

USER PERSPECTIVES ON BRANCHING IN COMPUTER-AIDED DESIGN

**CSCW
2023**

The 26th ACM Conference on Computer-Supported
Cooperative Work and Social Computing

Kathy Cheng, Phil Cuvin, Alison Olechowski, and Shurui Zhou



**Kathy
Cheng**
(Presenter)



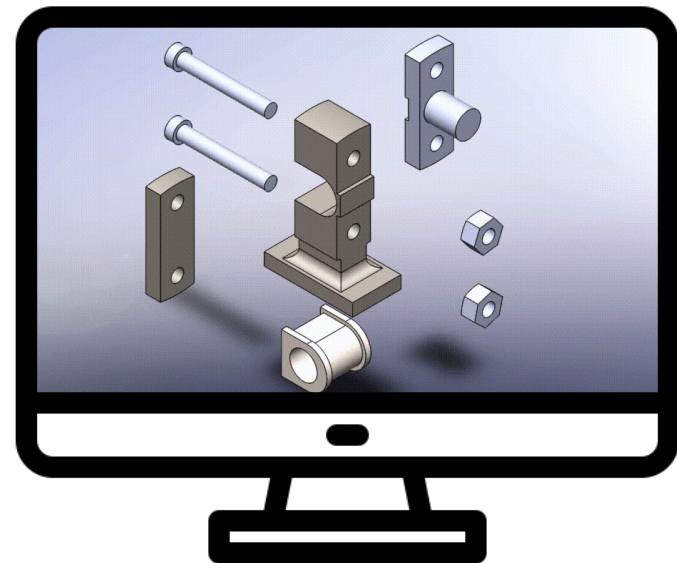
**Dr. Alison
Olechowski**



**Dr. Shurui
Zhou**

CAD is integral to the product development process

Computer-aided design is used to virtually design and test product concepts before fabrication



