Given that we're going to have to create all these things anyway, we might as well design them intentionally and leverage the tools and approaches that the design community has created.

Specific phases, specific activities



Double Diamond design process - popularized by the British Design Council in 2005

What happens at each stage?

| | Discover | Define | Develop | Deliver |
|------------|---|---|---|--|
| Goal | Expand options, gather as much information about the problem and situation | Group, aggregate, narrow down to a solid definition of the key problem at hand | Explore and expand the potential approaches to the problem | Implement the most effective option |
| Activities | Interviews, reading and research, workshops and group discussions, use cases, personas, user journeys | Synthesize information, create systems maps, identify potential intervention points | Whiteboarding, discussions with stakeholders, prototypes, mockups, etc. | Creation and delivery of the selected solution |

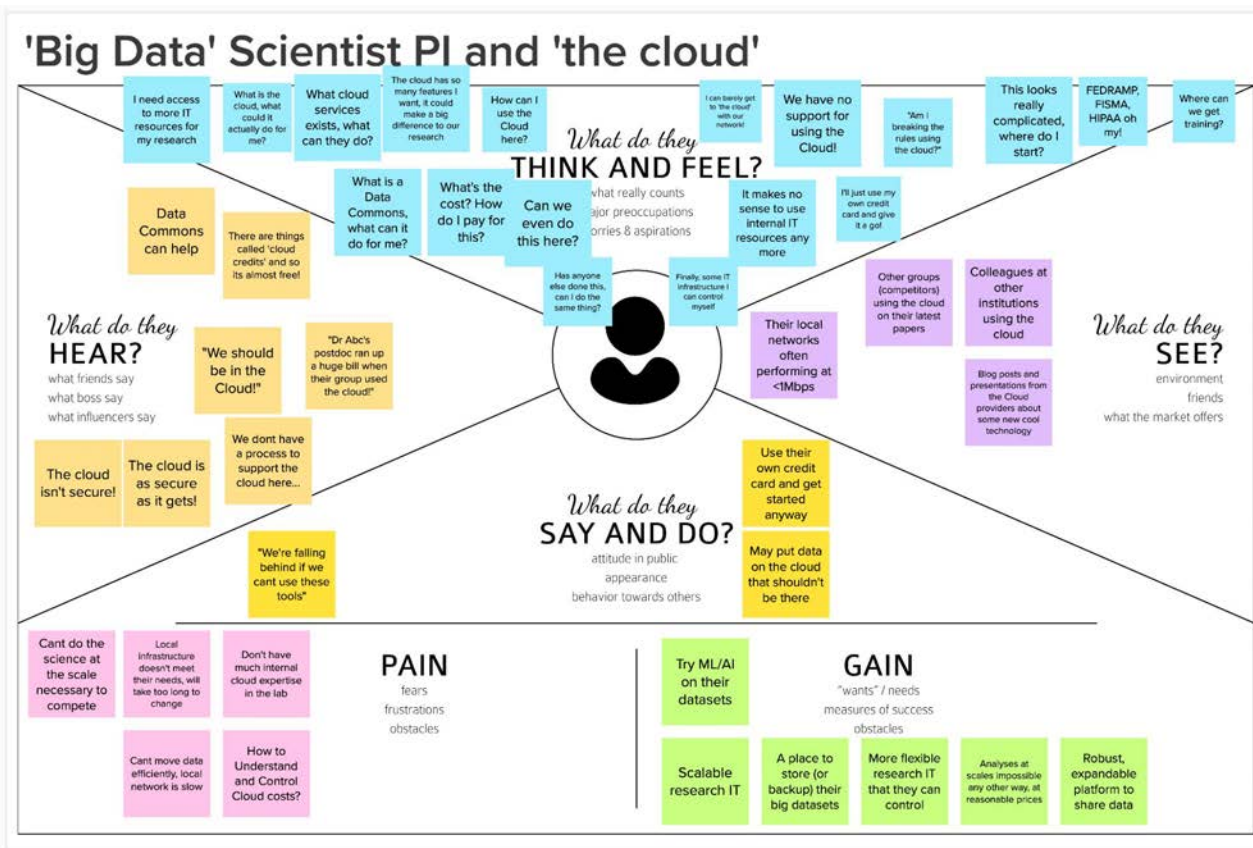
Interviews (discussions, chats, etc)

Never underestimate the power of talking to people!

- Do your research - who are they, what do they do, why are they relevant to the problem at hand
- Have a plan for what you want to ask
- Be prepared!
 - It may be the first time anyone has actually sat down and listened to them...
- Take good notes, record the discussion if everyone agrees.
- Afterwards, review your notes for
 - Things that are working
 - Things that are not working
 - Existing workarounds
 - Suggestions and ideas



Get inside their head with Empathy Maps



Document key Use Cases

Staff Researcher

Support to use the cloud effectively



As a **PI**, I want **training and guidance to move to the cloud** in order to **be able to effectively utilize the cloud to support my research.**

