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Co-Designing to Create Sustainable Software

How to leverage a user-centered process to co-design sustainable software with users and stakeholders

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5.26.2022

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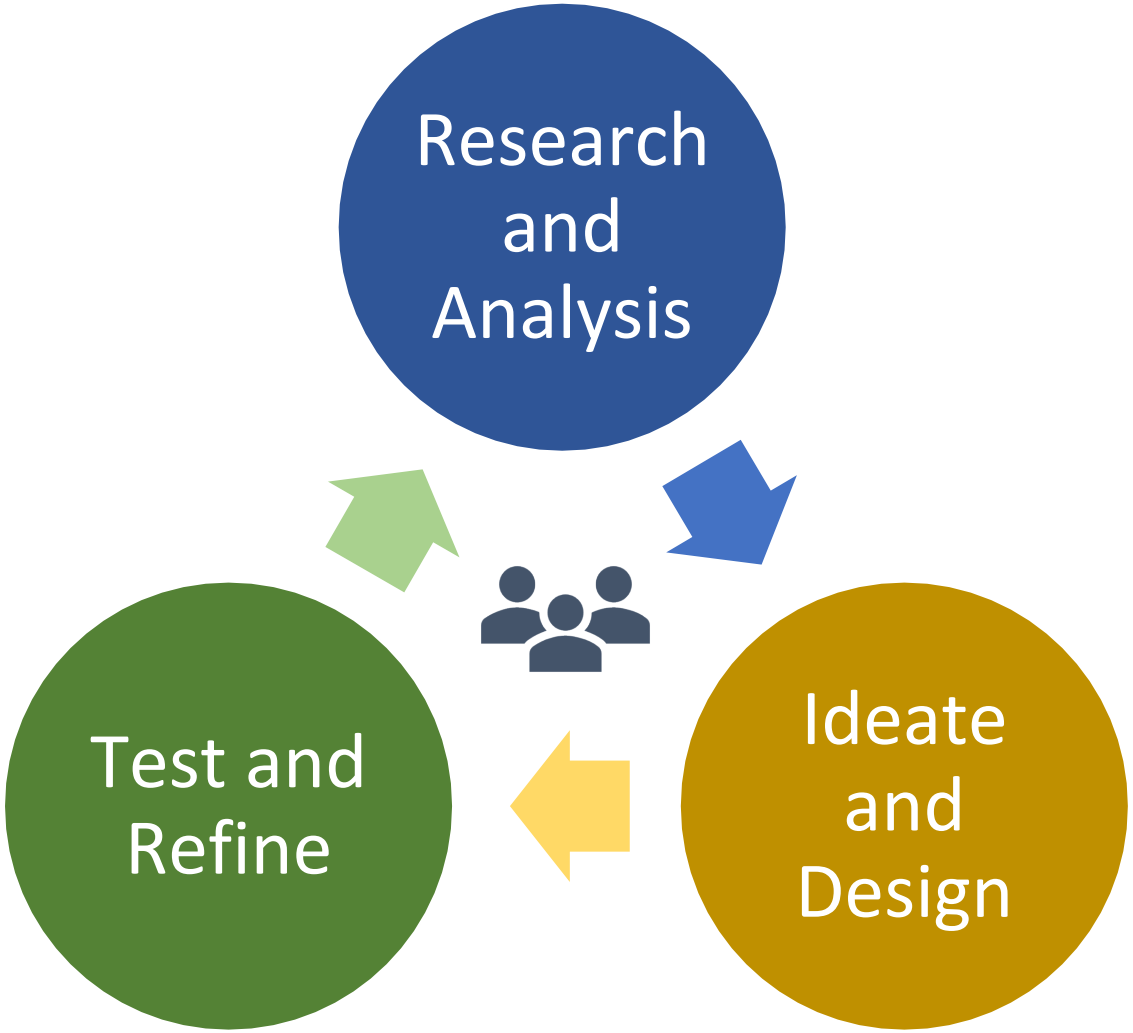
User Centered Design

Building sustainable products by designing with the user at the center of the process



Case Study

Research and Analysis

Goals:

- Build Empathy
- Understand users
- Identify and define use case(s)
- Create a foundation for sustainable products
- Ensure value

TABS User Research: Why & How

Research Purpose

- Learn about TABS existing user's and prospective user's needs
- Identify:
  - What's working well with the existing tool (TABS v5.0)
  - Opportunities for improvement
  - Barriers to adoption
  - Gaps between user expectations and new tool capability

Research Procedure

- Semi-structured interviews
  - Conducted 11, 1-hour interviews
- Participants
  - Six Internal and five external users
  - Participants Defined:
    - Current users: Battery Engineers who actively and consistently use the TABS tool
    - Prospective users: Battery Engineers whose work could fit into TABS scope, but do not use it
    - TABS SME

Identified Use Cases

Research & Development

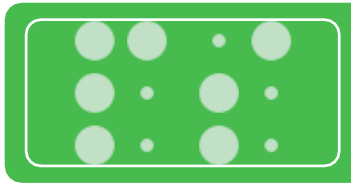
- Data/Products are not yet realized
- Theory

Design

- R&D informs; make adjustments with intent to implement
- Meet requirements

Ad-Hoc Curiosities

- Exploratory/Building Block questions – casual; leads to more sophisticated questions
- “We don’t know what we don’t know”



Non-Traditional

- Aging

Building Subject Matter Expertise

- New battery designer learns about batteries through the tool
- As the tool’s abilities evolve, so do the user’s: “I grow with the tool”

User Design Drivers

As a _____ user, I want to:

Prospective User

easily build models and run simulations for quick turnaround analysis

Design Drivers:

- Clean, simple UI
- Easily accessible tool
- Progress me through the standard workflow
- Develop basic expertise
- No command line
- Error avoidance
- Robust visualizations

Novice User

be empowered to investigate a whole manner of questions

Design Drivers:

- Clean, simple UI
- Easily accessible tool
- Progress me through standard+ workflows
- Enable me to answer my own questions
- Grow my expertise
- Error resolution
- Robust visualizations

Experienced User

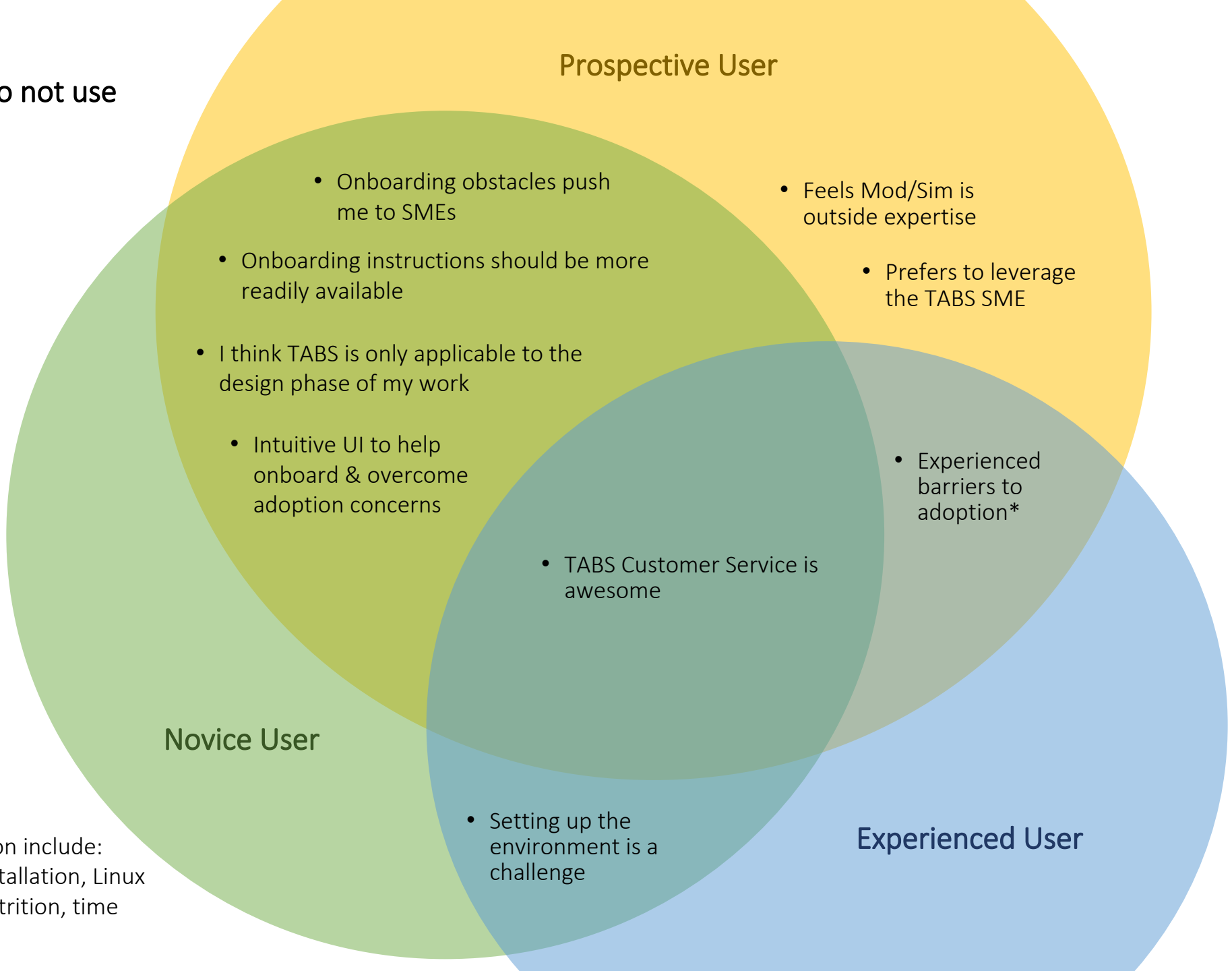
have more insight into what informs my analysis (e.g. mesh details)

Design Drivers:

- Access to more details
- Raw data
- Help through complex use cases
- Build robust expertise
- Understand what's going on behind the sciences
- Error resolution
- Insight into & interaction with mesh & material database
- Robust visualizations

Theme 1:

I have reason to not use TABS



Give me: Persistent resources like videos and interactive classes that help make help standard and accessible

*Barriers to adoption include: time consuming installation, Linux OS, CLI, resource attrition, time constraints to learn

