

TEAM **NASA**

# TEAM NASA

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Jon Bidwell user research lead  
Jessa Hafer-Zdral document lead  
Joanna Bresee design lead  
M. Azim Ali project manager



# project advisors

## Ames HCI Group

Alonso Vera

Mike McCurdy

Mel Ludowise

## Intelligent Robotics Group

Terry Fong

Trey Smith

David Lees



# presentation outline

1. background
2. project focus
3. research methods
4. findings
5. design implications
6. project timeline
7. brainstorming

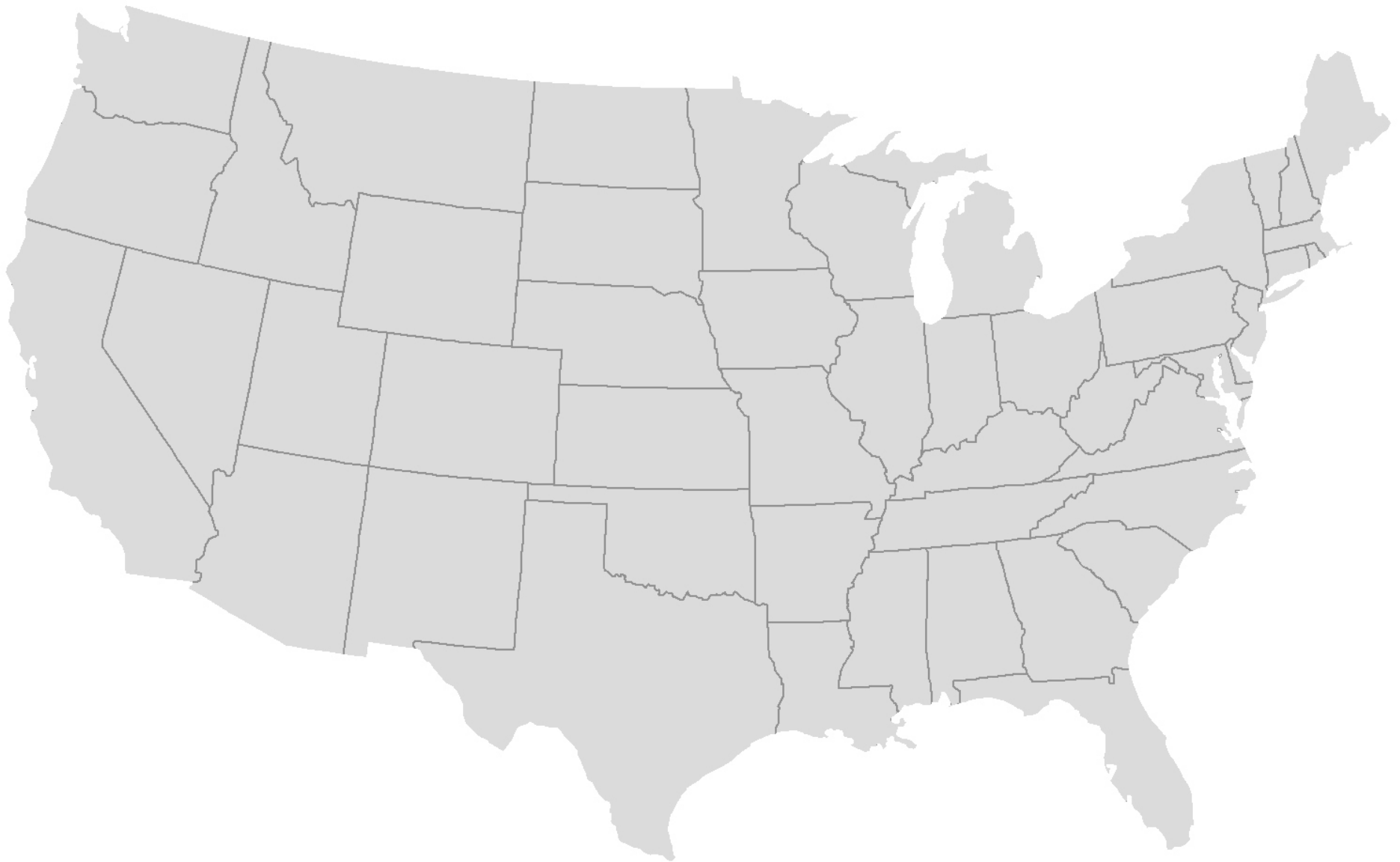


# our project focus

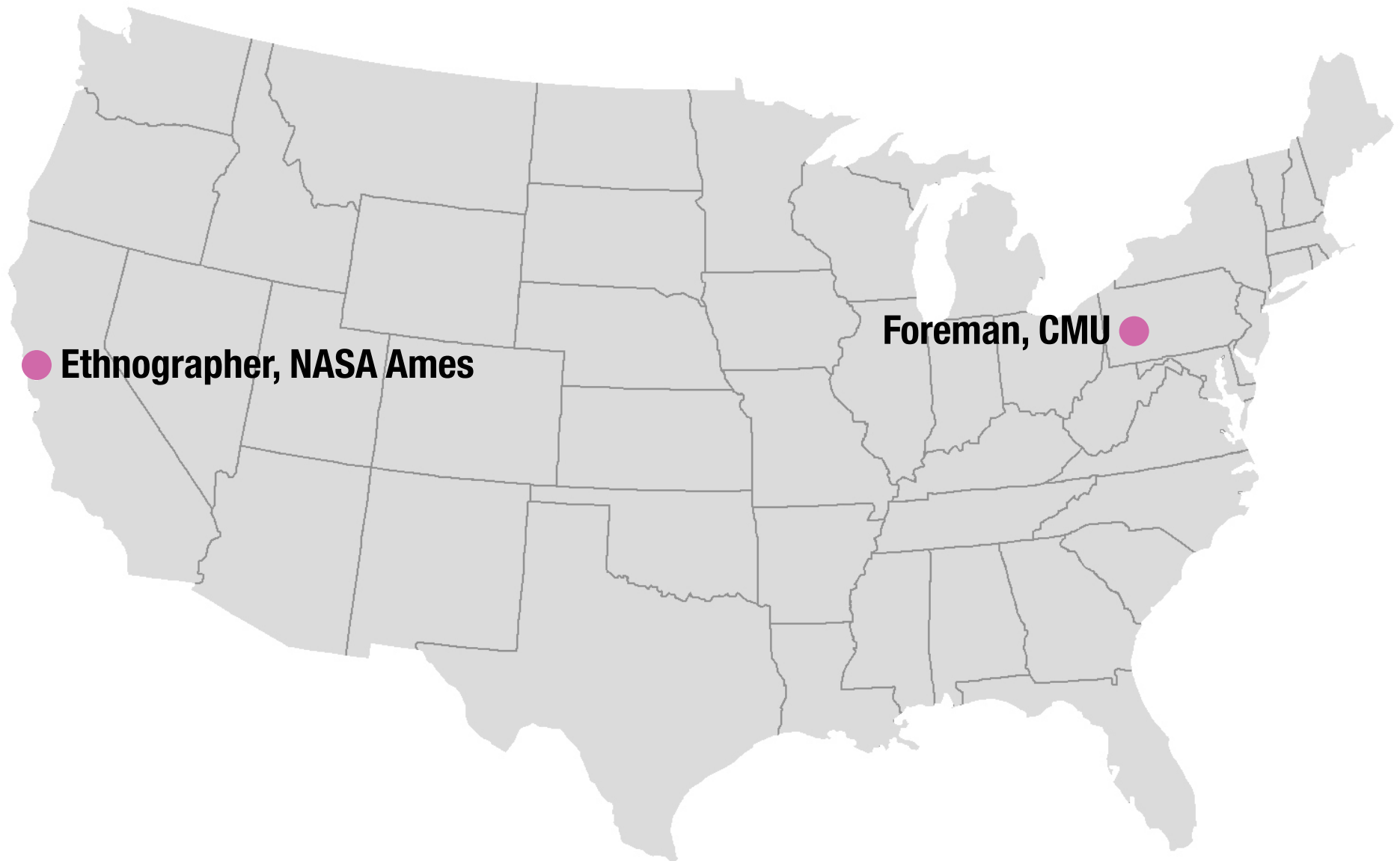
Design a planning tool to  
**improve the speed** in which  
scientists analyze data and plan  
robotic recon activities