Nearly all products are designed with CAD

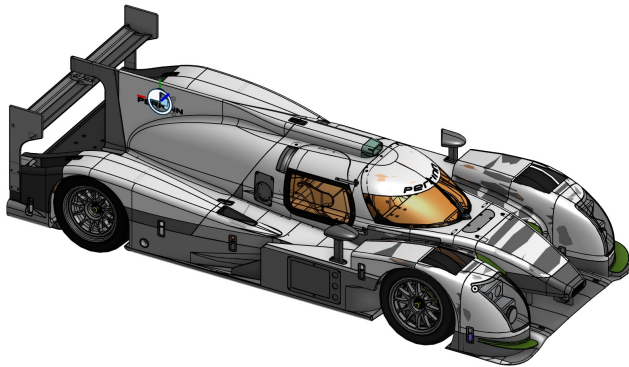
laptop



racecar



Nearly all products are designed with CAD



The CAD process is collaborative



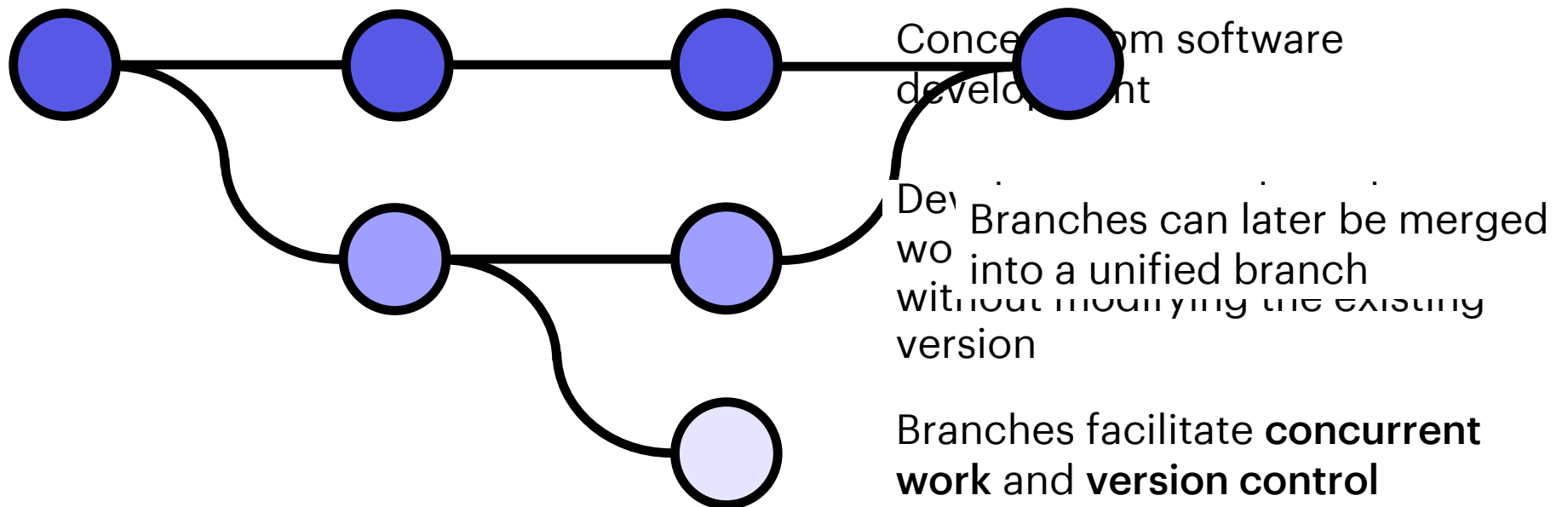
CAD collaboration is challenging

Designers struggle with **concurrent work** and **version control**

But, recent advances bring branching and merging.

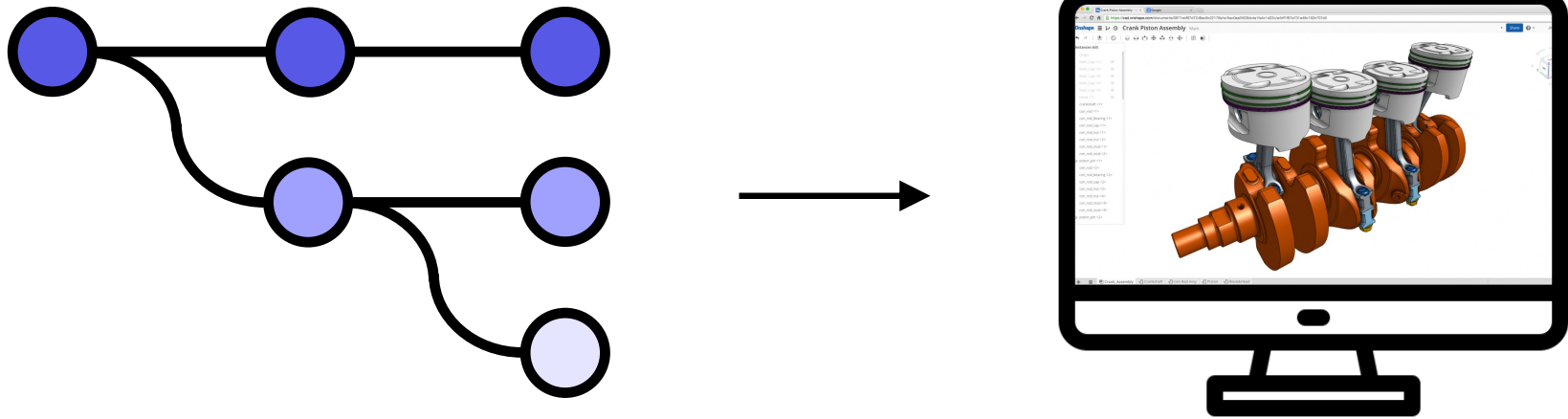


Branching and merging is an effective means of collaboration



Seems like an obvious strategy to implement in CAD

Branching is still new to CAD



Existing work is theoretical and lacks empirical studies.

RQ1:

How do CAD designers use **branching functionality** for hardware design?

RQ2:

What are the **design shortcomings** and gaps of existing CAD branching tools?

Why mine online CAD forums?