Give me: a clear idea of what the SMEs can/should do for me vs. what I can do myself

Project goal: less customers, more users

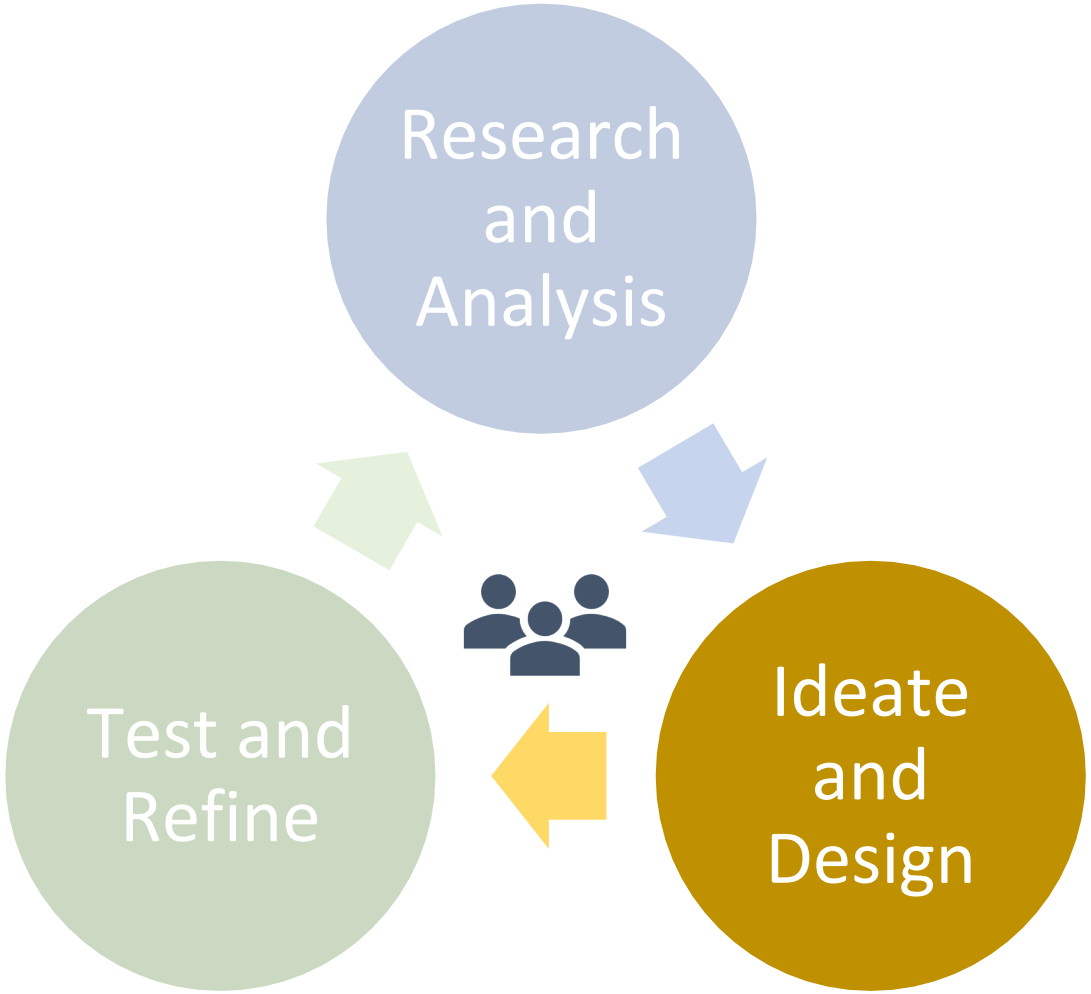
Give me: a web app so I don't have to set up an environment

Give me: the simple, intuitive, UI I've grown to appreciate in TABS, to help me easily navigate the thermal battery workflow

Ideate & Design

Goals:

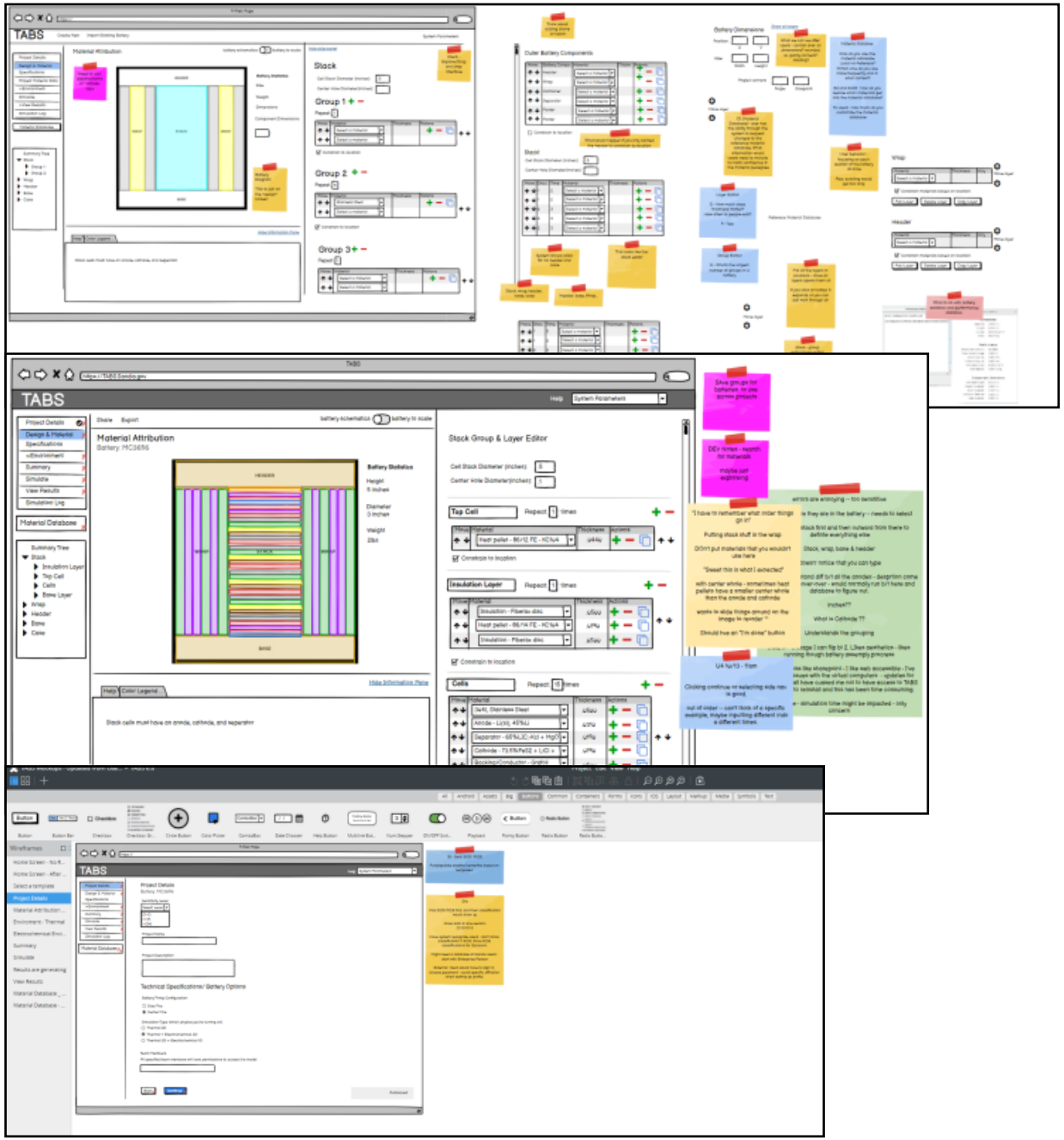
- Involve stakeholders
- Rapidly turnaround concepts
- Ensure value



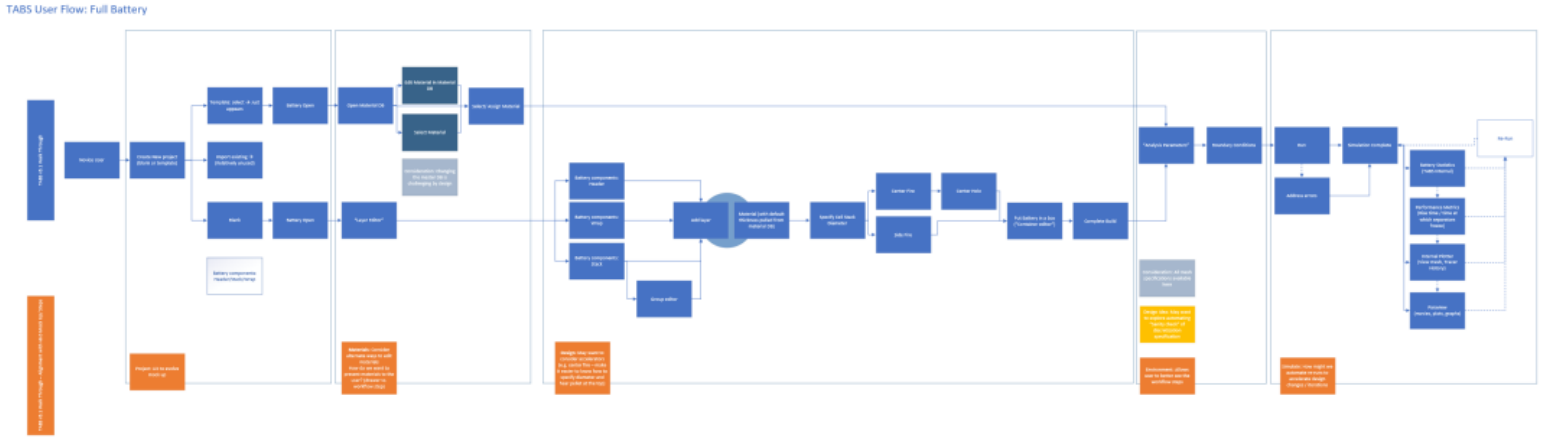
Ideate & Design

- Designing with Stakeholders
  - Co-Design Sessions
  - User Interviews/Usability Studies

- Procedure
  - Low-fidelity mockups
  - Focus content, layout, and flow, rather than intricate details
  - Facilitator acts as the “pen”
  - Use tools that allow for modification during the session
  - Document findings & decisions
  - Start early, repeat often, don’t be afraid to ditch ideas