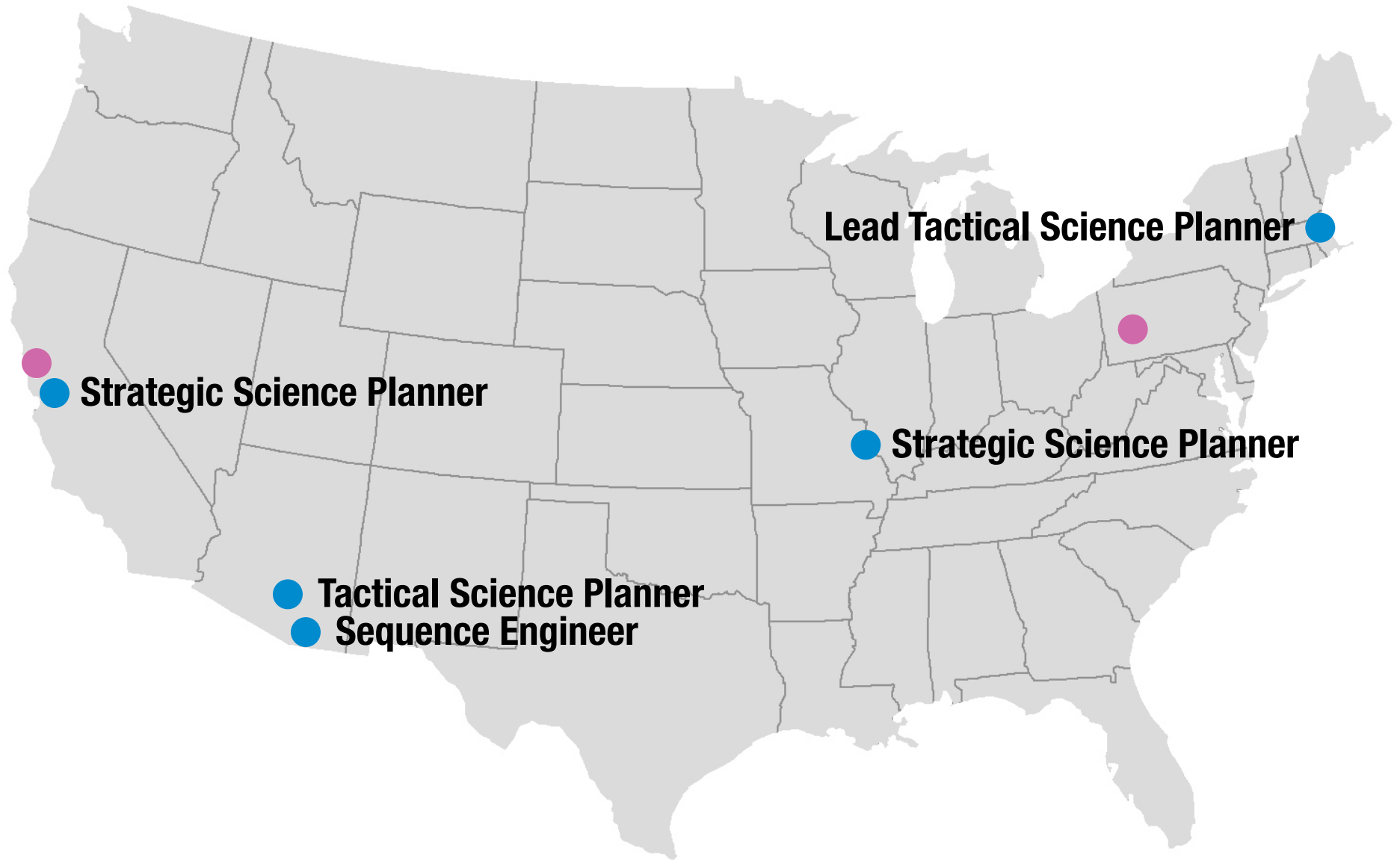
# research process



# analogous interviews

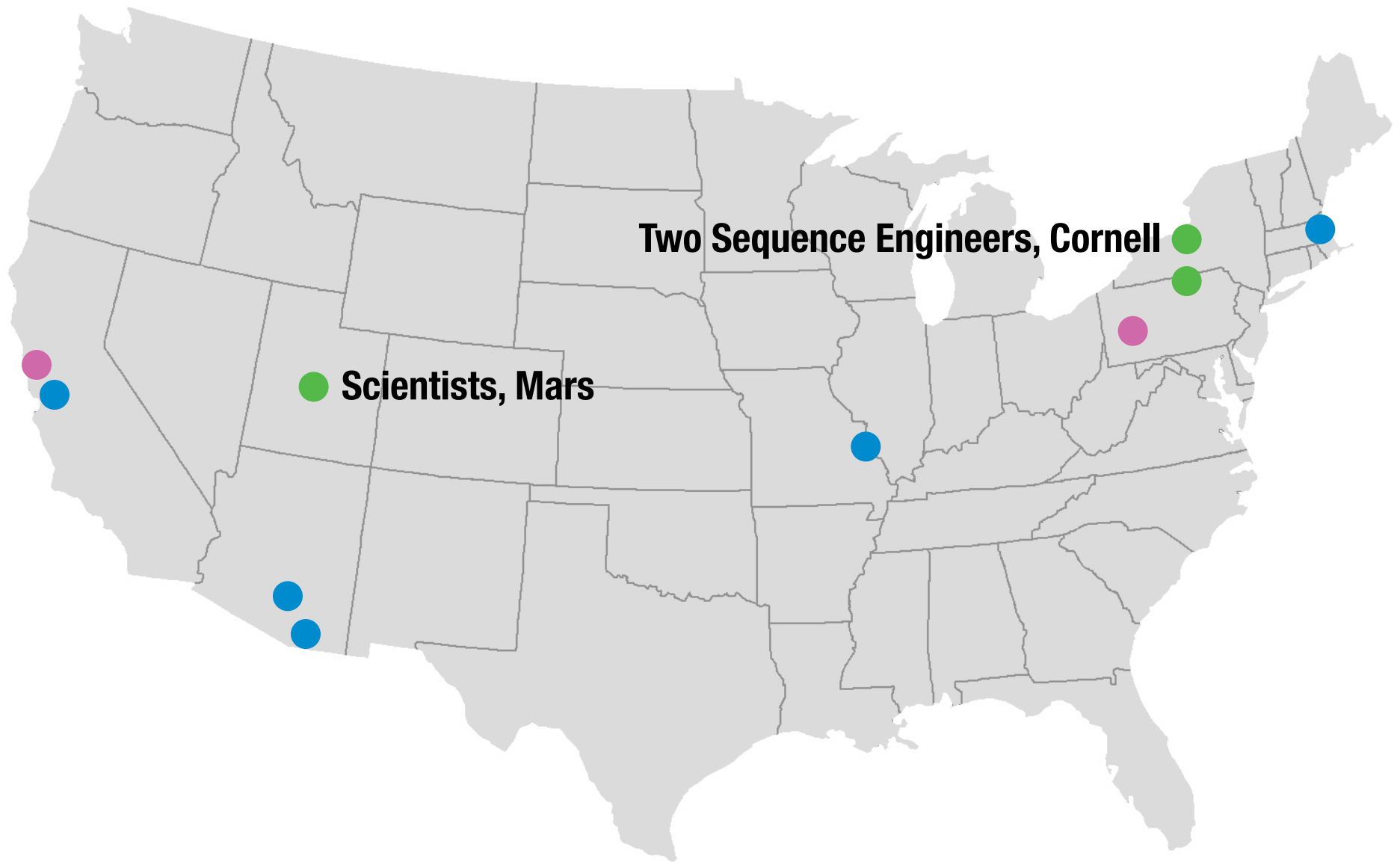


# retrospective CIs

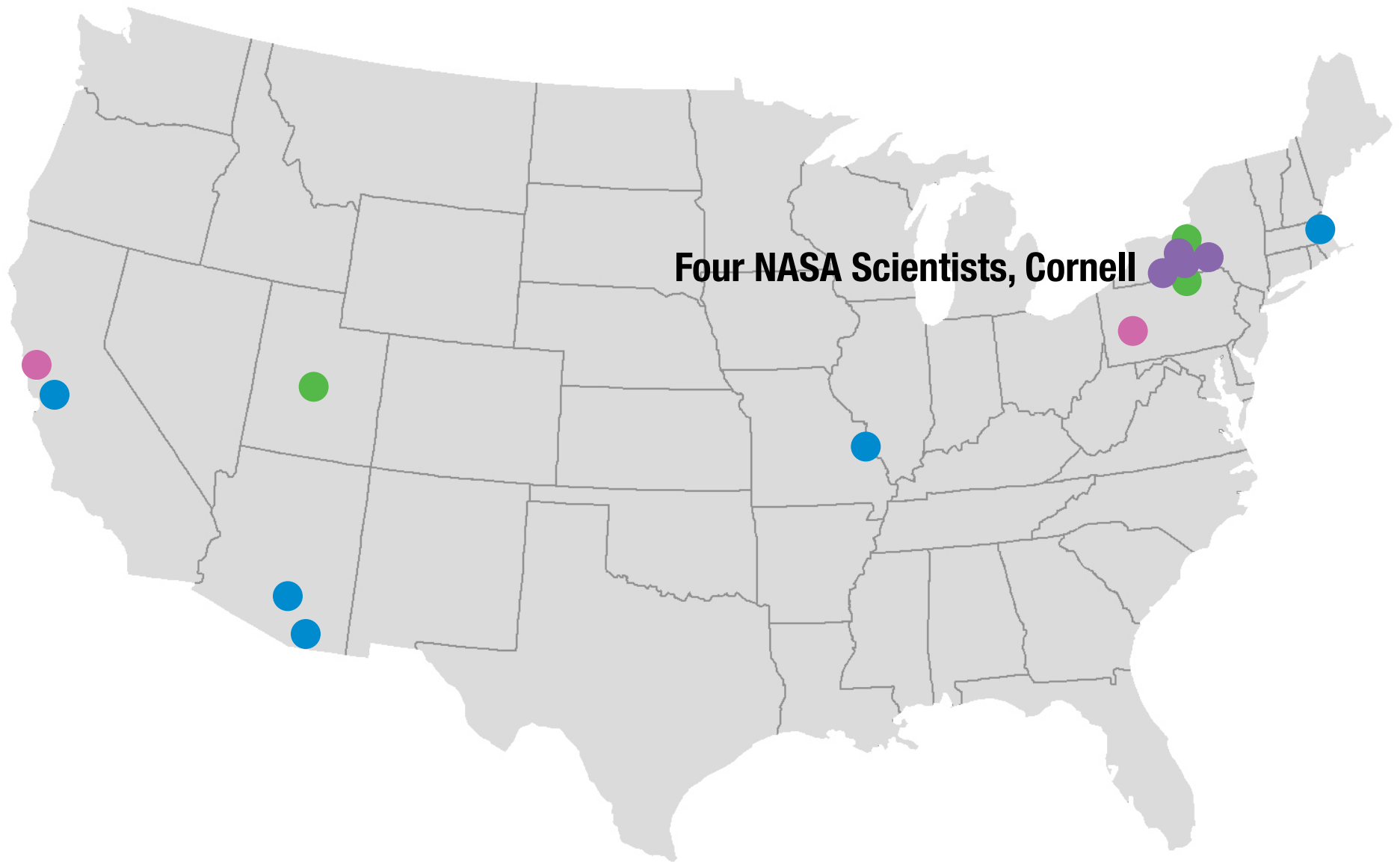




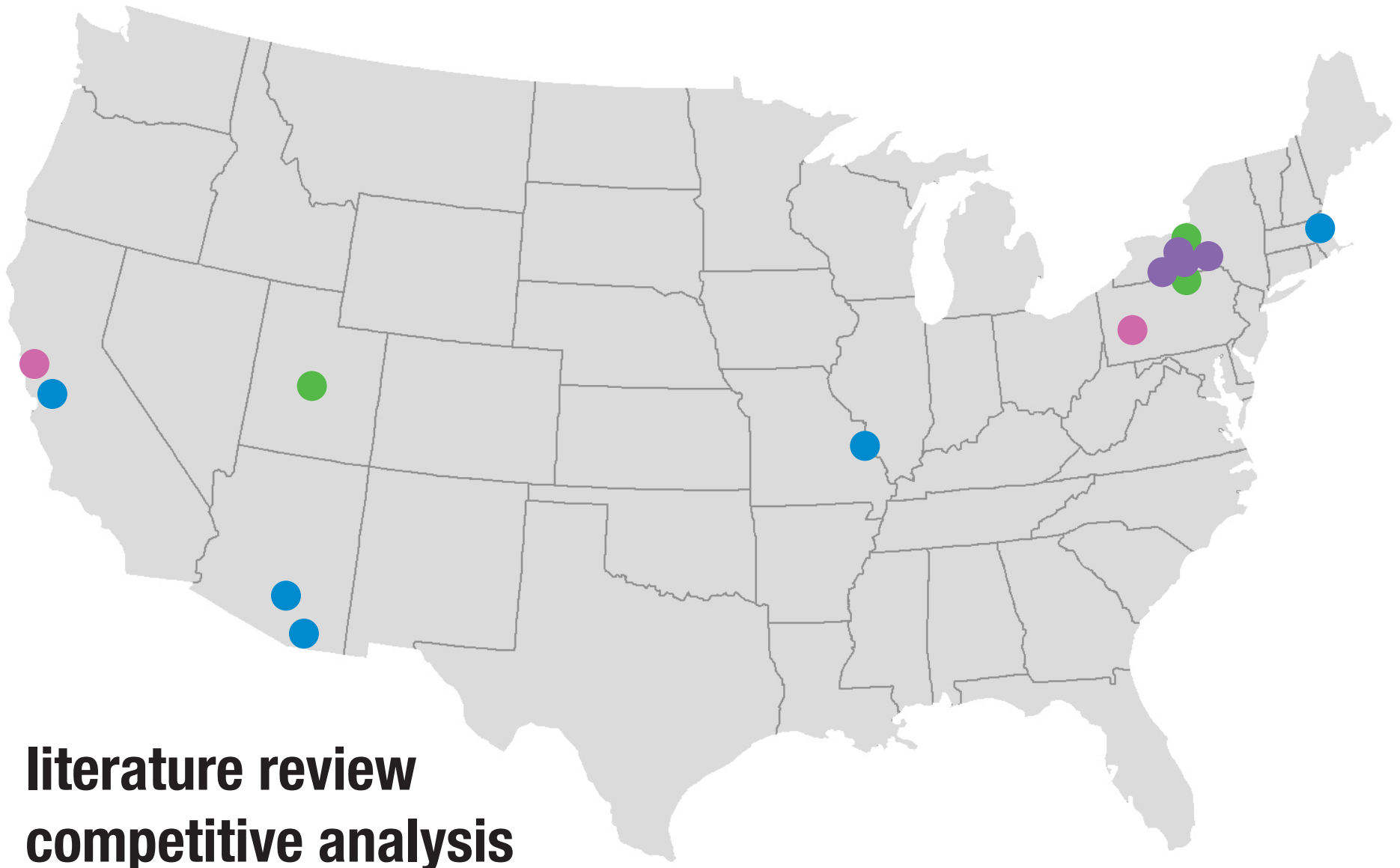
# CIs



# interviews



# other research



**literature review**  
**competitive