Icon by Round Icons from flaticon.com

Core Motivations

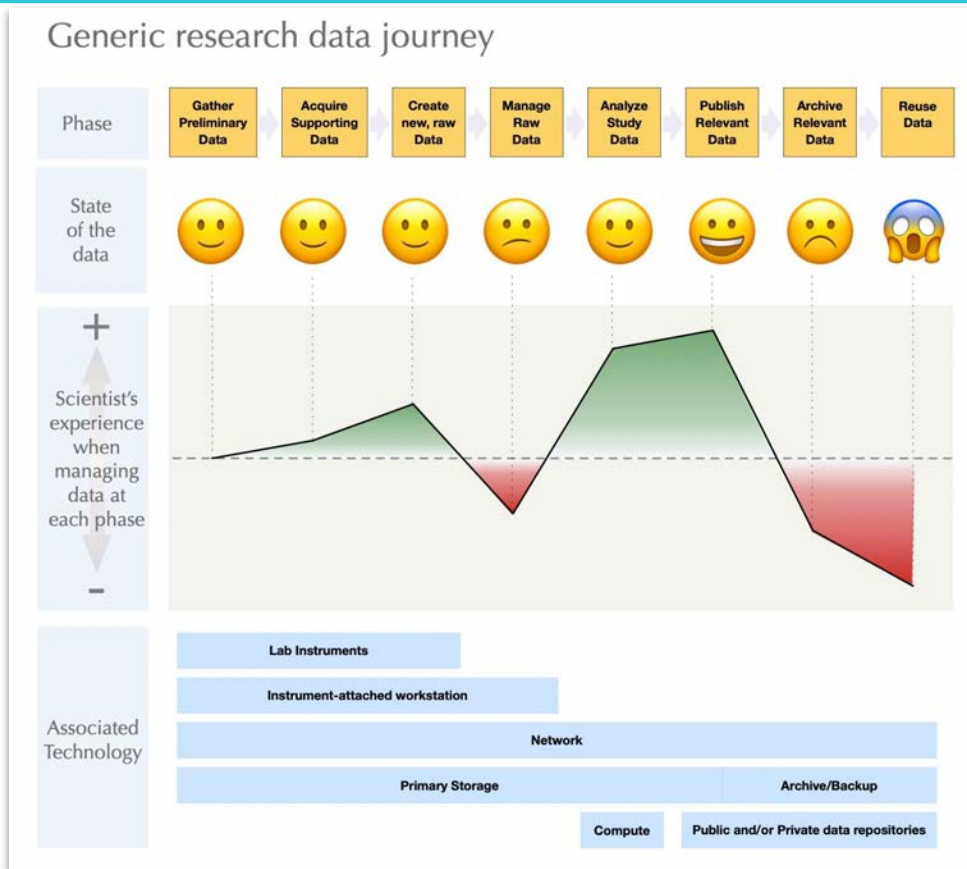
- Many PIs are interested in using the cloud in their work
- However, there are many unknowns: how to design a cloud system, how to move existing workflows, the budgetary implications, how to move data to and from the cloud, how the Org can help, etc.
- These are all barriers to more widespread adoption of the cloud