TABS User Flows & Requirements



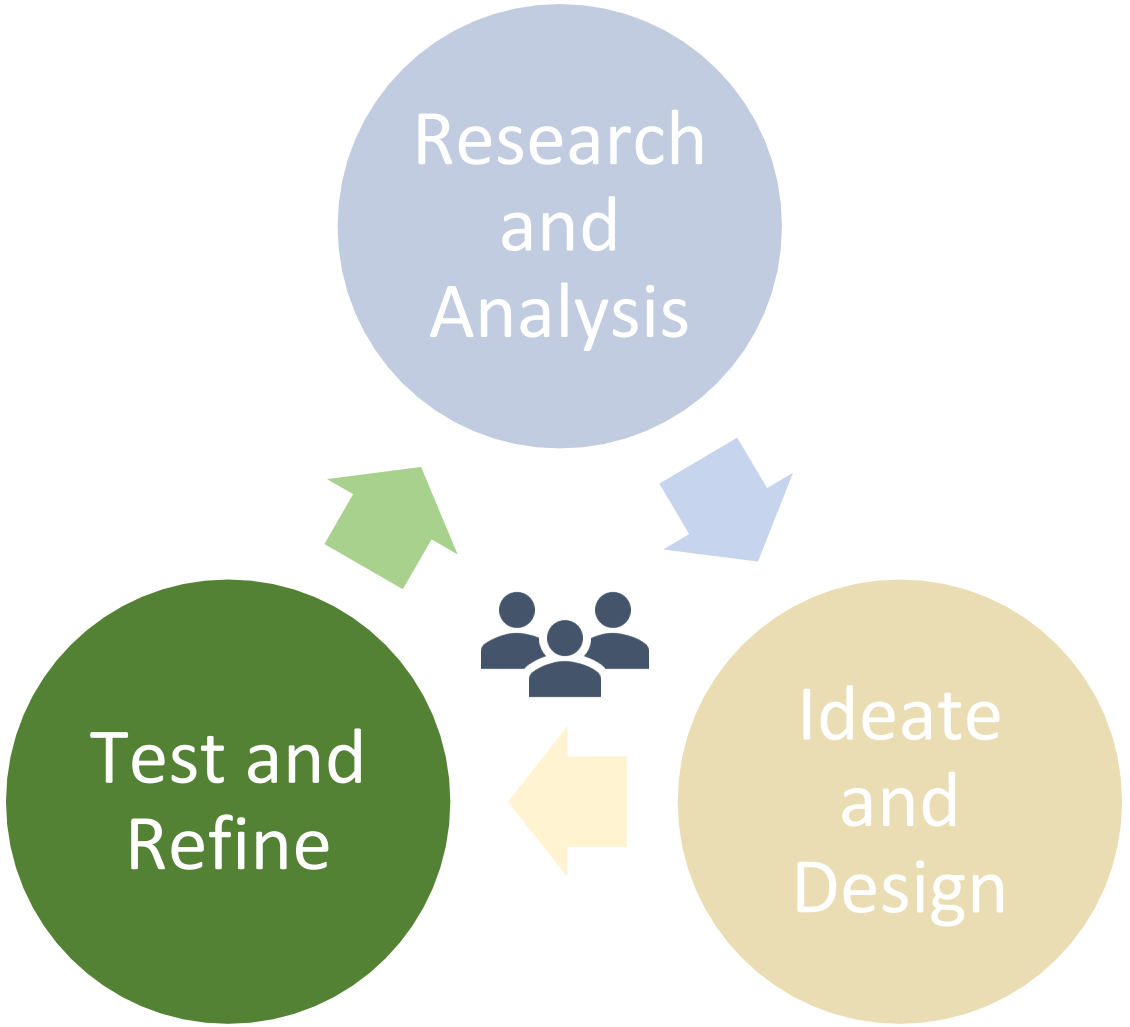
User Flow: Full Battery

Material Database: Relationship Requirement Model

Test & Refine

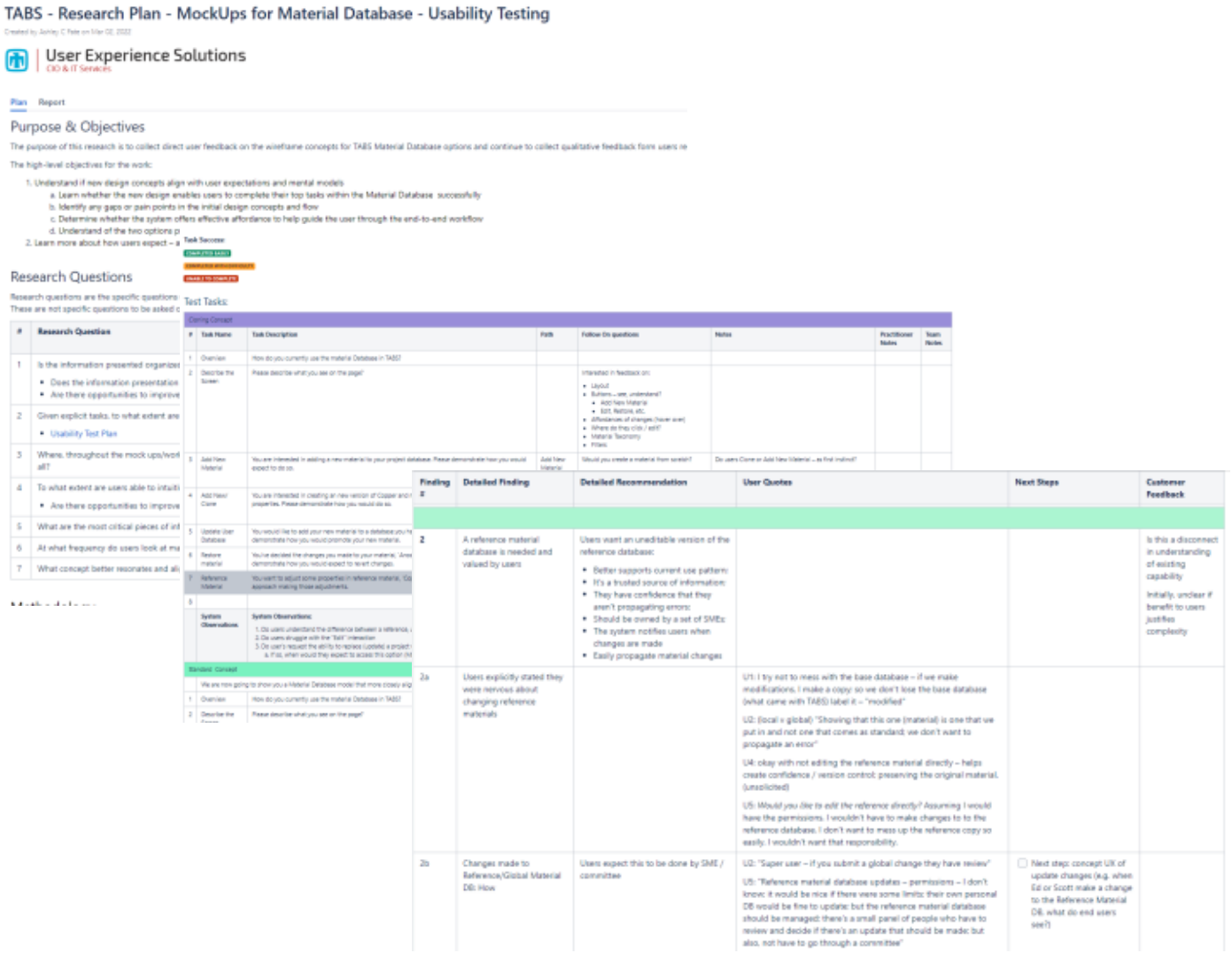
Goals:

- Disprove assumptions and hypotheses
- Align with user mental models
- Ensure value



Test & Refine-Usability Studies

- Create research plan and verify with customers
- Create test tasks that align with research questions
- Test with various user types
- Document findings, recommendations, and decisions based on user data
- Test early and often!



TABS - Research Plan - MockUps for Material Database - Usability Testing

User Experience Solutions
CIO & IT Services

Plan Report

Purpose & Objectives

The purpose of this research is to collect direct user feedback on the wireframe concepts for TABS Material Database options and continue to collect qualitative feedback from users re

The high-level objectives for the work:

1. Understand if new design concepts align with user expectations and mental models
   a. Learn whether the new design enables users to complete their top tasks within the Material Database successfully
   b. Identify any gaps or pain points in the initial design concepts and flow
   c. Determine whether the system offers effective affordance to help guide the user through the end-to-end workflow
   d. Understand of the two options p
2. Learn more about how users expect – a

Task Success

Research Questions

Research questions are the specific questions
These are not specific questions to be asked

#	Research Question
1	Is the information presented organize • Does the information presentatio • Are there opportunities to improve
2	Given explicit tasks, to what extent are • Usability Test Plan
3	Where, throughout the mock ups/wor all?
4	To what extent are users able to intuiti • Are there opportunities to improve
5	What are the most critical pieces of int
6	At what frequency do users look at ma
7	What concept better resonates and all

Test Tasks:

Coming Concept

#	Task Name	Task Description	Path	Follow On questions	Notes	Practitioner Notes	Team Notes
1	Overview	How do you currently use the material Database in TABS?					
2	Describe the Screen	Please describe what you see on the page!		Interested in feedback on: • Layout • Buttons – see, understand? • Add New Material • Edit, Restore, etc. • Affordances of changes (hover over) • Where do they click / edit? • Material Taxonomy • Filters			
3	Add New Material	You are interested in adding a new material to your project database. Please demonstrate how you would expect to do so.	Add New Material	Would you create a material from scratch?	Do users Clone or Add New Material – as first instinct?		
4	Add New/ Clone	You are interested in creating an new version of Copper and c properties. Please demonstrate how you would do so.					
5	Update User Database	You would like to add your new material to a database you h demonstrate how you would promote your new material.					
6	Restore material	You've decided the changes you made to your material, 'Area demonstrate how you would expect to revert changes.					
7	Reference Material	You want to adjust some properties in reference material, Co approach making those adjustments.					
8							
	System Observations	System Observations: 1. Do users understand the difference between a reference, 2. Do users struggle with the "Edit" interaction 3. Do user's request the ability to replace (update) a project a. If not, when would they expect to access this option (no					