analysis**

# modeling and consolidation



# machine shop foreman



# international space station



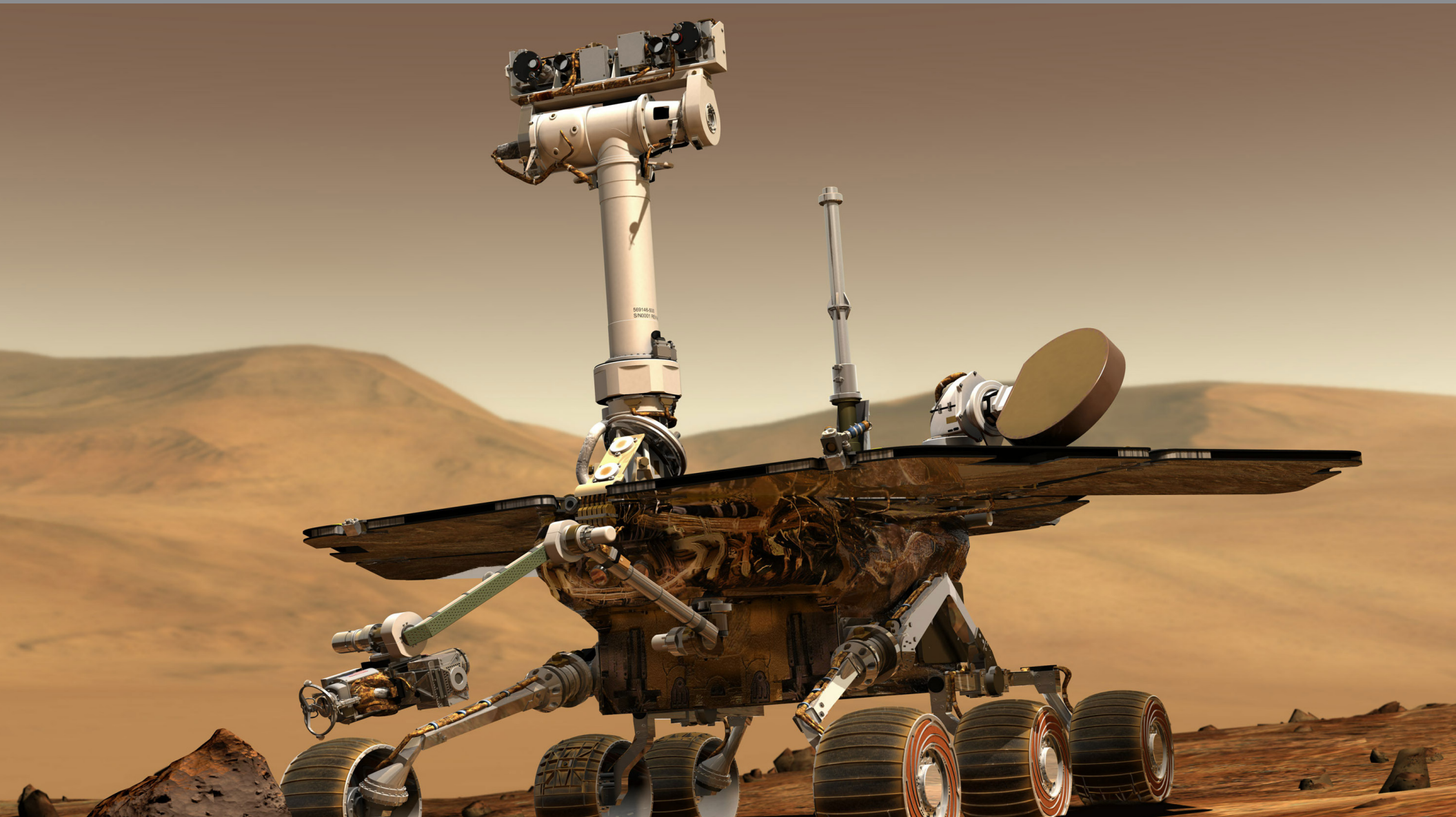
Jessa Hafer-Zdral, M. Azim Ali, Jon Bidwell, Steve Hillenius, Joanna Bresee

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# mars desert research station