Potential Data Sources

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- STRIDES

Create Journey Maps of processes

- Map out key processes
- Identify pain points
- Communicate to stakeholders



In-depth journey maps

Empathy map

Key phases

Physical touchpoints

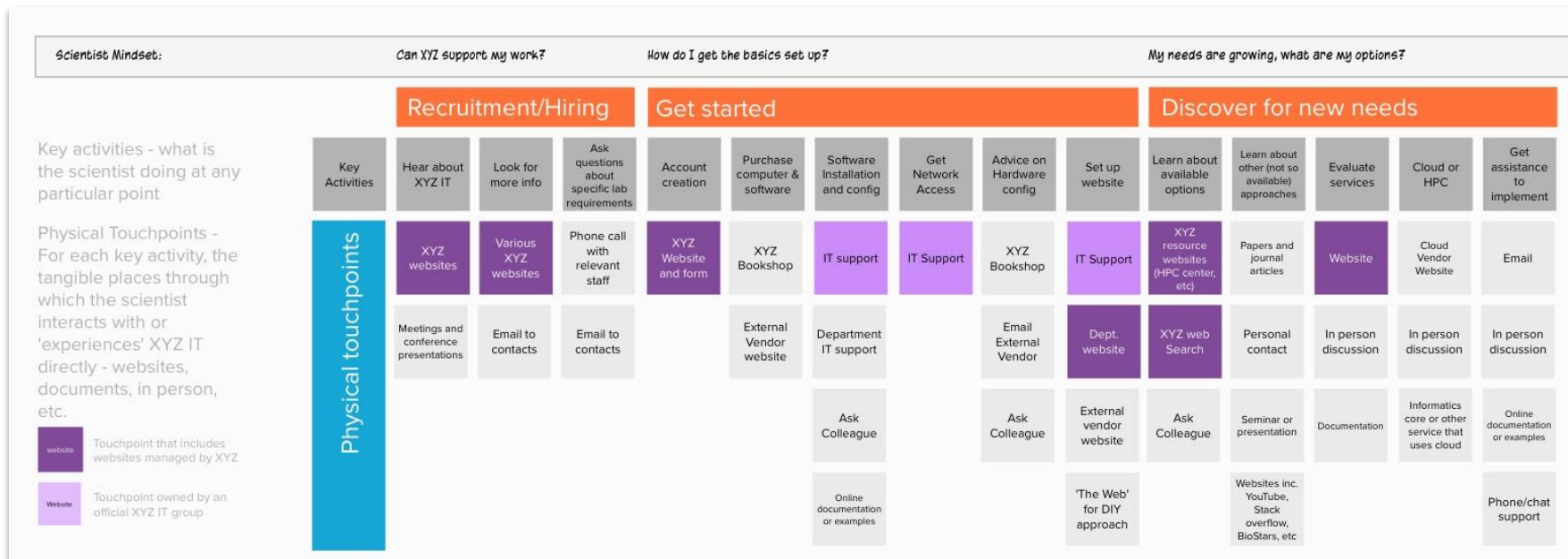
People involved

Positive feedback

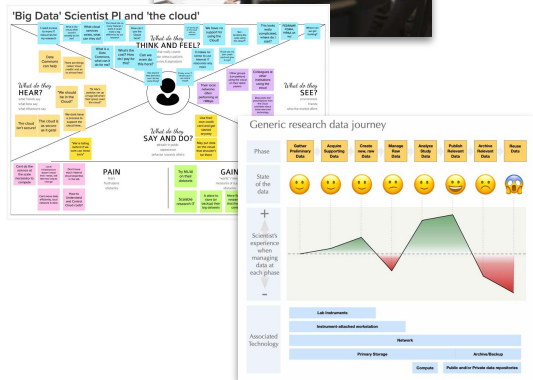
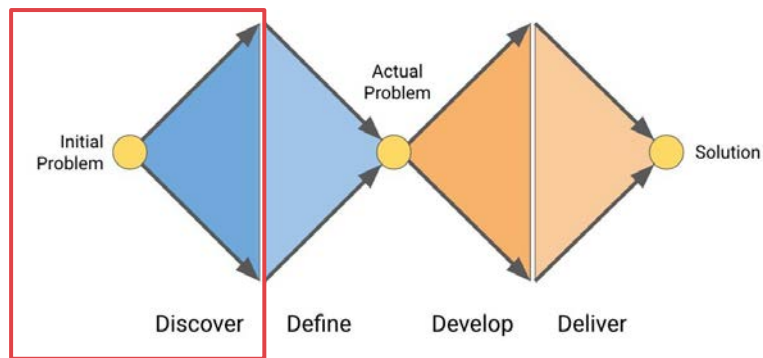
Negative feedback



In-depth journey maps



Design methods help us collect and communicate information



We now know about

- The People
- Their Use Cases
- Their Processes
- Their pain points

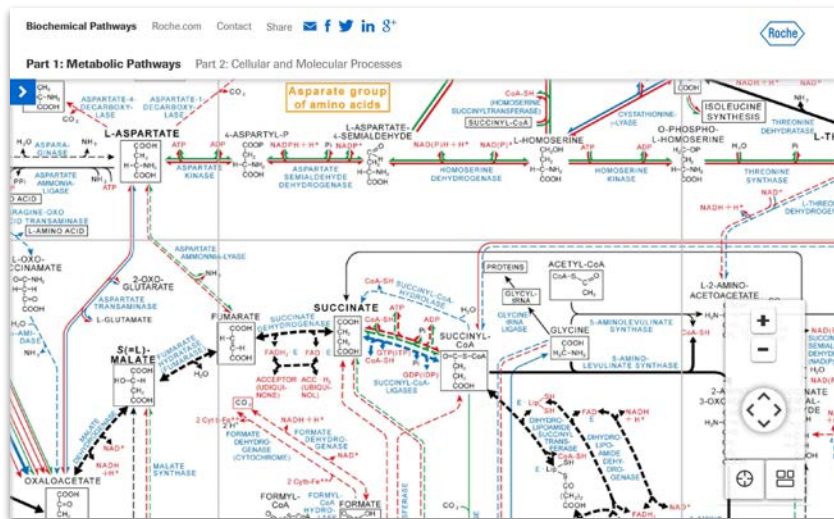
But what's really going on?



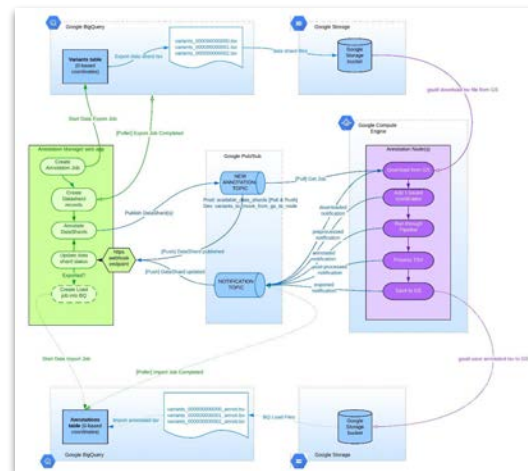
Systems

What do we mean by a system?

These are systems: they have components, relationships, dependencies, feedback loops, but we're focusing on ones where people are in the mix...