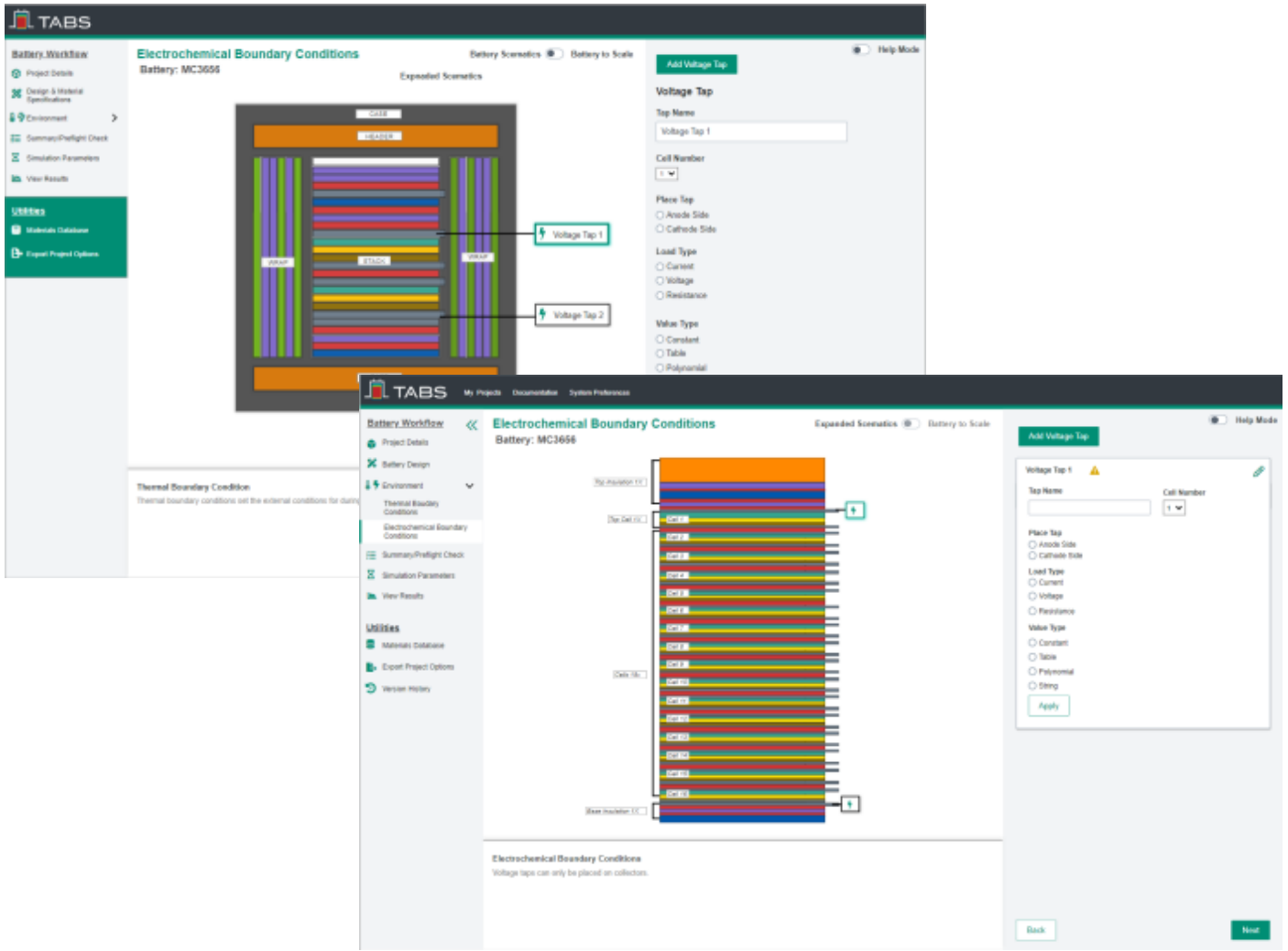
Standard Concept

	We are now going to show you a Material Database model that more closely aligns						
1	Overview	How do you currently use the material Database in TABS?					
2	Describe the Screen	Please describe what you see on the page!					

Finding #	Detailed Finding	Detailed Recommendation	User Quotes	Next Steps	Customer Feedback
2	A reference material database is needed and valued by users	Users want an uneditable version of the reference database: • Better supports current use pattern • It's a trusted source of information • They have confidence that they aren't propagating errors • Should be owned by a set of SMEs • The system notifies users when changes are made • Easily propagate material changes			Is this a disconnect in understanding of existing capability Initially, unclear if benefit to users justifies complexity
2a	Users explicitly stated they were nervous about changing reference materials		U1: I try not to mess with the base database – if we make modifications, I make a copy so we don't lose the base database (what came with TABS) label it – "modified" U2: (local v global) "Showing that this one (material) is one that we put in and not one that comes as standard: we don't want to propagate an error" U4: okay with not editing the reference material directly – helps create confidence / version control: preserving the original material. (unsolicited) U5: *Would you like to edit the reference directly?* Assuming I would have the permissions. I wouldn't have to make changes to to the reference database. I don't want to mess up the reference copy so easily. I wouldn't want that responsibility.		
2b	Changes made to Reference/Global Material DB: How	Users expect this to be done by SME / committee	U2: "Super user – if you submit a global change they have review" U5: "Reference material database updates – permissions – I don't know: it would be nice if there were some limits: their own personal DB would be fine to update; but the reference material database should be managed: there's a small panel of people who have to review and decide if there's an update that should be made; but also, not have to go through a committee"	☐ Next step: concept UX of update changes (e.g. when Ed or Scott make a change to the Reference Material DB, what do end users see?)	

Test & Refine- High Fidelity Mockups

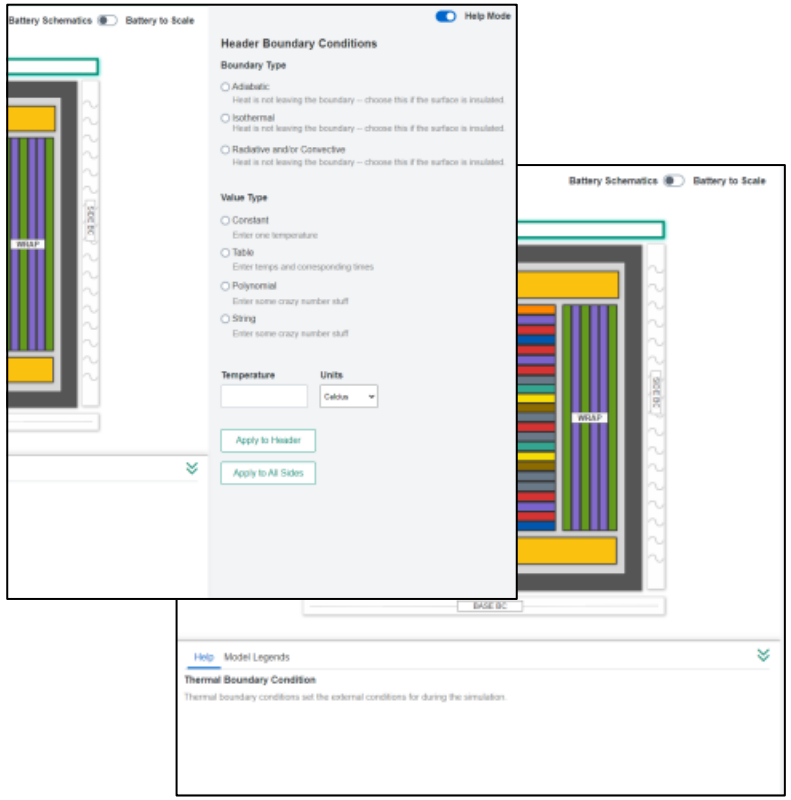
- Test & continue to design with stakeholders
  - Co-design sessions
  - Usability studies
  - Design reviews with colleagues
- Focus on:
  - Refining & reworking UI elements
  - Interaction patterns, look and feel of design



UI Elements for Specific User Types

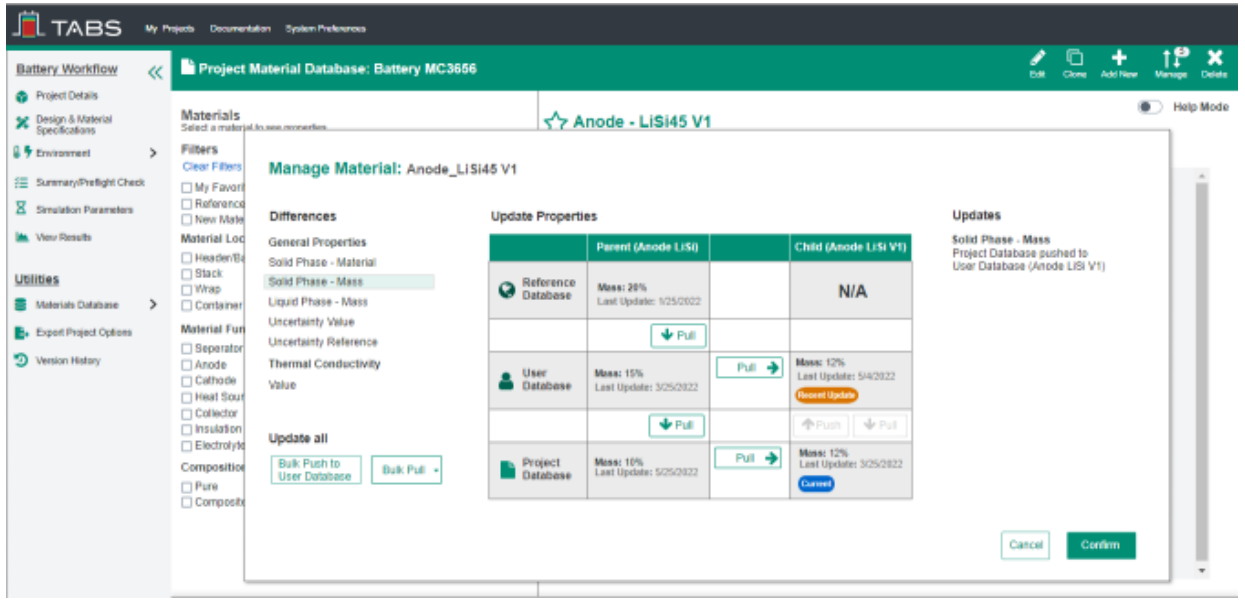
Novice/Prospective Users

- “Help Mode” for question-specific guidance
- Collapsible help panel for in-depth help