# mars exploration rover

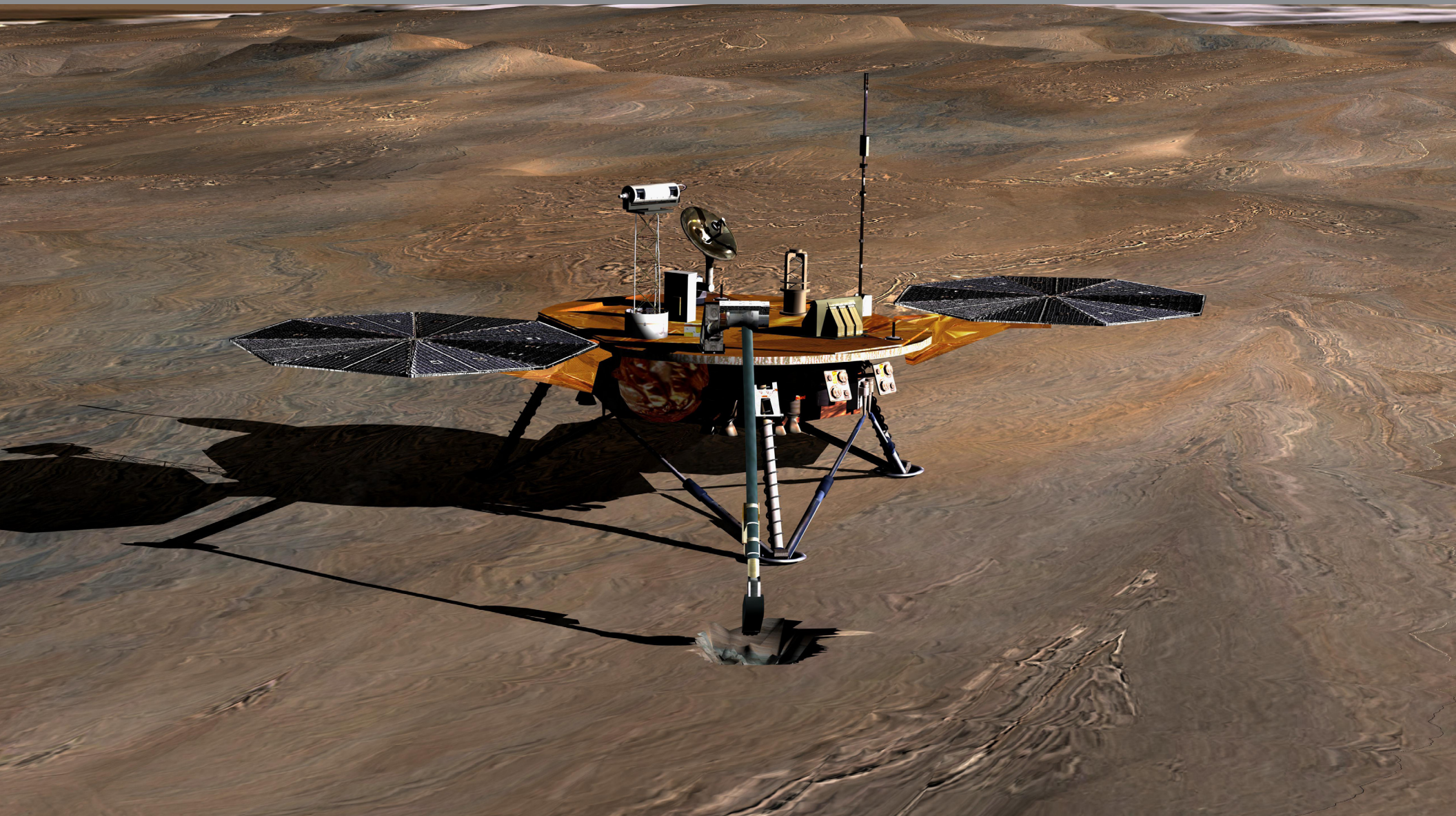


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# phoenix lander

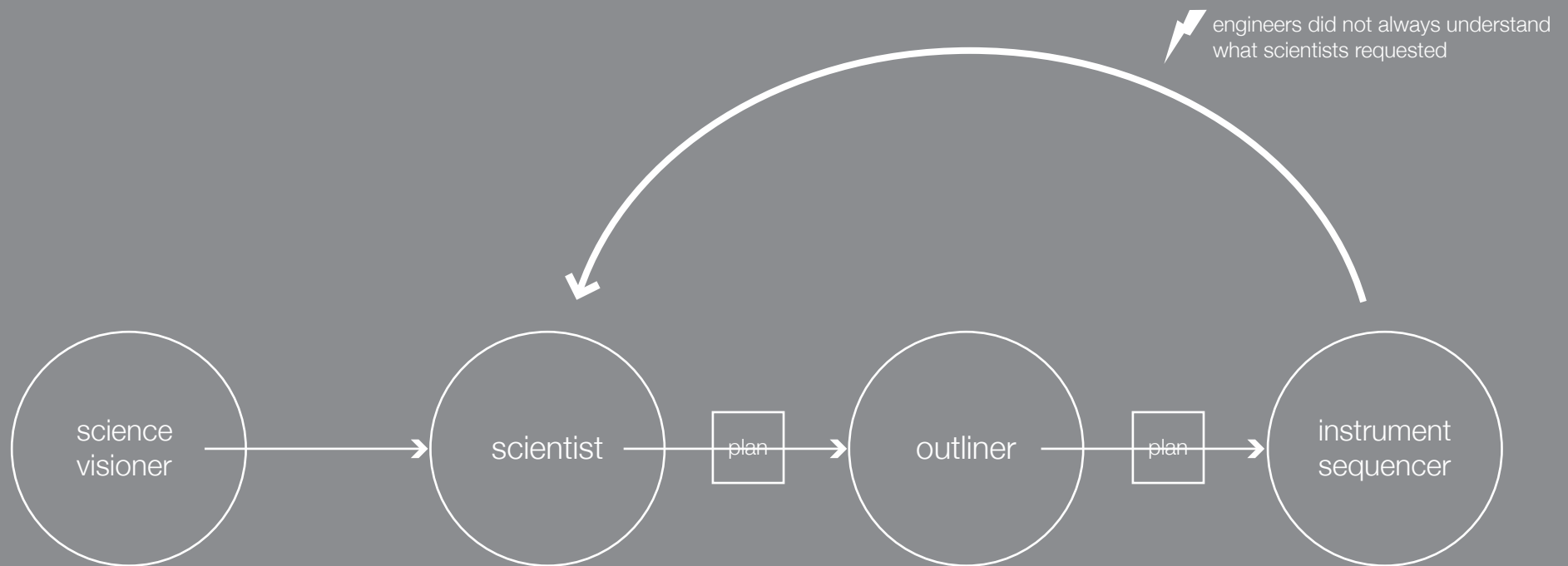


# themes

1. Scientists were not able to communicate in a language engineers could use
2. Ongoing local problem solving required immediate communication
3. Specialized tools created fragmented planning workflow



# theme 1: scientists were not able to communicate in a language engineers could use



**“Scientists think everything  
is possible all the time.”**

**-Phoenix Instrument Sequence Engineer**

**“I’d like to say that everyone was competent, but that’s just not the case sometimes.”**

**-Phoenix Instrument Sequence Engineer**

**“They knew that they  
[expletive deleted] at PSI, and  
they would tell us that.”**

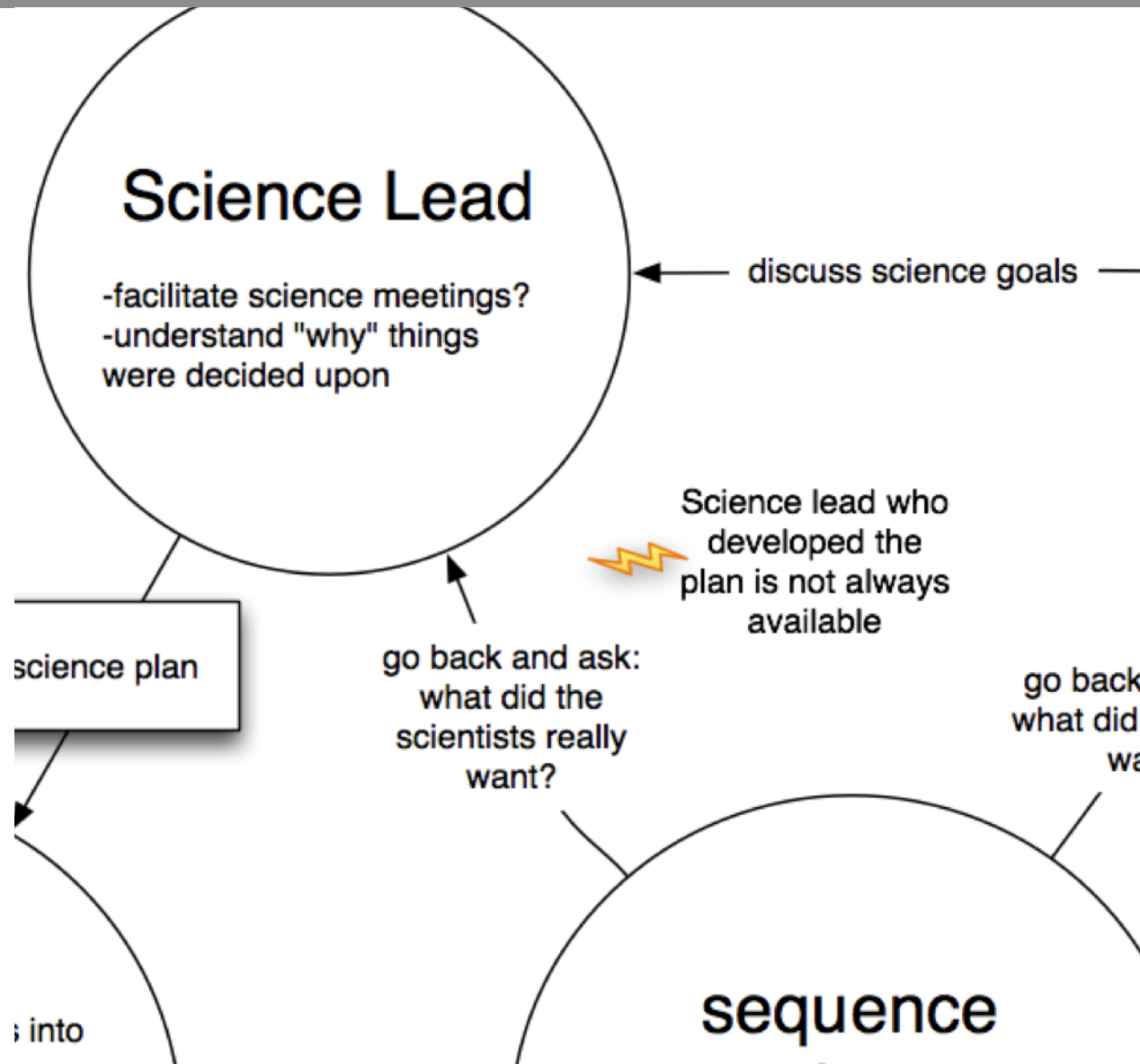
**-Phoenix Tactical SPI**

# constraints not communicated

**“How long it takes to turn an instrument on would constantly change and that information didn’t get out to all forty people that could be building a plan.”**