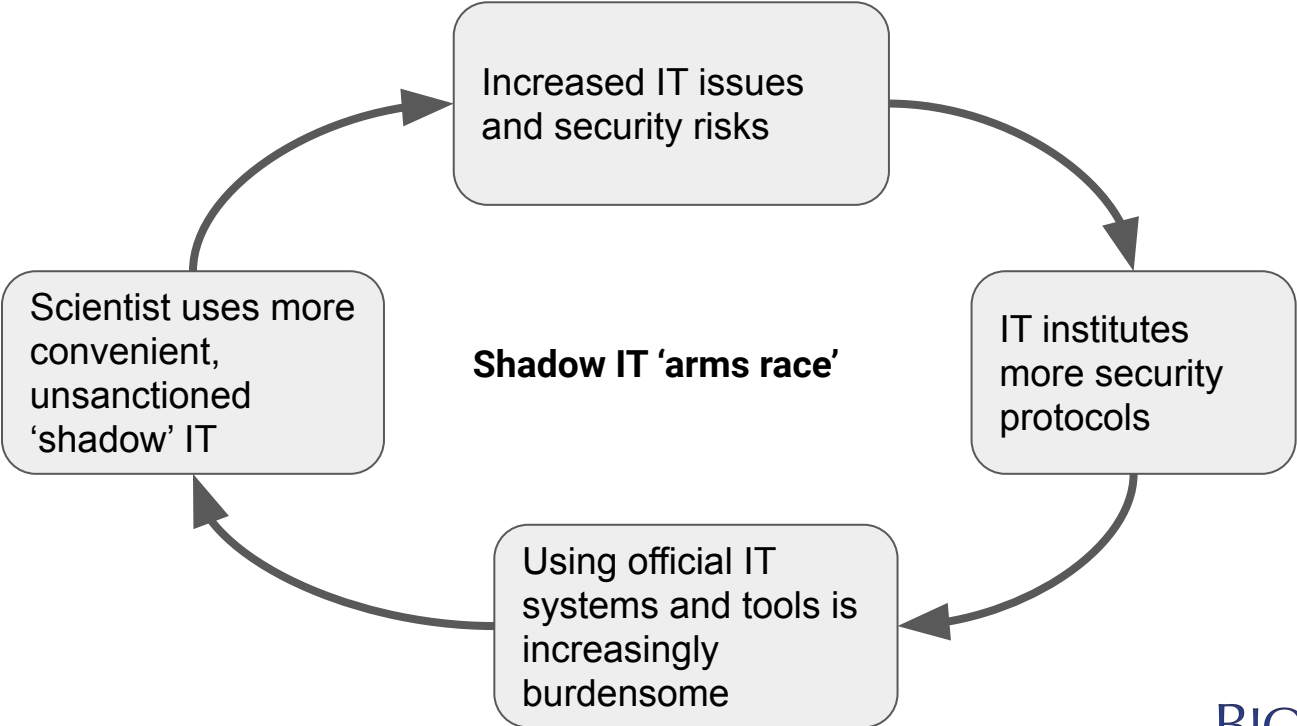


Roche Metabolic Pathways (biochemical-pathways.com)