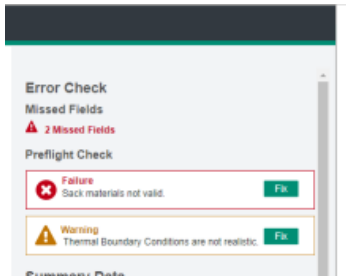
Experienced Users

- Materials Database(s) to allow for experimentation of existing materials and creation of new materials, either within specific projects or across all projects



All Users

- Error prevention and resolution

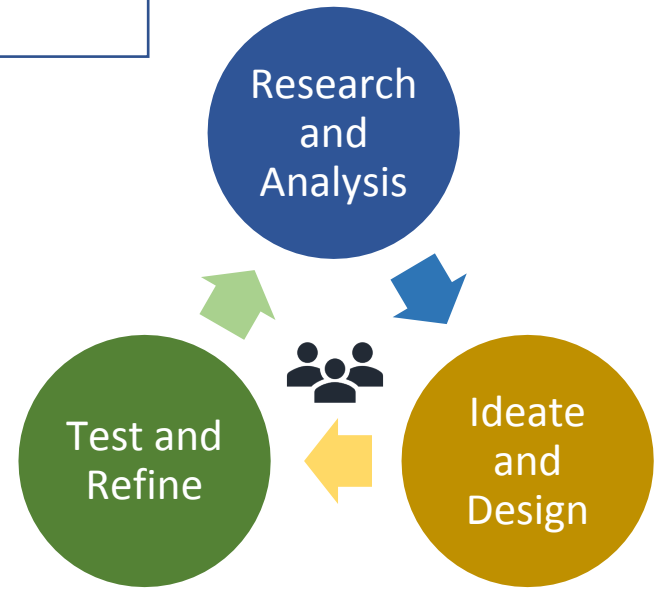


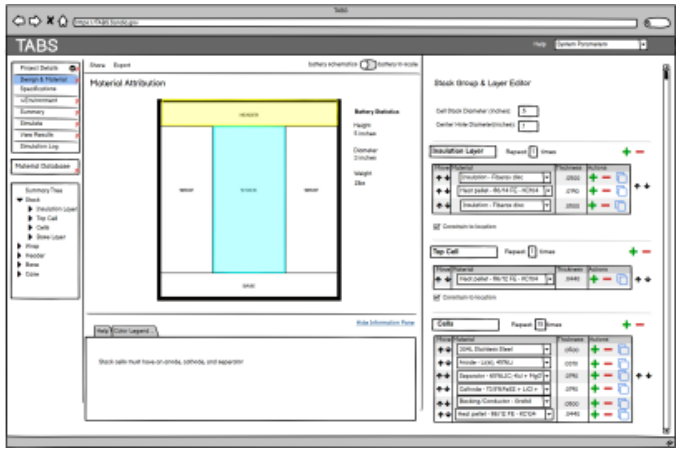
User Centered Design: TABS

Purposely built for Engineering questions; Designed with the user in mind

Give me: the simple, intuitive, UI I've grown to appreciate in TABS, to help me easily navigate the thermal battery workflow

Give me: a web app so I don't have to set up an environment

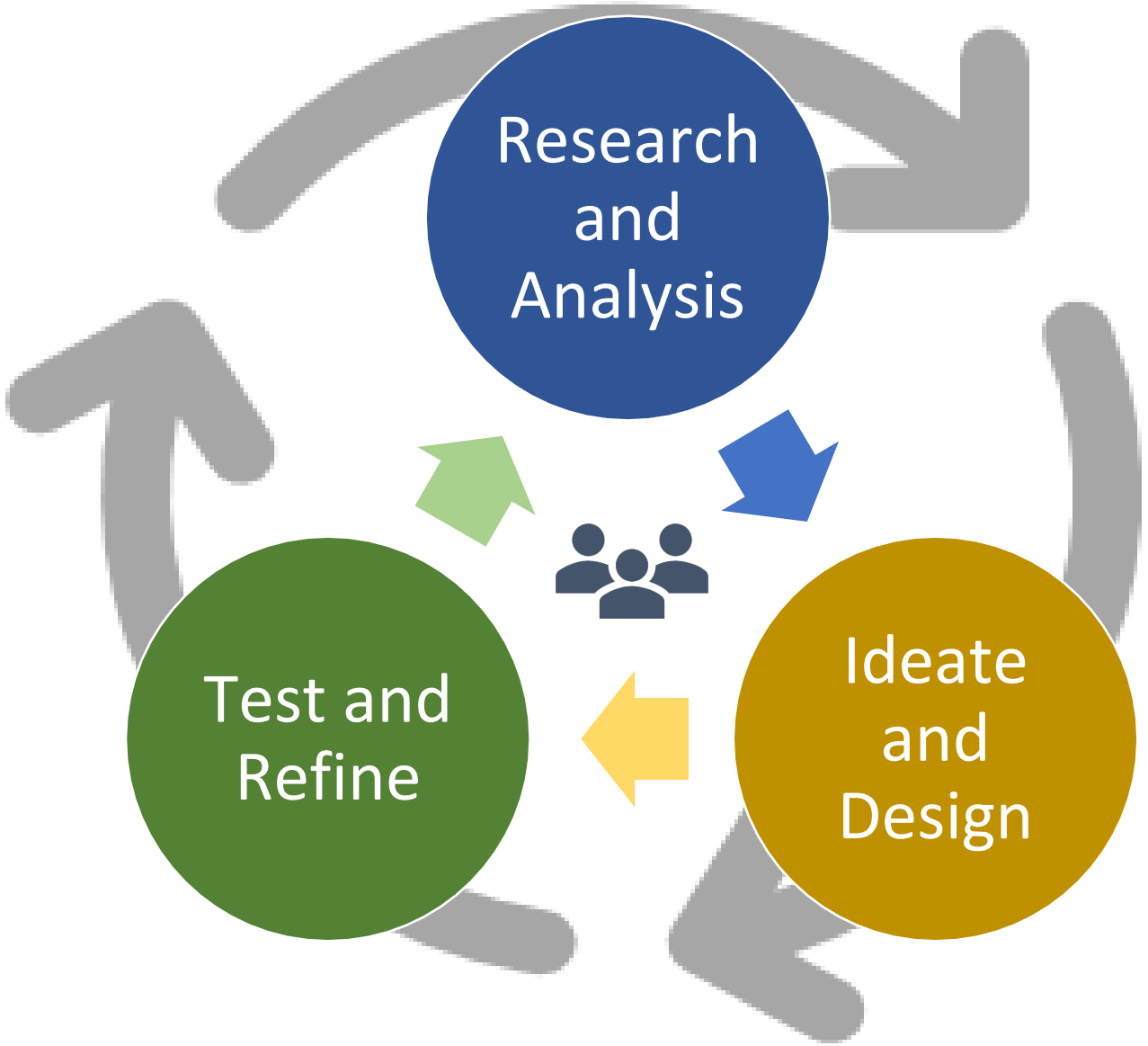




User Centered Design

Effective UX research and user centered design can lead to more sustainable products by ensuring value, usability, and usefulness to you users…

But, **it's a process.**



Questions?

Backup Slides

User-Centered Design

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Novice User

Experienced User

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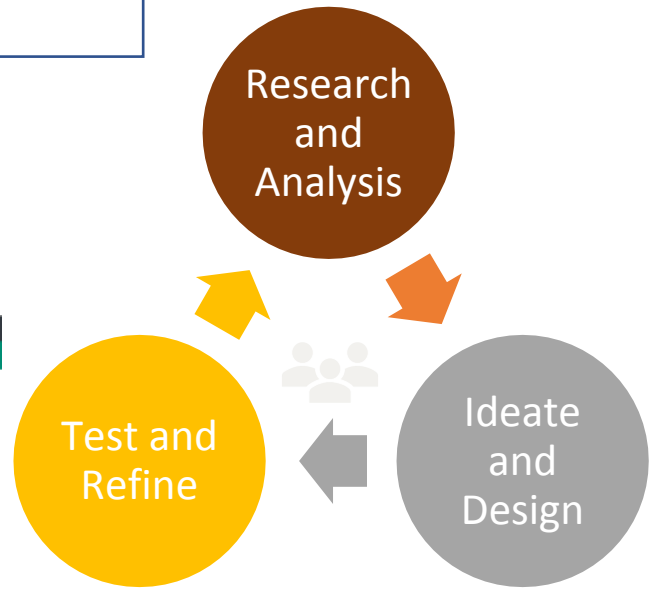
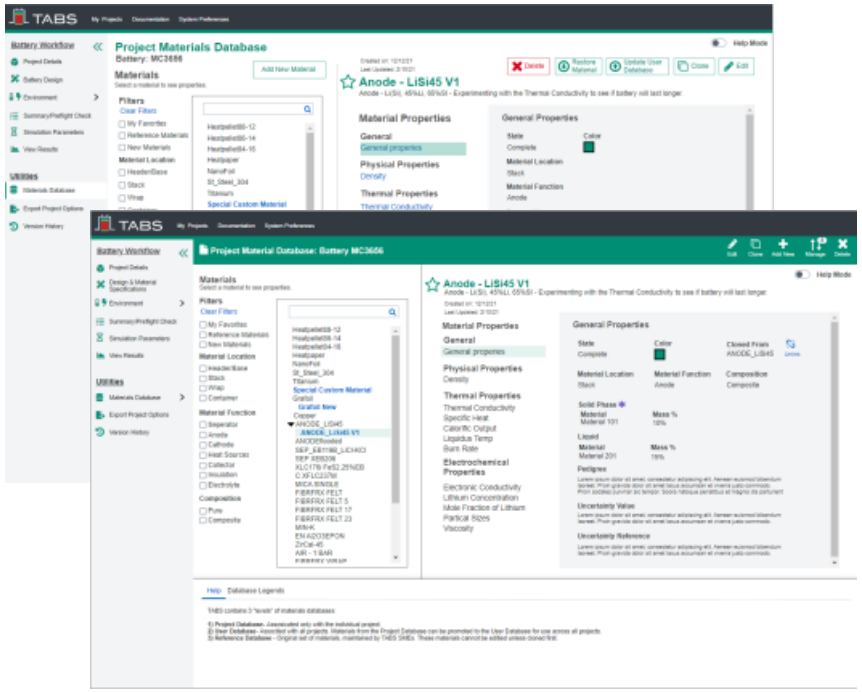
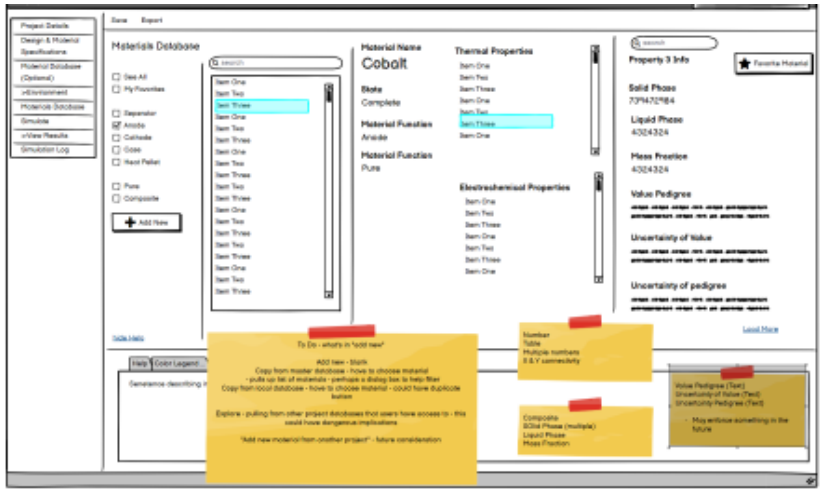