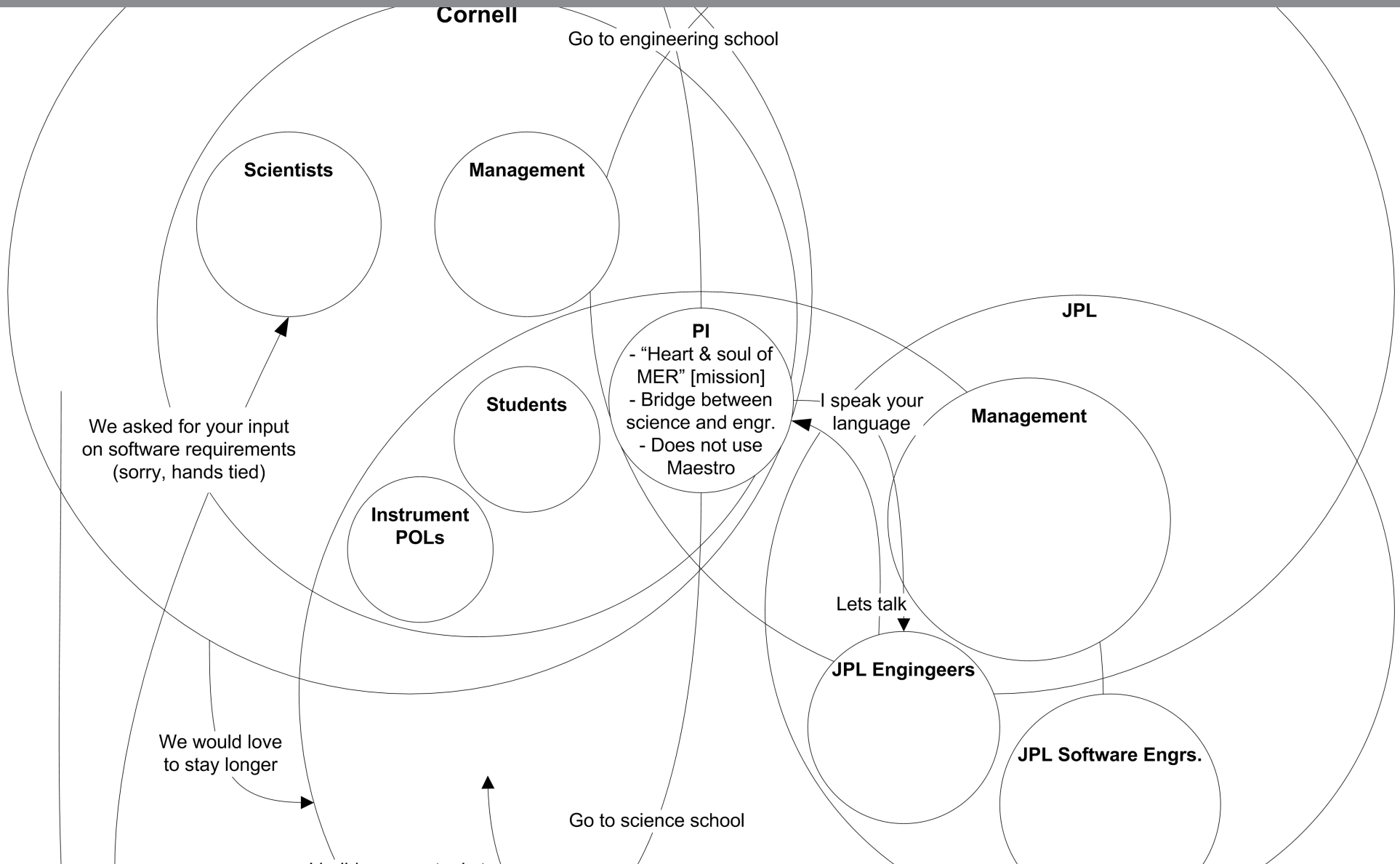
**-Phoenix Tactical SPI**

# hard to understand intent





# cross training



# hard to understand intent

**“Do the students’ requests get better over time?”**

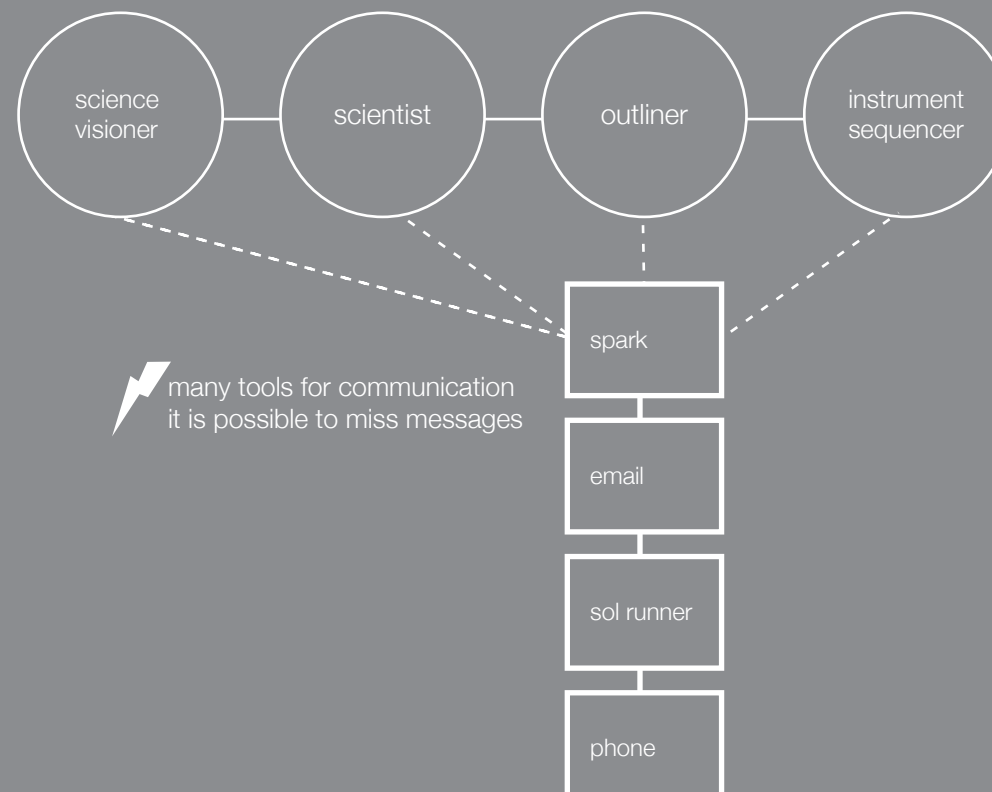
**“Absolutely.”**

**-CMU machine shop foreman**

**design implication:  
visualize constraint information in a way  
that is easy for scientists to understand**

## theme 2:

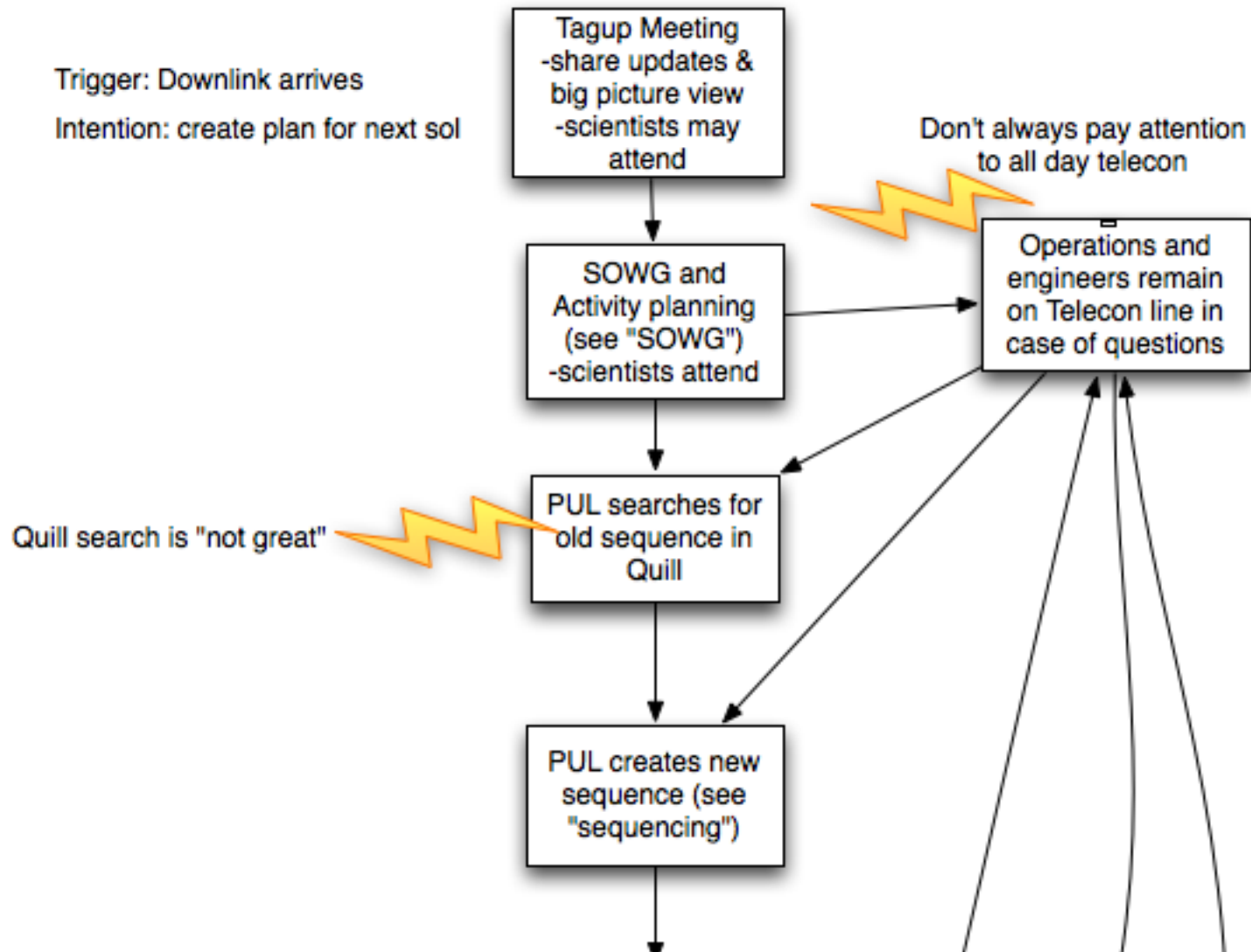
# ongoing local problem solving required immediate communication



**“It was frustrating because you knew there was someone who could answer your question right away, but they weren’t available.”**

**-Phoenix Instrument Sequence Engineer**

# teleconference loop



- Calendar
- Contacts
- Deleted Items
- Dheeraj
- Drafts [1]
- Inbox
- Journal
- Junk E-mail
- Notes
- Outbox
- Sent Items
- Sync Issues
- Tasks
- Search Folders
- Archive Folders
- Personal Folders
- Calendar
- Contacts
- Deleted Items
- Drafts
- DRPT
- ELMS
- Mail
- Calendar
- Contacts
- Tasks
- Notes

Look for: Search In: Inbox Find Now Clear

**Inbox**

Arranged By: Date Newest on top

**Today**

bchandra@iitk.ac.in	5:48 PM	[acadstaff] [Fwd: Re: To attend the PAN I...]
cguest@iitk.ac.in	3:11 PM	Proficiency Test
cguest@iitk.ac.in	Received: Thu 9/8/2005 3:11 PM Size: 49 KB	Proficiency test
Gopesh Tiwari	1:42 PM	An important Tip
Gopesh Tiwari	12:04 PM	Pl scrutinise the paper
SUNDAR J	11:42 AM	[Fwd: clustering] clustering articles
Arun Kumar Sharma	9:25 AM	
<b>Dheeraj Sanghi</b>	<b>1:43 AM</b>	<b>reminder</b>

**Yesterday**

Dheeraj Sanghi	Wed 11:34 PM	[Fwd: CC scanner not working]
Voice & Data Reader service	Wed 3:26 PM	Voice&Data - September '2005 issue - Now O...
info@samsantravels.com	Wed 3:00 PM	Re: Air Deccan
Yatindra Nath Singh	Wed 1:31 PM	[acadstaff] Brihaspati problem - update.