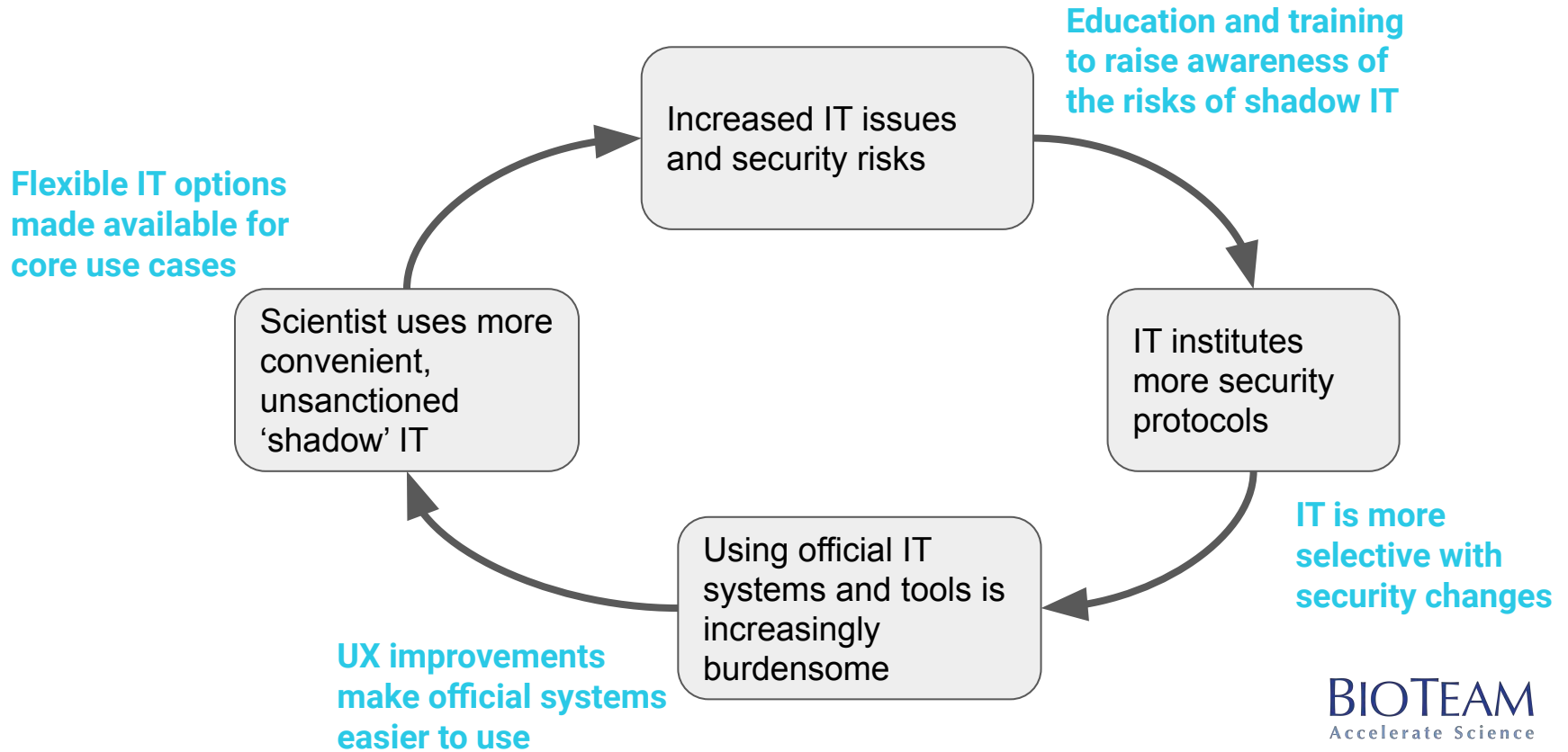


GCP Variant Annotation pipeline

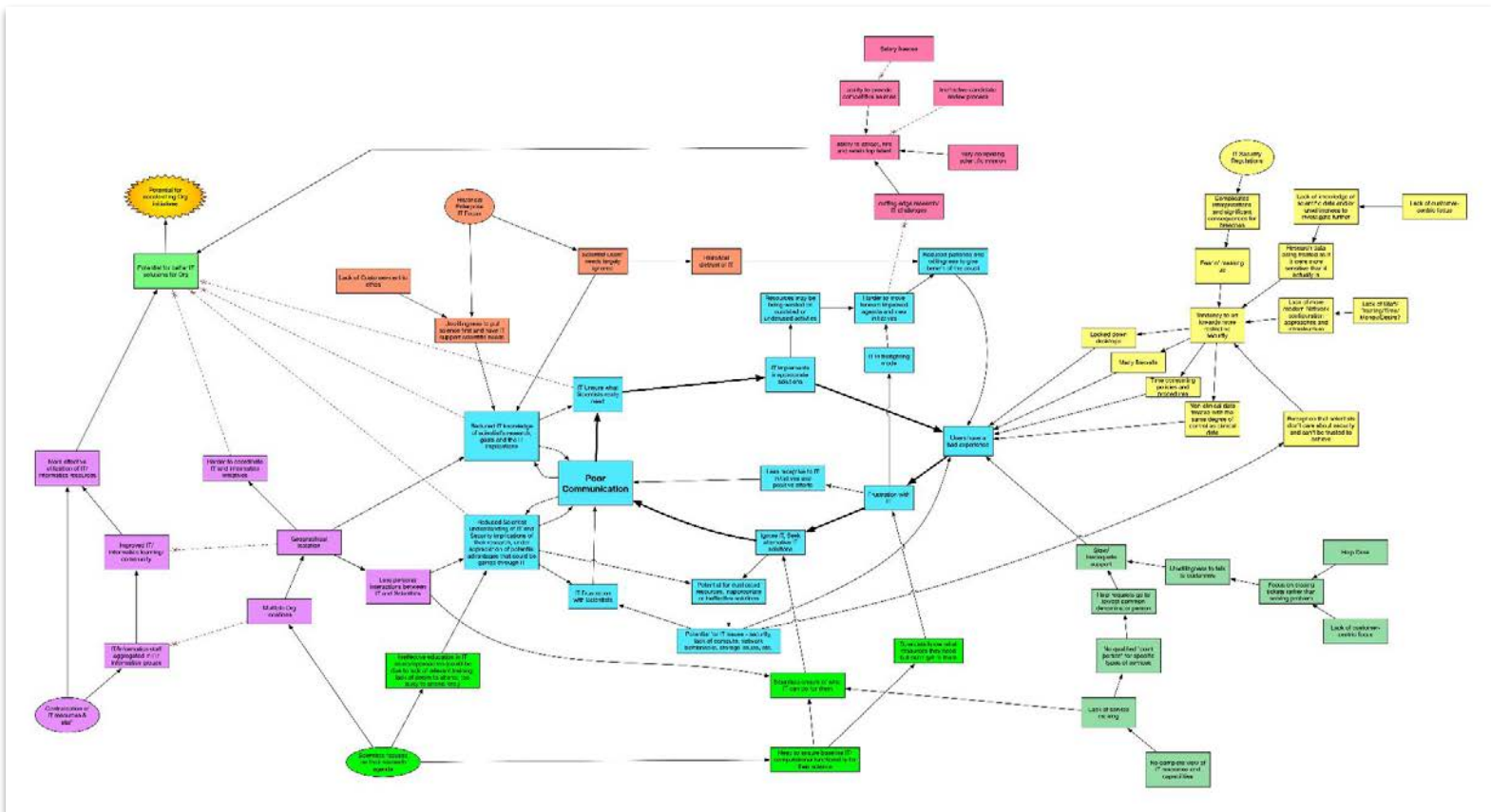
Systems maps - A leads to B, which leads to C