TABS 6.0 high fidelity (refined) Mock Up



TABS 6.0 low fidelity Mock Up



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Novice User

Experienced User

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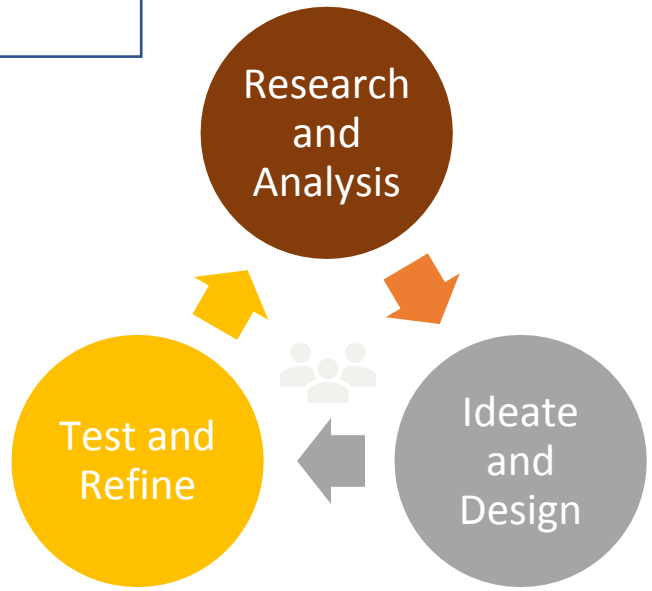

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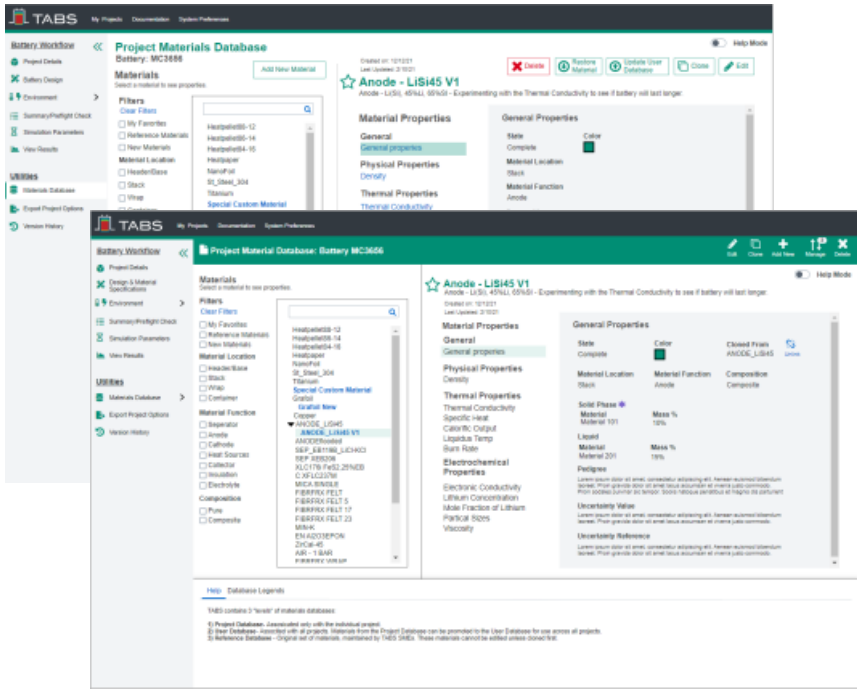

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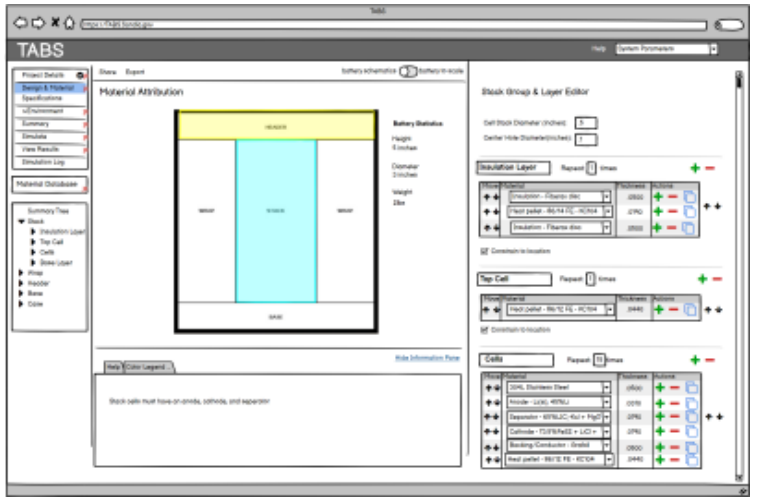
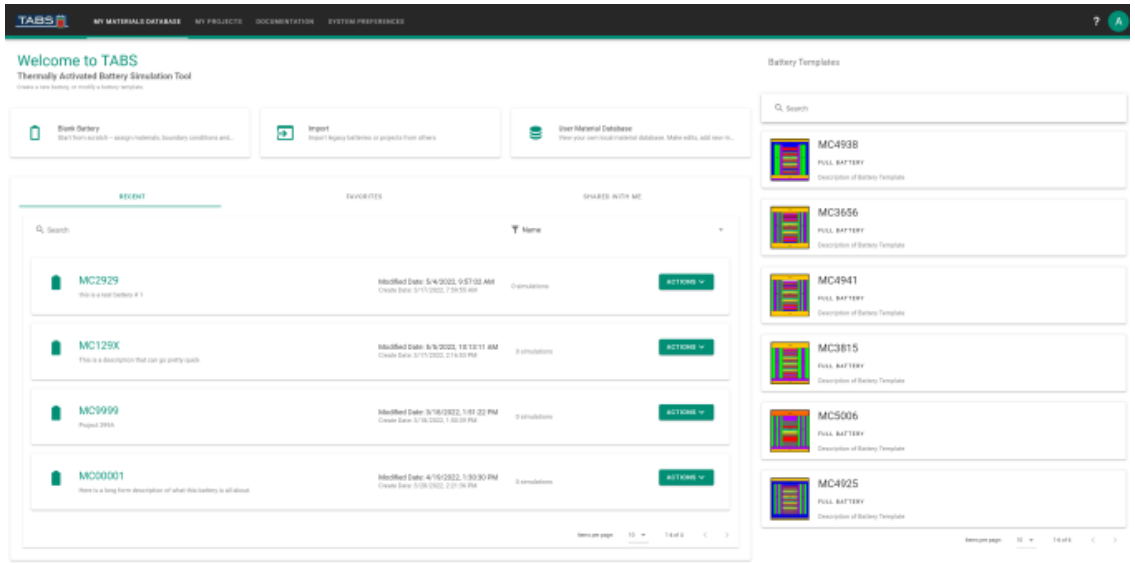
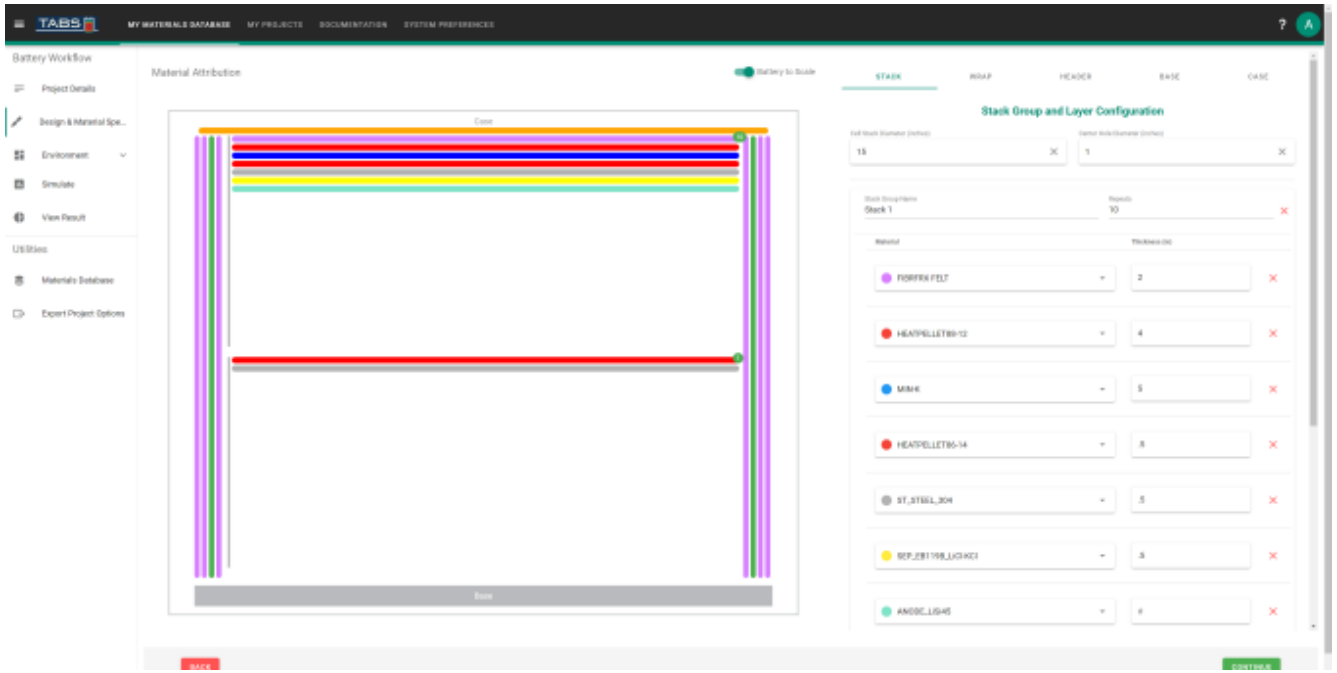