**Tuesday**

Dheeraj Sanghi	Tue 11:34 PM	
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**reminder**

Dheeraj Sanghi [dheeraj@iitk.ac.in]

To: Gopesh Tiwari

Two things:

1. Test at 2:00 PM
2. Send a mail to ug00@lists.iitk.ac.in asking the to move to exchange server.

-dheeraj  
--  
Dheeraj Sanghi  
<http://www.cse.iitk.ac.in/users/dheeraj>  
Professor, CSE Dept., and Off: 259-7077,7638 E  
259-0725,7586  
Head, Computer Center Off: 259-7252,7651 E  
IIT Kanpur, UP 208016

-----  
If you want to make enemies, to  
Wilson

**Spark - mark**

Spark Contacts Actions Help

**Mark Sexton-Petrie**  
Online

**Jive Software (28 online)**

- Aaron Johnson
- Anthony Dotson - On the phone
- Barry Tallis
- Ben LeBlond
- Bill Lynch - Heads down
- Bruce Ritchie
- Dave Hersh - Extended Away
- Dennis Devery - On the phone
- El Gato
- Erskine Williams - On the phone
- Greg Unrein

**Fastpath Conversation with luis**

(10:14 AM) luis: sure

(10:15 AM) pcabellor: ok, give I found this article in Firefox knowledge base:  
[http://support.mozilla.com/kb/ost-Bookmarks#Restoring\\_bookmark\\_backups](http://support.mozilla.com/kb/ost-Bookmarks#Restoring_bookmark_backups)

(10:15 AM) pcabellor: you may want to give it a look and see if it suits your case

(10:16 AM) luis: I think I'll try the restore procedure and get back to you if necessary

(10:16 AM) luis: thanks!

(10:17 AM) pcabellor: sure, I'll be here the net couple of hours or so, just mention my id (pcabellor) when you get back

(10:17 AM) pcabellor: hope that helps

☺ ☑ Canned Responses

# many communication tools

**“You don’t have time to look in twenty different places to find out if you’ve been communicated with.”**

**-Phoenix Lead Tactical SPI**



**“Visuals helped a lot when they were there.”**

**-Phoenix Lead Tactical SPI**

# image annotation

# 2

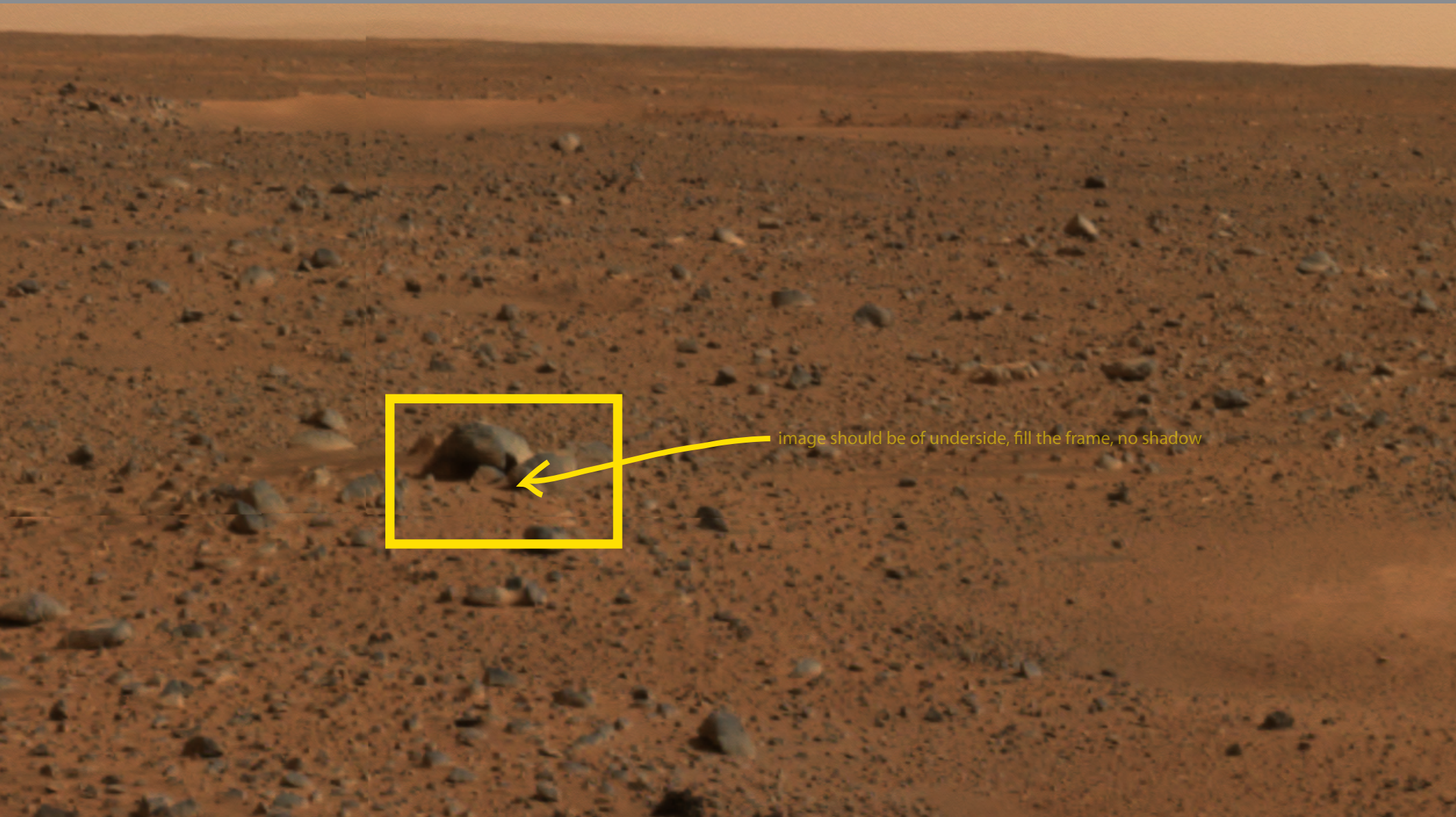
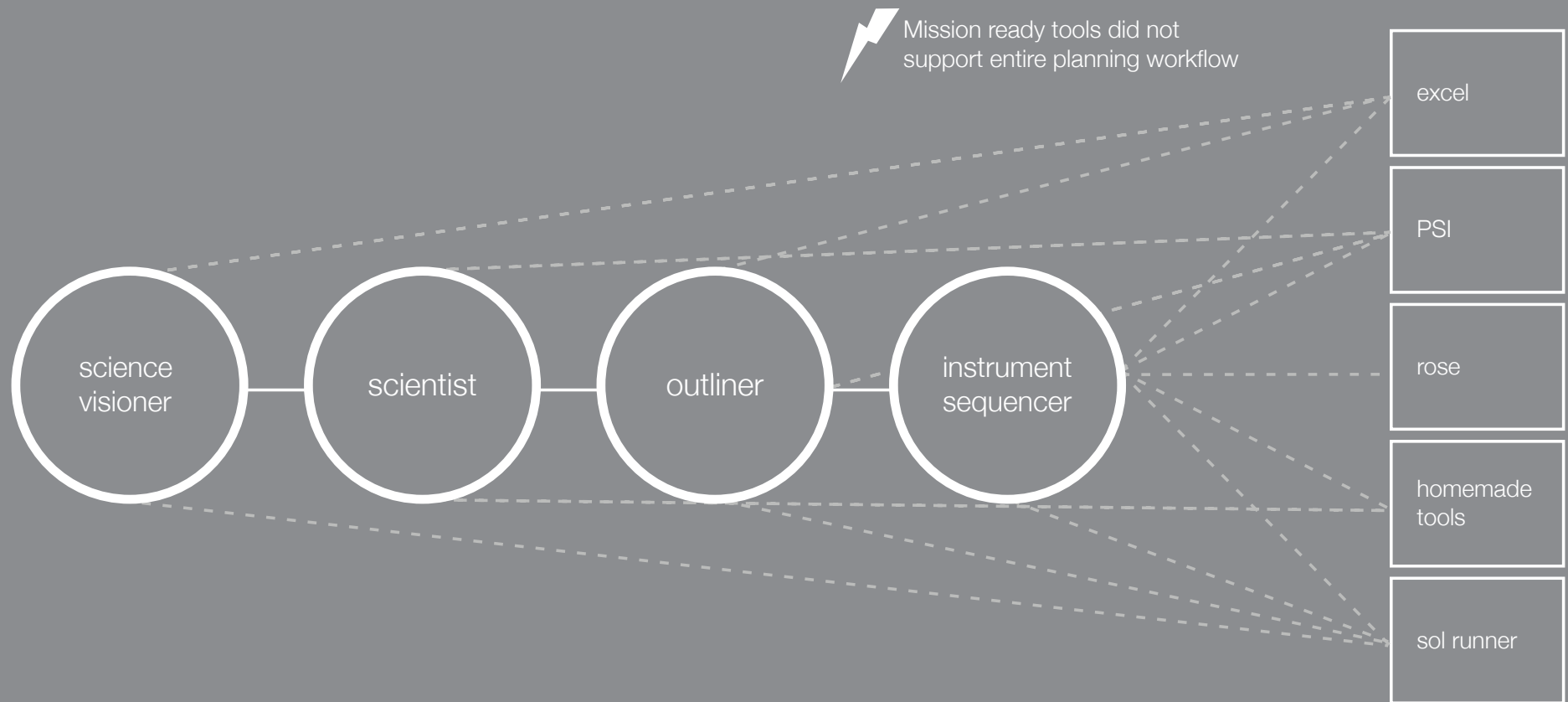