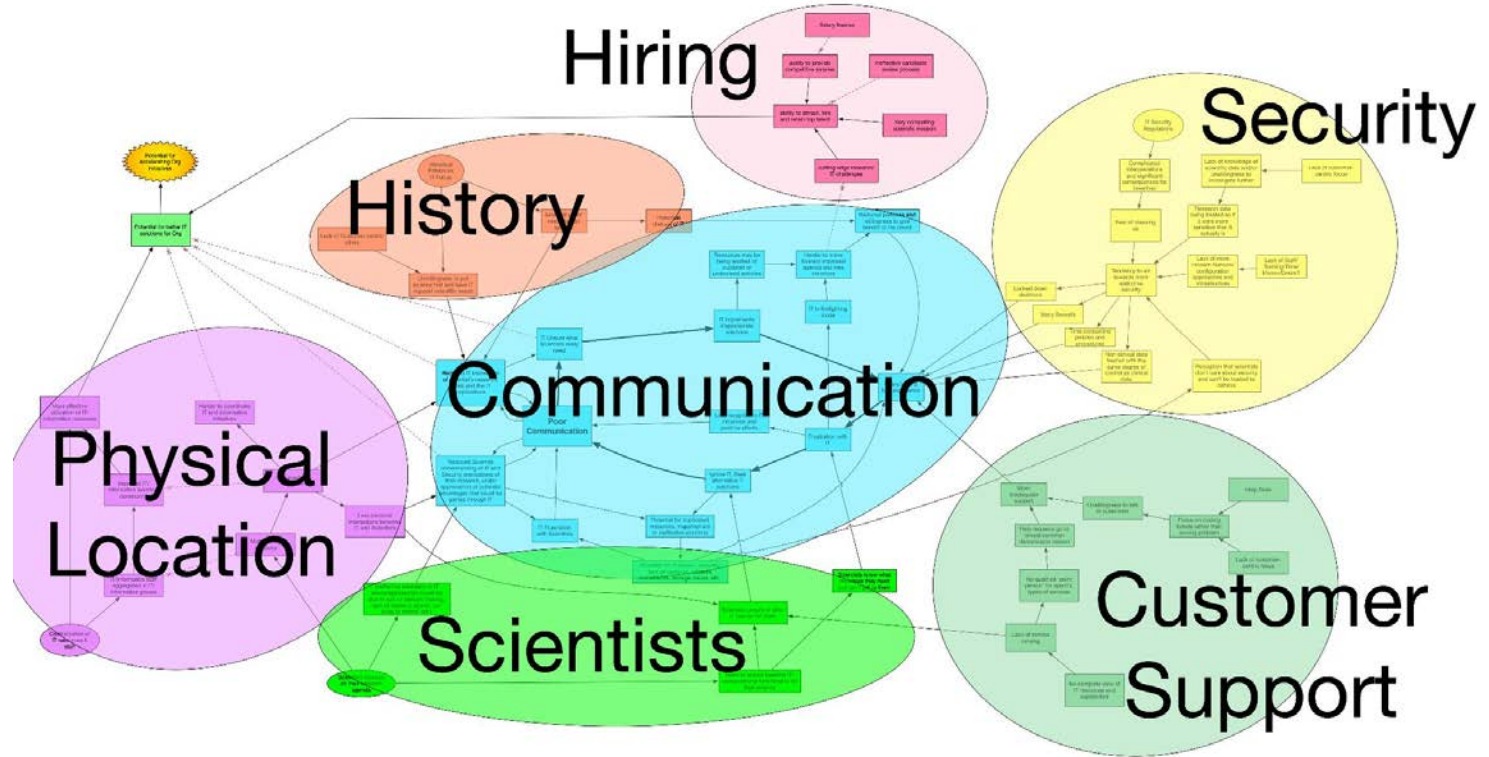
Identification of intervention points



Large organization IT systems map



Large organization IT systems map



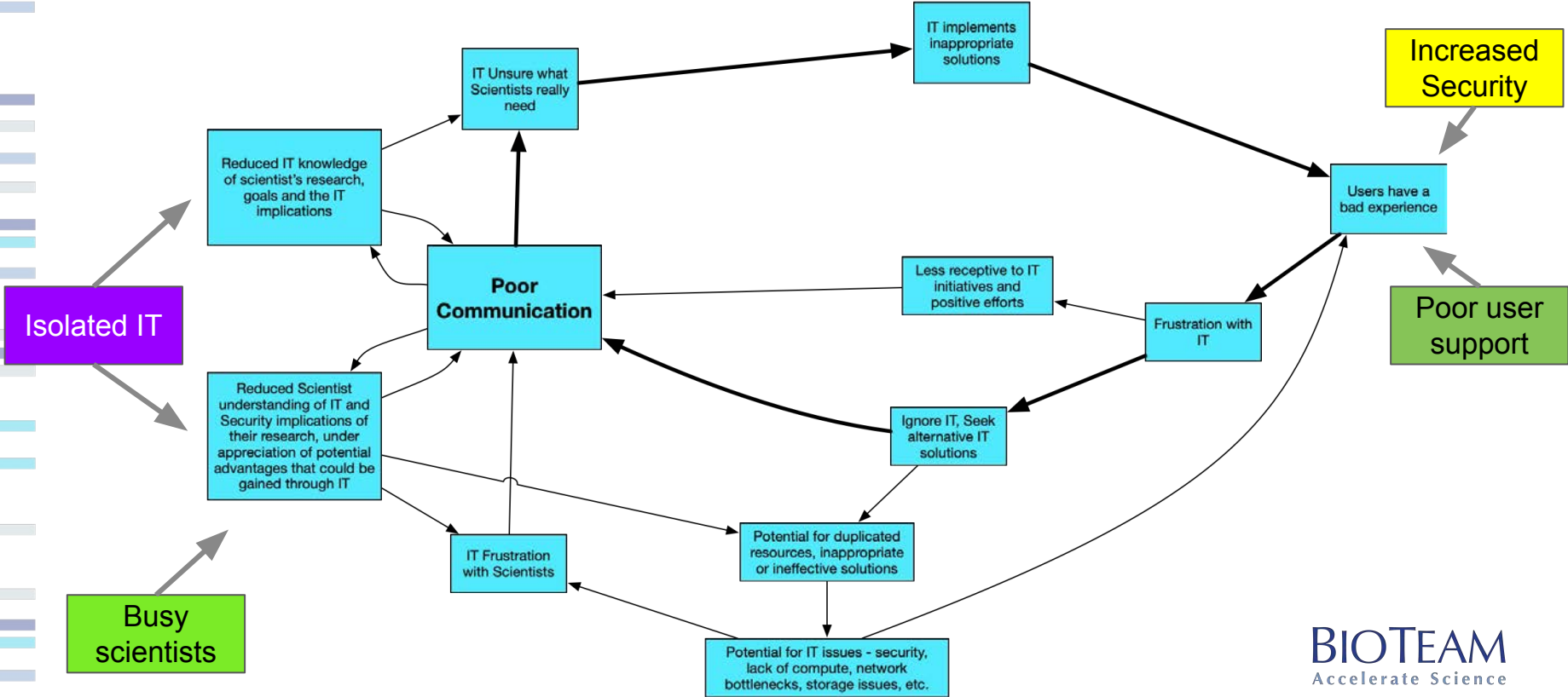


Does this seem familiar...?

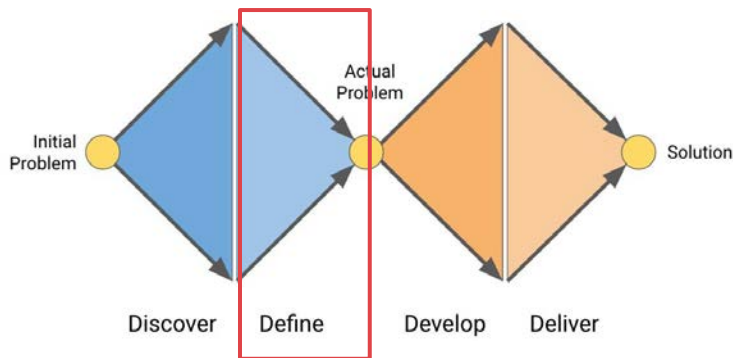
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Core loop - communication



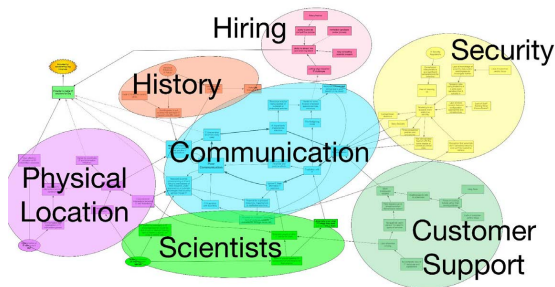
Systems maps help us put the information in context



We now know about

- The components
- The relationships
- The feedback and regulatory systems
- The actual problem

But how to change it?