Thermally Activated Battery Simulator (TABS)

A design tool designed for engineers



TABS WebUI – In development



User Types Defined

Battery Engineers whose work fits into TABS' scope,

5 Prospective User

…but don't interact with the TABS system, directly

Reasons for non-use:

- Prefers SME
  - Complex problems
- Time constraints
- Learnability concerns
- Modeling is "terrifying"

2 Novice User

…and they have attempted to use elements of the TABS system

Reasons for limited use:

- TABS' perceived applicability to specific project phases
- Time constraints
- Inherited models

3 Experienced User

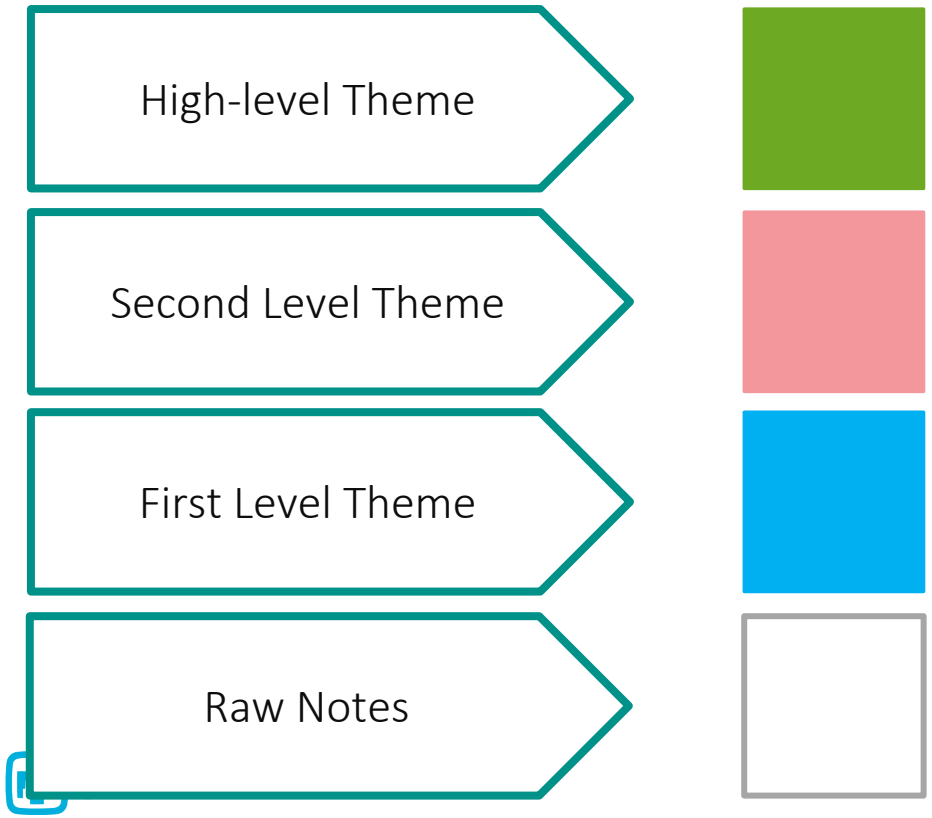
…and derive direct value from working with the TABS system

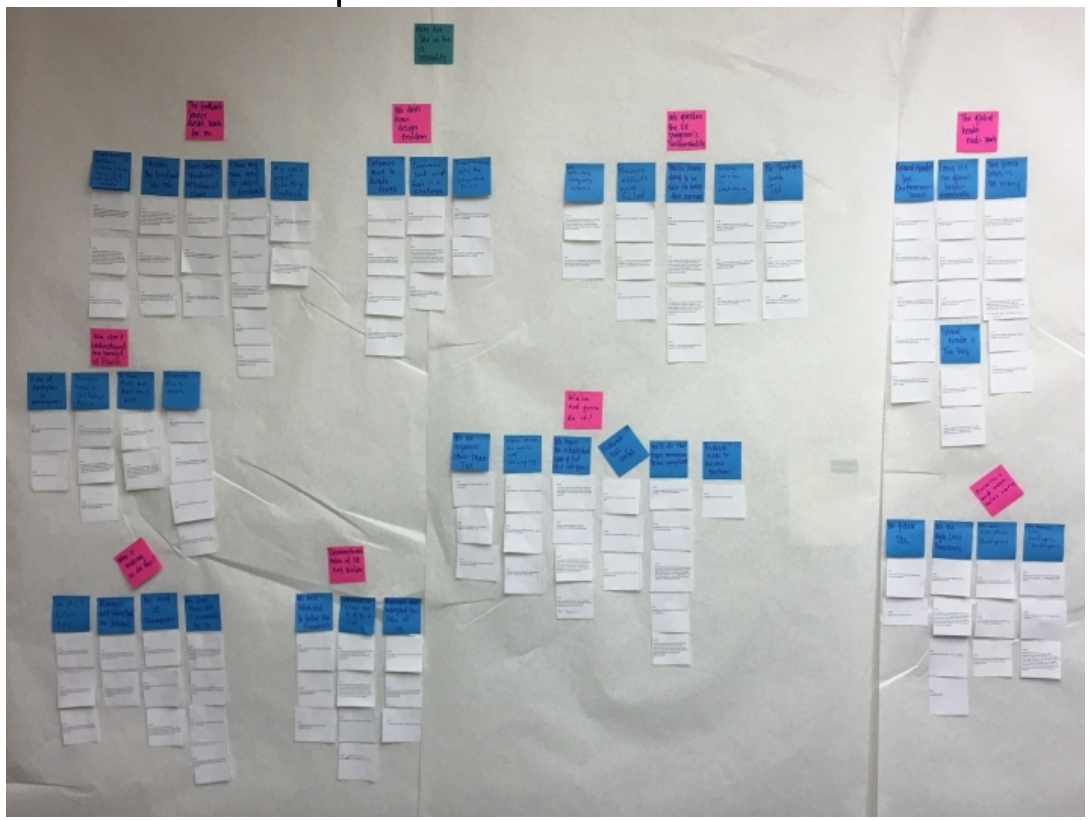
Reasons for adoption & continued use:

- Run simulations frequently
- Access to other TABS users
- Develop thermal battery expertise
- Proven value

Process: Thematic Analysis

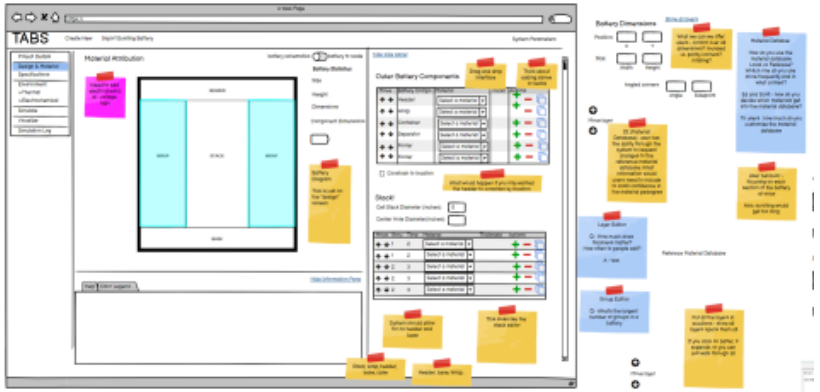
- Method of organizing qualitative data
- Themes are derived from multiple participants
  - Eliminates bias; not focused on a single, individual experience