image should be of underside, fill the frame, no shadow

**design implication:  
incorporate communication tools within  
planning for rapid troubleshooting**

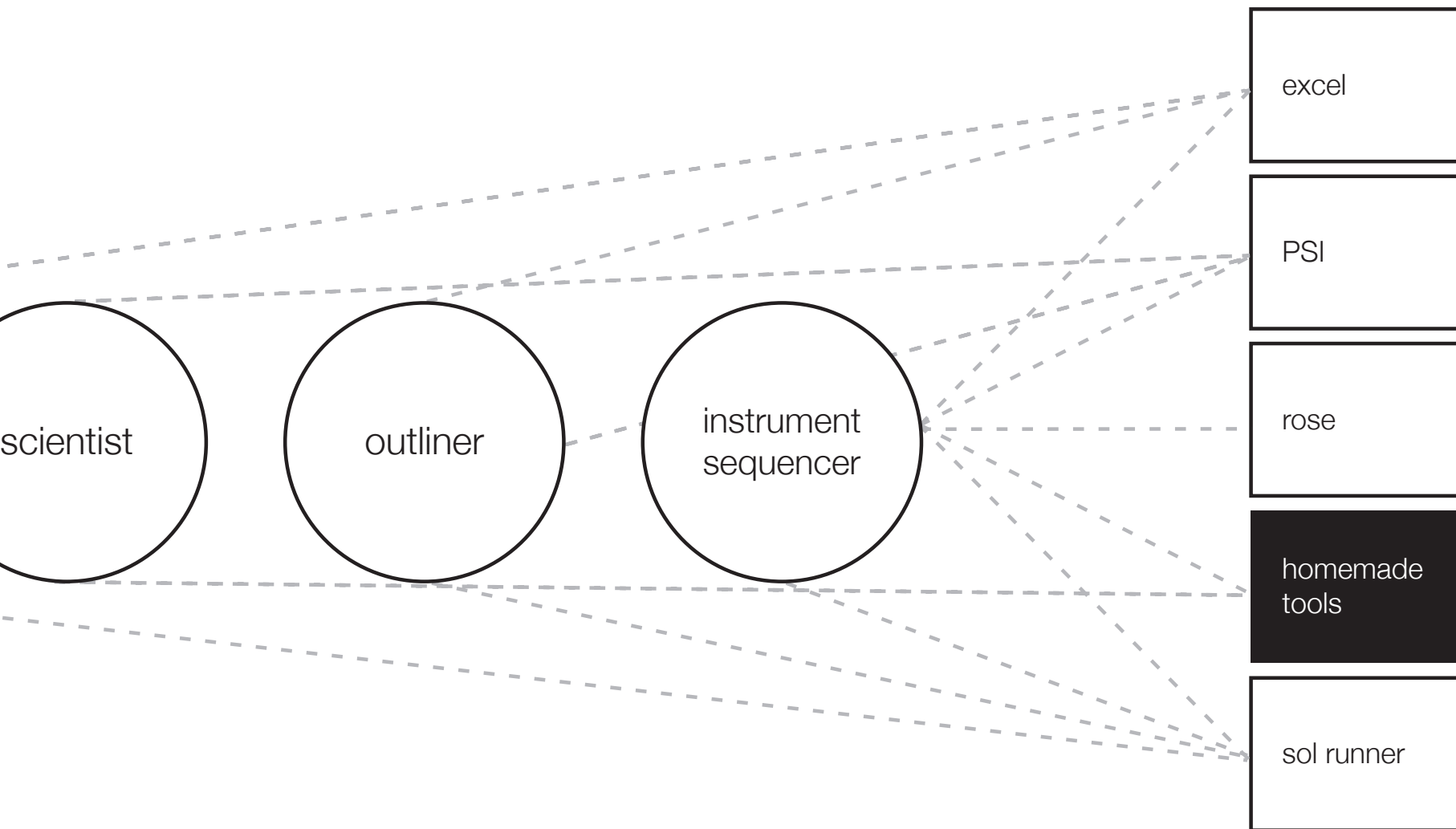
## theme 3:

### specialized tools created fragmented planning workflow

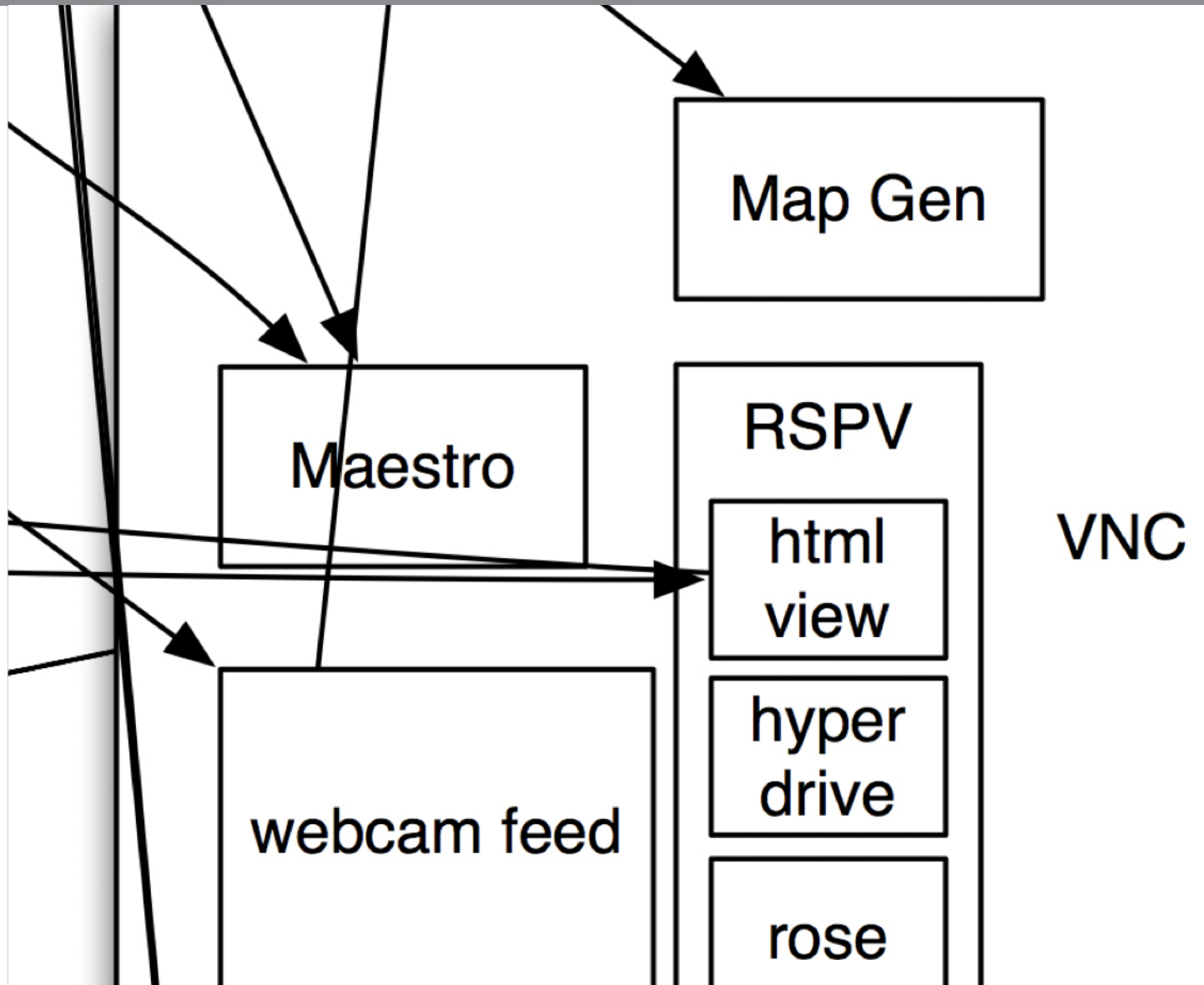


# homemade tools

# 3



# tool switching



## generic tools

Planning day	PRIMARY MISSION					
Planning day of the week	Sol 57	Sol 58	Sol 59	Sol 60	Sol 61	Sol 62
ns due to SSP by AM of:						
Restricted Power						
Interaction Limit (ISEs)						
Sampling Interop	Scraping at SnowWhite, B2F Maneuver, TEGA and WCL0 del pose	RA Placement Test, Scraping in Snow White	RA down day, B2F Xfer and dump	4x4 RASP, acquire sample and delivery to TEGA	Sprinkle sample on MECA cover	Scrape, RASP Acquire and Deli sample to TEG
Surface Imaging		Photometry	Change Monitoring DodoGoldi, photom, Happy pan	Coordinated HiRISE		Change monitori (DodoGoldi)
RAC	Doc clean scoop and divot		Image scoop			

# no standardization

## RA IDE [\[Edit\]](#)

**Summary.** - 2008-06-26 01:32:59 GMT  
**Last Updated:** - 2008-06-26 04:34:58 GMT

### **General overview**

Tosols RA activities consisted of delivering a sample to WCL0, a first time activity. Post deliver then moved to the acquire sample site and a RAC image taken. The scoop was then moved to the ws followed by RA actuator characterization at an azimuth pose p from the sol 4 run of the same

## SSP - Strategic Sci Planr [\[Edit\]](#)

**Summary.** - 2008-07-09 13:20:34 GMT  
**Last Updated:** - 2008-07-09 13:22:02 GMT

PLAN:

-----  
 strategic\_sol45\_primary\_v1

APF:

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**design implication:  
enable planning tools to evolve with the  
mission**

# robotic recon

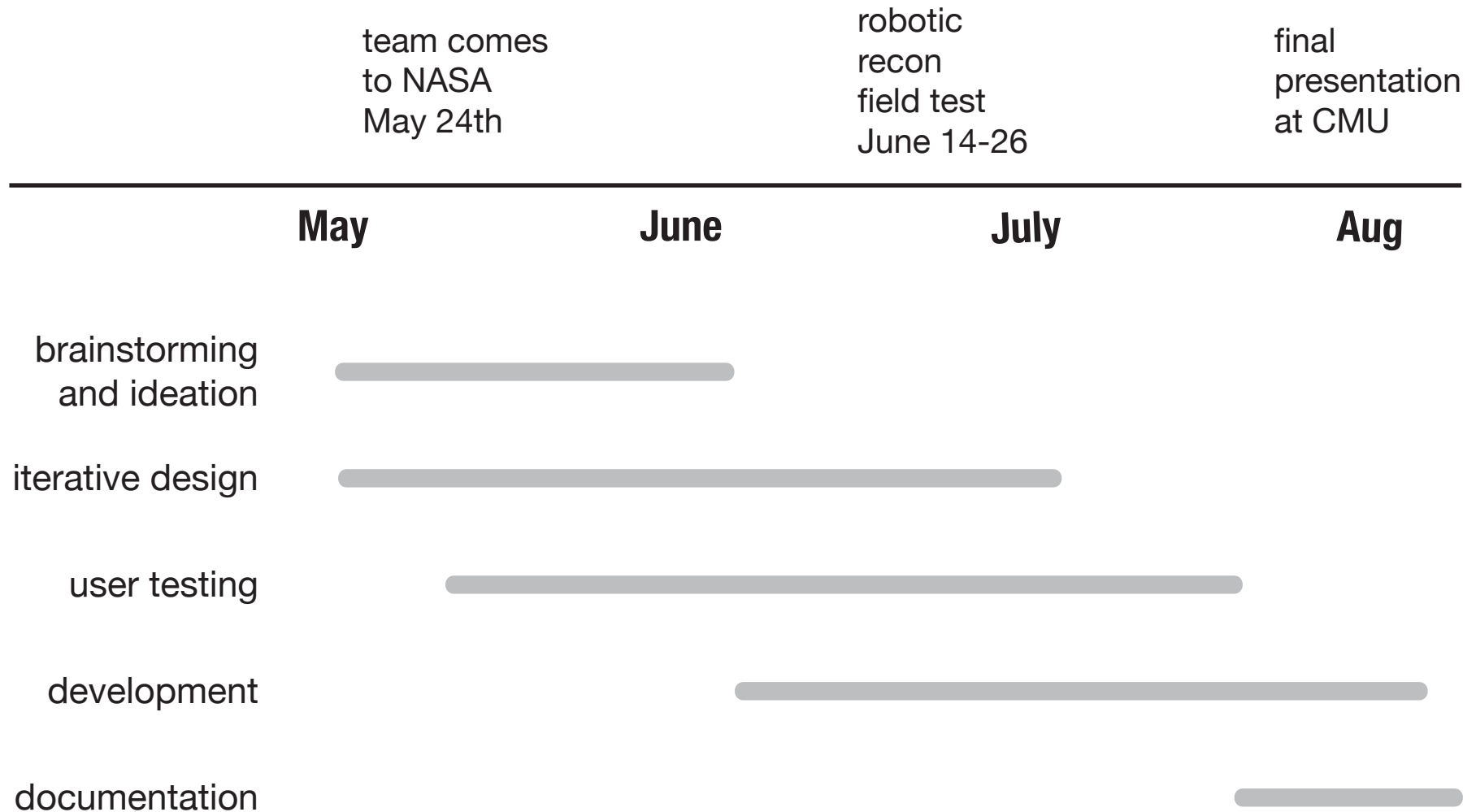
- 1. Advance field survey**
- 2. Surface data vs. orbital data**
- 3. Maximize crew productivity**