Change

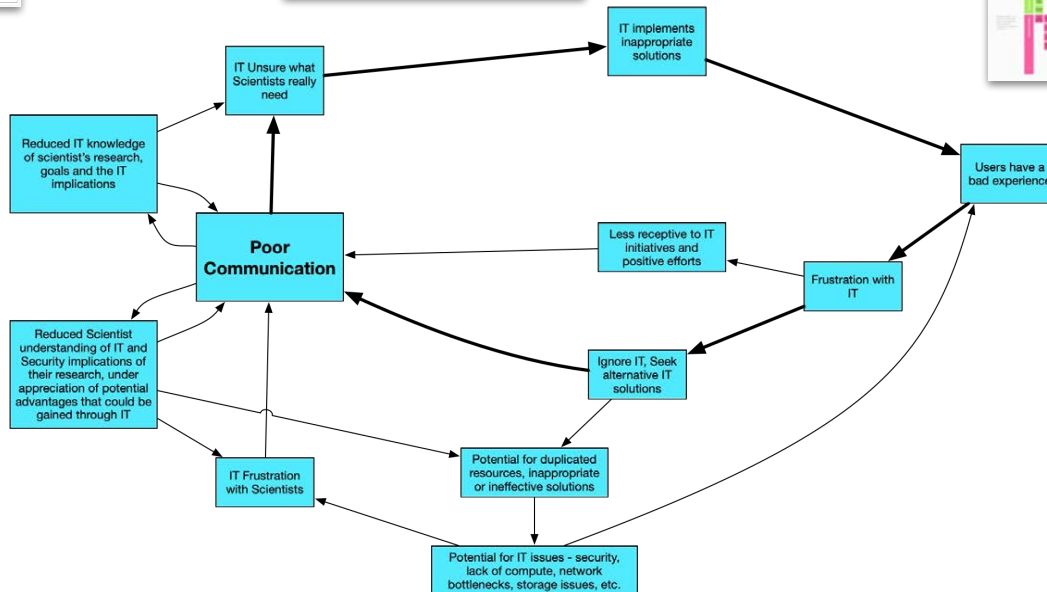
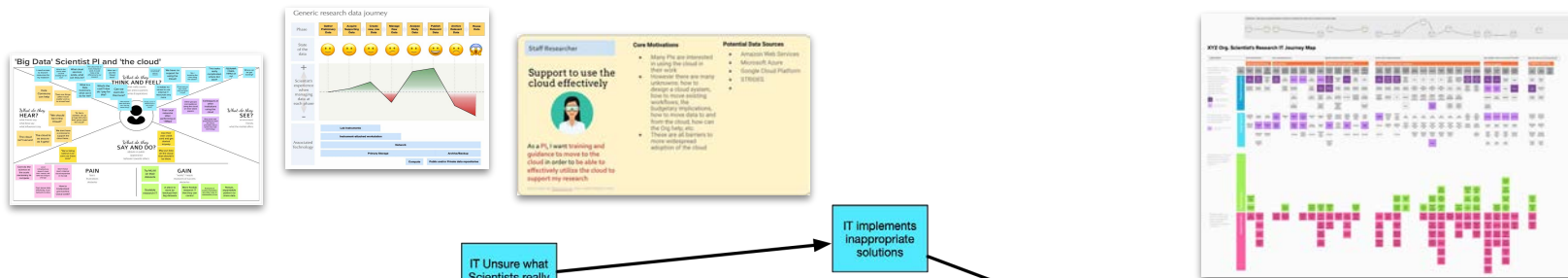
Common goals, communication

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We now have a lot of information



Identify other places for change

Isolated IT

Busy
scientists

Increased
Security

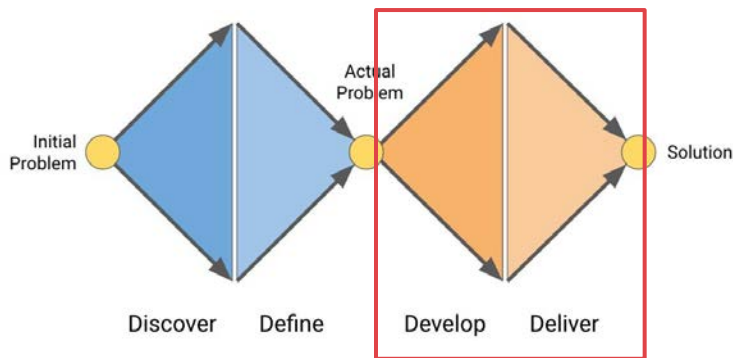
Poor user
support

In this example, communication and establishing common ground are key:

- Town Hall meetings to discuss the issues more widely
- Collaborative projects to get IT and researchers working together, aligned around a common goal
- IT office hours in the lab space to make IT more accessible
- Lunch and Learn on Data Management, using the tiered storage, getting the most out of the network, large-scale data transfer methods, getting started on the cloud, etc.

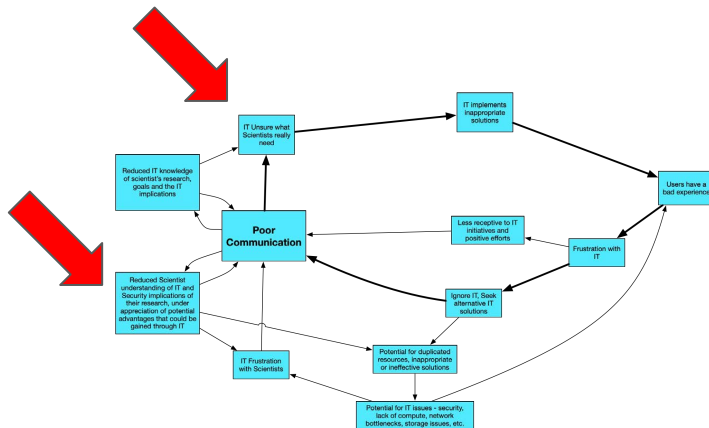


Systems maps help identify how to change



We have a model to help:

- Flag areas to intervene
- Identify possible solutions
- Identify potential unintended consequences
- Suggest small proof of concept activities



Something (always) needs to change - now we have some new tools to make it happen

Our storage is full/broken/old/not backed up, etc.