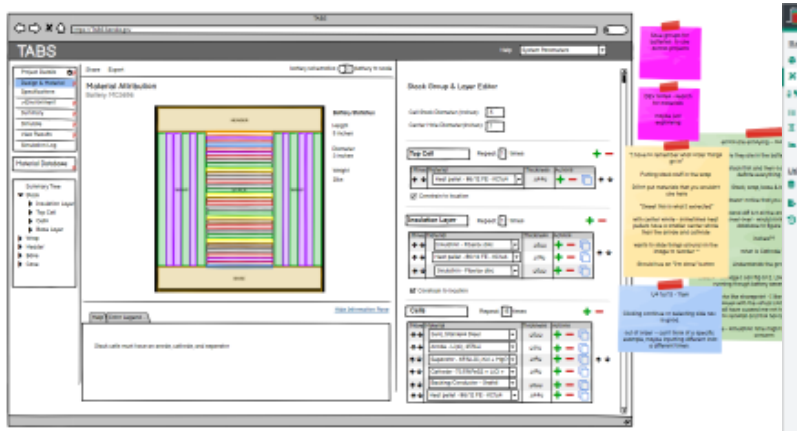


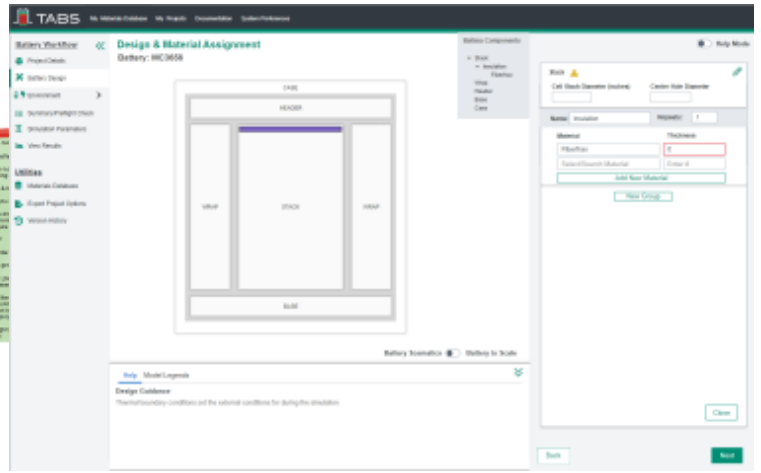


Design Iterations – backup slide

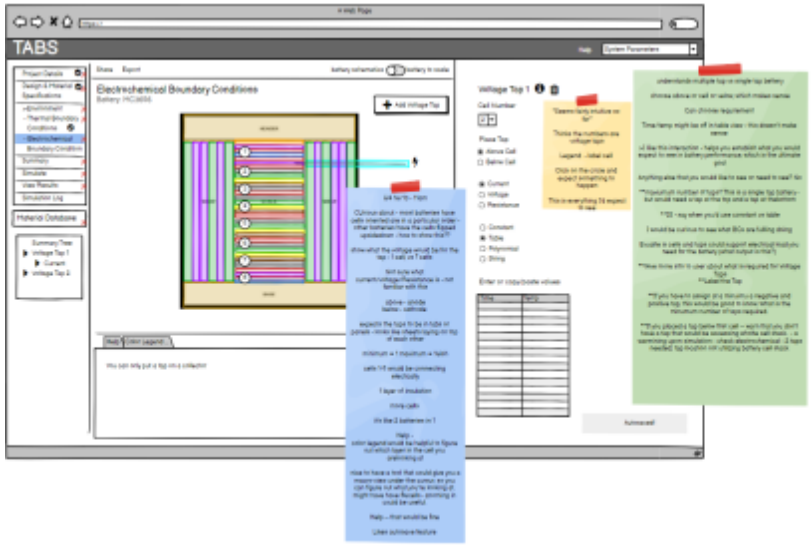
Battery Design – Material Assignment

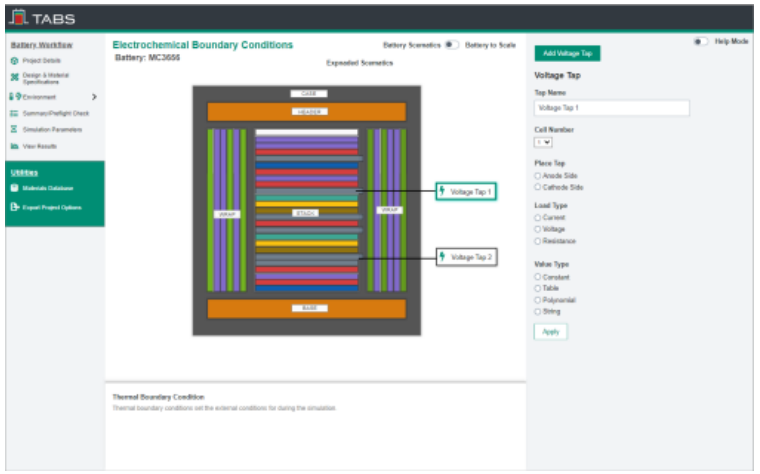


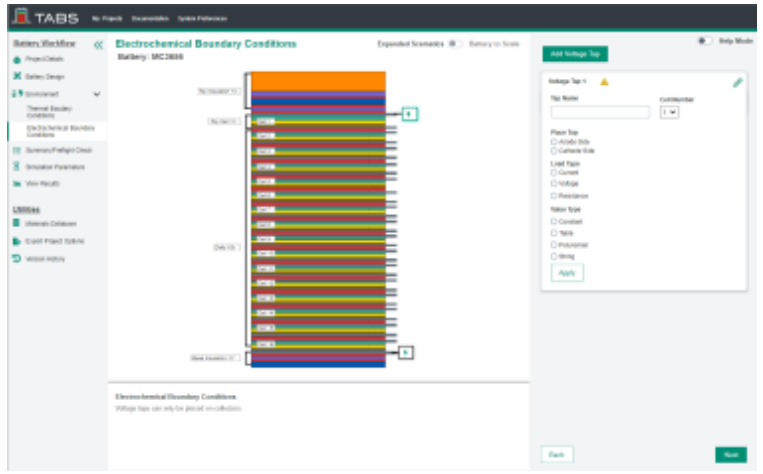




Electrochemical Boundary Conditions – Adding Voltage Taps

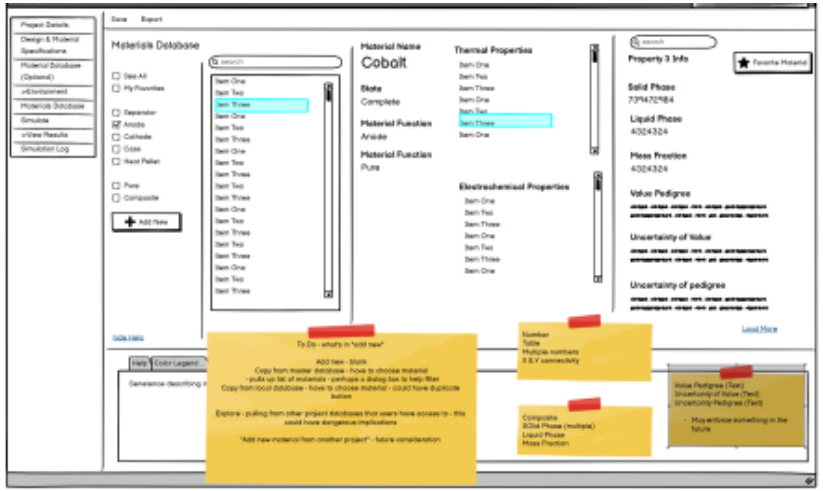


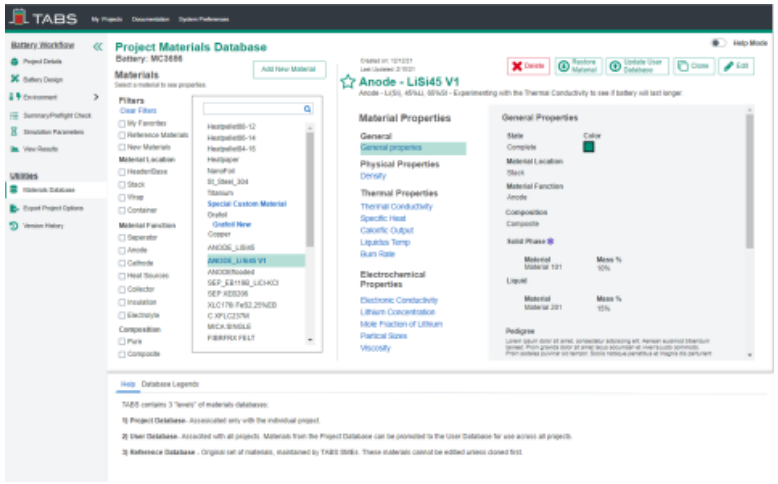


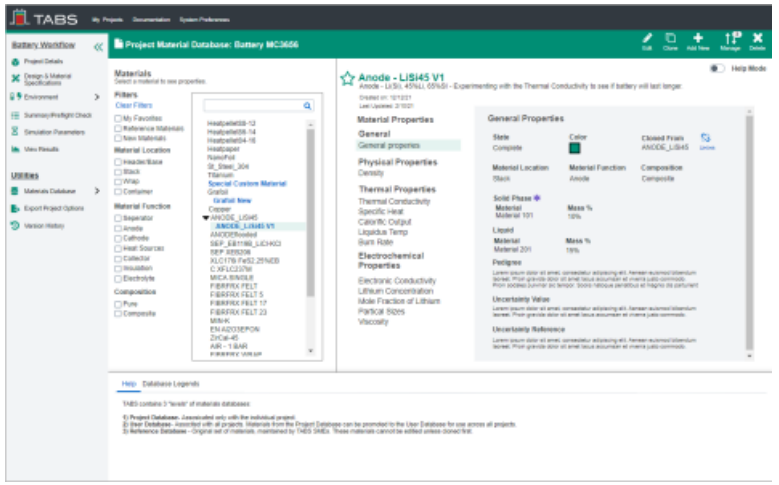


Backupslide

Materials Database







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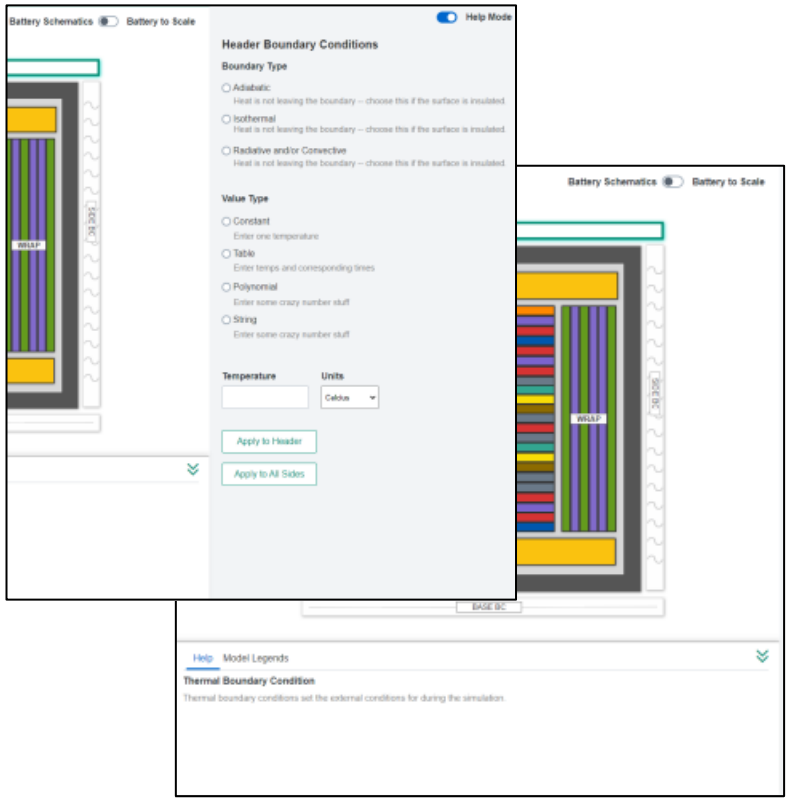
- Collapsible help panel for in-depth help



Experienced User

- Materials Database(s) to allow for experimentation of existing materials and creation of new materials, either within specific projects or across all projects