# findings

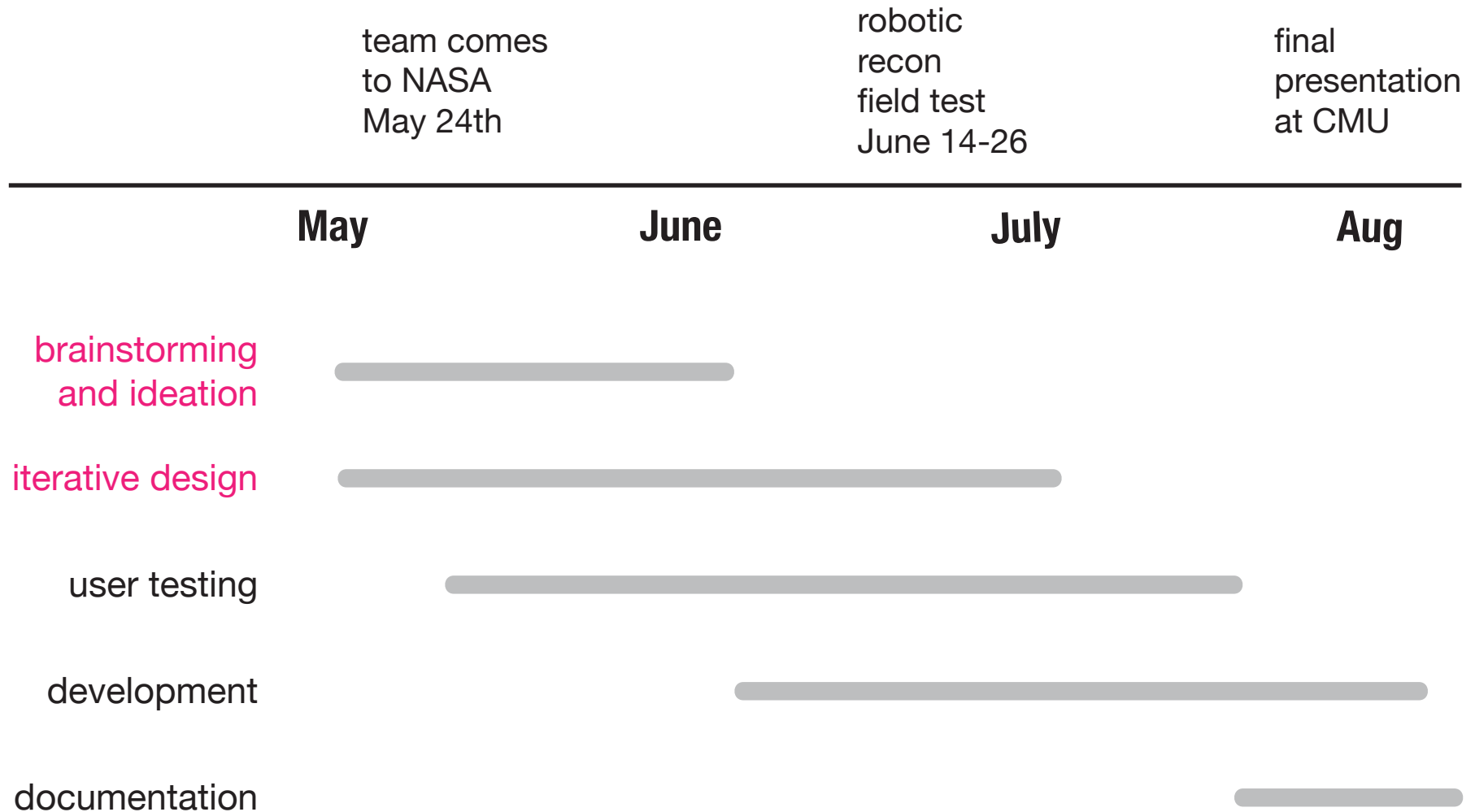
primary bottleneck is **science operations**

“There are **competing pressures** to analyze new data vs. generate next plans.”

# project timeline



# project timeline



# brainstorming

**1** Communication between groups (science and flight ops) for troubleshooting

- Plan History
- Share your screen
- See who made which part of plan - link to chat/console
- Window into other person's screen
- mission analytics
- distributed teams
- 3rd person's eye on both
- See who made which part of plan - link to chat/console

**2** Analyzing data: "Most of the time was spent discussing what they thought and what they thought they should do next."

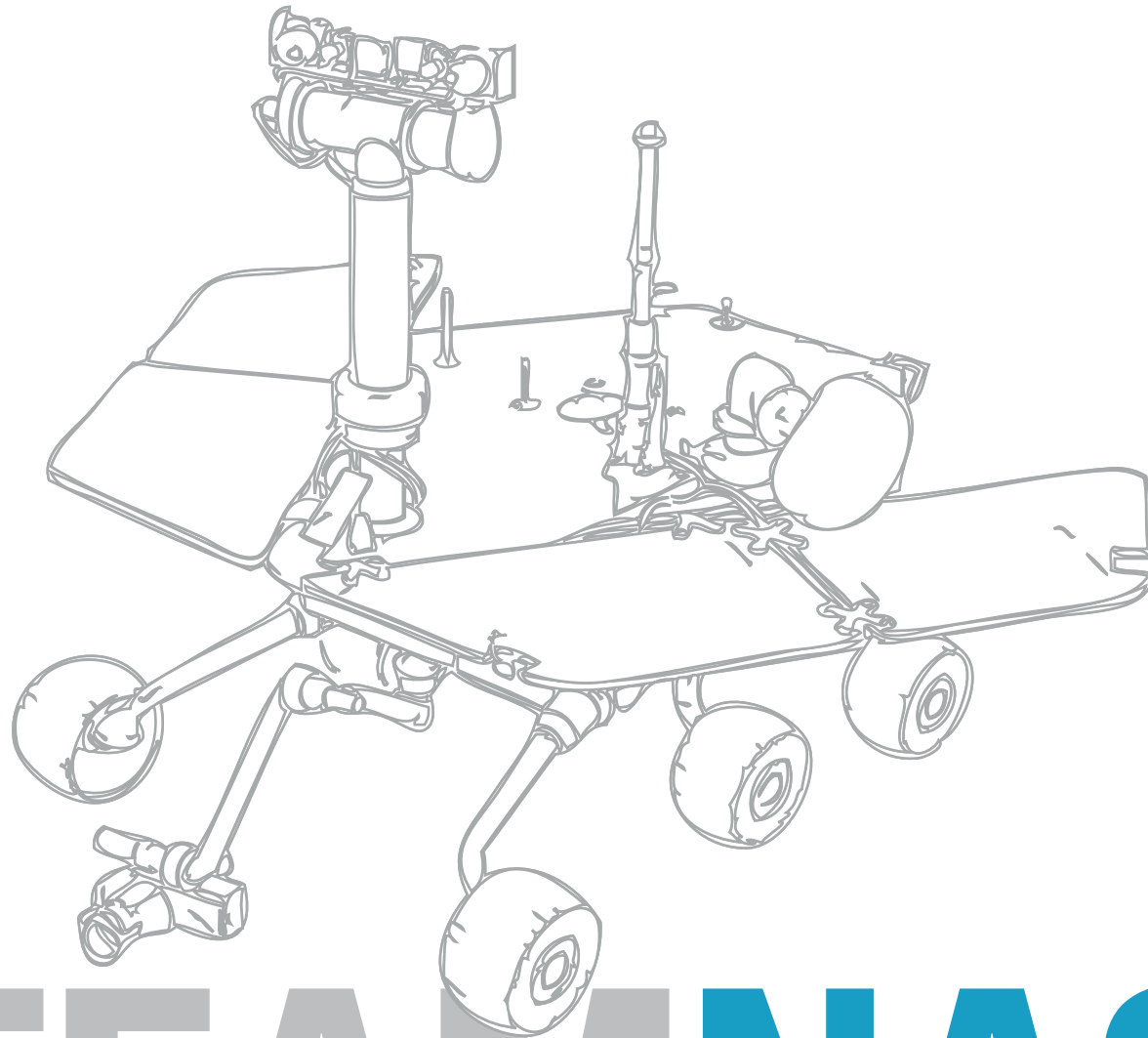
- Plan panorama
- Showing analysis, most promising sides get added to a "potential plan"
- Analysis speeding: Breaks Assign things that need to be analyzed to ind. scientists, they then only come together to discuss points that look interesting.
- Questions:
  - Do they return to places they haven't visited?
  - Explain by linking observations (sets of observations integrated into recon plan?)
- Simultaneous views when analyzing from "Terrain"
- Illustrate sun as falls on objects? "See" when sun is too harsh - in camera lens - simulate plan from

**3** Showing/explaining constraints

- Constraints that matter
  - Terrain
  - Sun: robot can't see when sun in lens
- Ask for help? NOTifies engineer.
- Visually differentiate "Sun" violation
- Simultaneous views when analyzing from "Terrain"
- Illustrate sun as falls on objects? "See" when sun is too harsh - in camera lens - simulate plan from

# design directions

- 1. support communication between groups for troubleshooting**
- 2. create a tool to help speed up data analysis**
- 3. explain constraint information in a way that scientists can understand**



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