The scientists aren't happy with IT.
(and probably vice versa!)

We don't have access to enough compute.

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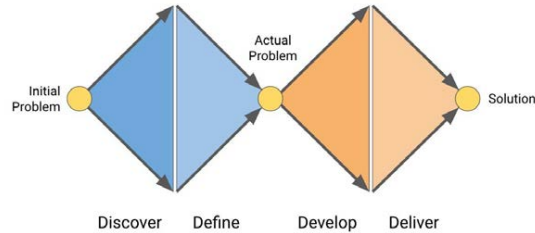
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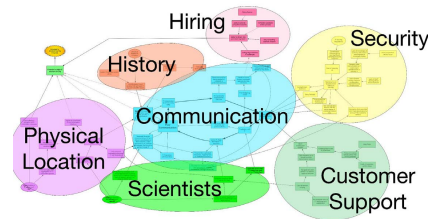
We need our own network to connect all our teams across the entire country!

Summary

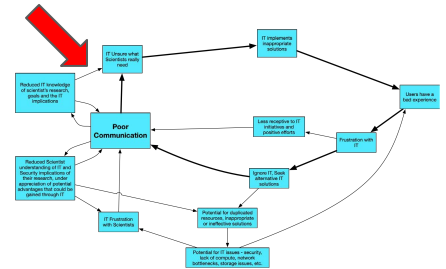
“Everyone designs who devises courses of action aimed at changing existing situations into desired ones.”



Design tools and processes



Systems Maps



Opportunities for Change




Useful links

Design Thinking

- interaction-design.org/literature/article/what-is-design-thinking-and-why-is-it-so-popular
- **Mapping Experiences**, Jim Kalbach, O'Reilly publishing, Journey mapping and other visualizations
- **Double Diamond** - fulcrum.rocks/blog/double-diamond-design

Systems Thinking, Systems Mapping

- Thinking in Systems - Donella Meadows
- Systems Mapping Training
 - acumenacademy.org/course/systems-practice/



Thank you for listening: Q&A

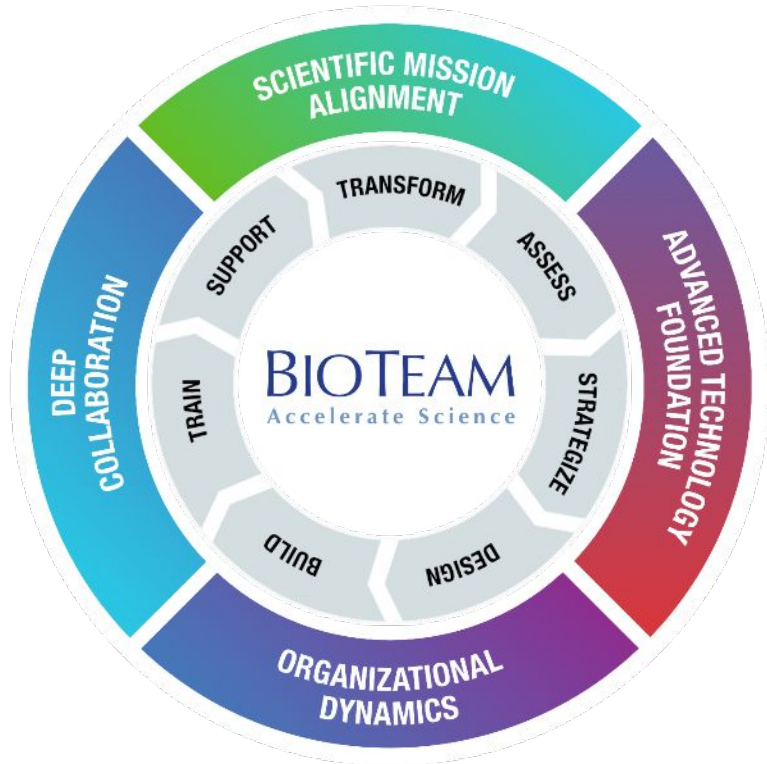
THANK YOU! Feel free to reach out with additional questions.

- Simon Twigger simon@bioteam.net

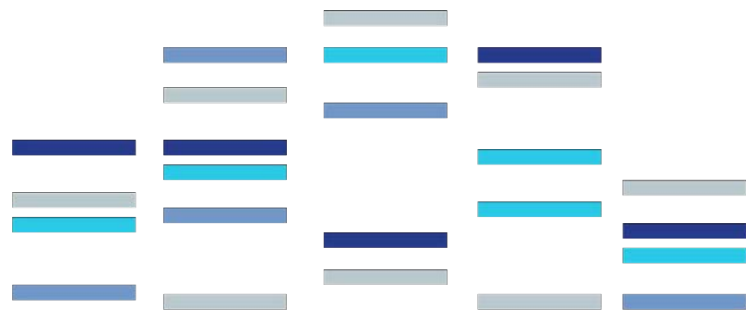
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Scientific data ecosystems require a holistic approach



- Align solutions with your **scientific mission** and digital transformation plans
- Deliver a well-integrated state-of-the-art **technology foundation** that fits your unique needs
- Incorporate **organizational dynamics** from day one
- Foster **deep collaboration** to help clients create their own success



BIO TEAM

Accelerate Science