Considered a
community of
practice



Popular resource
among CAD
users



Reach more CAD
users than with
interviews

We selected widely used CAD forums

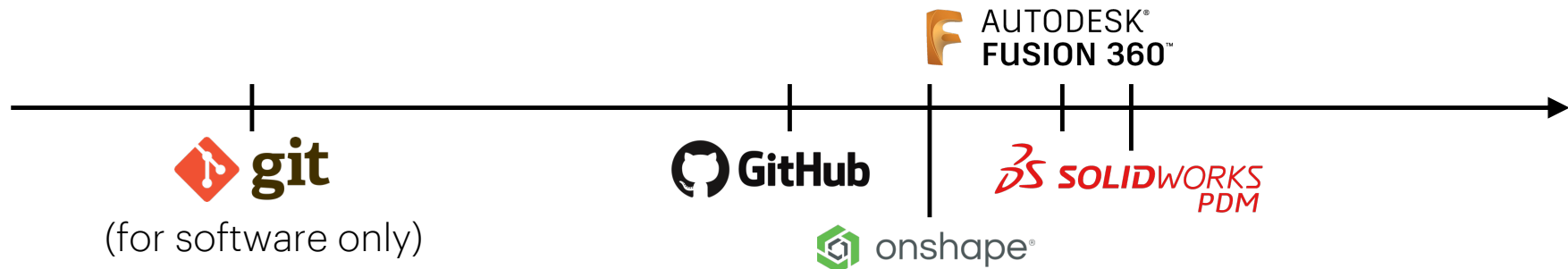
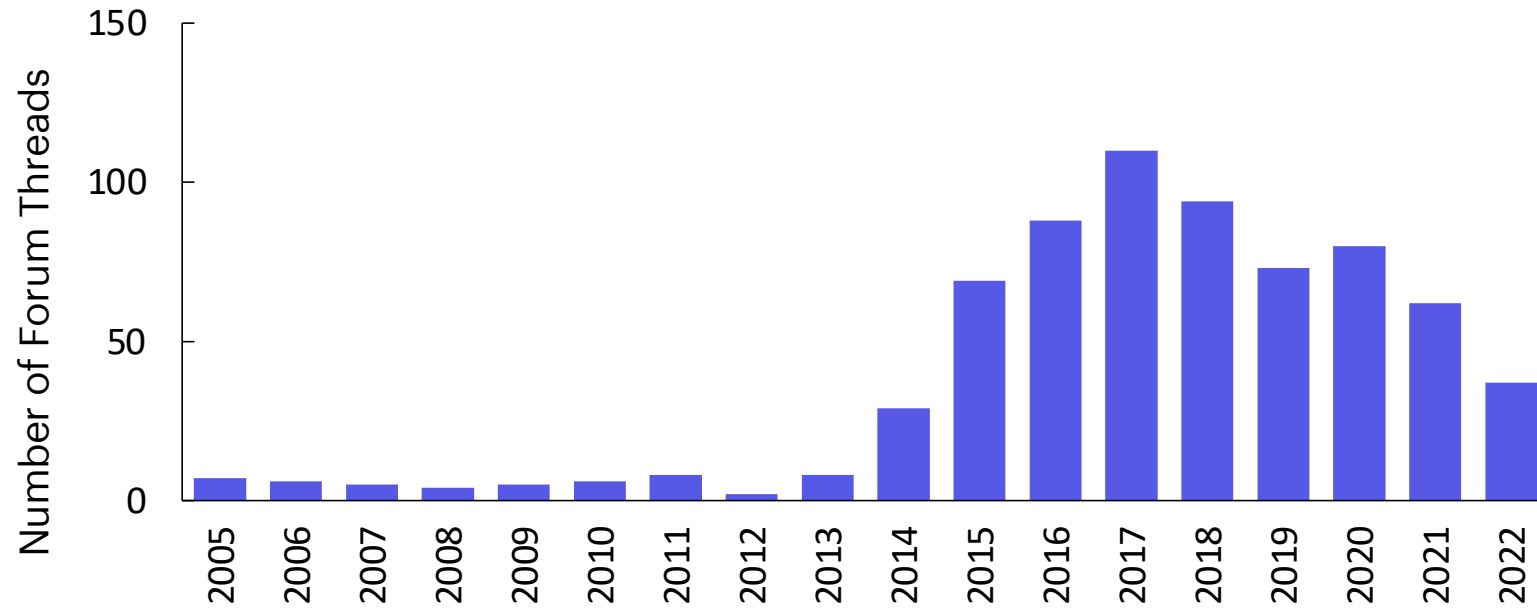
Forums owned by
platforms that
support(ed) branching



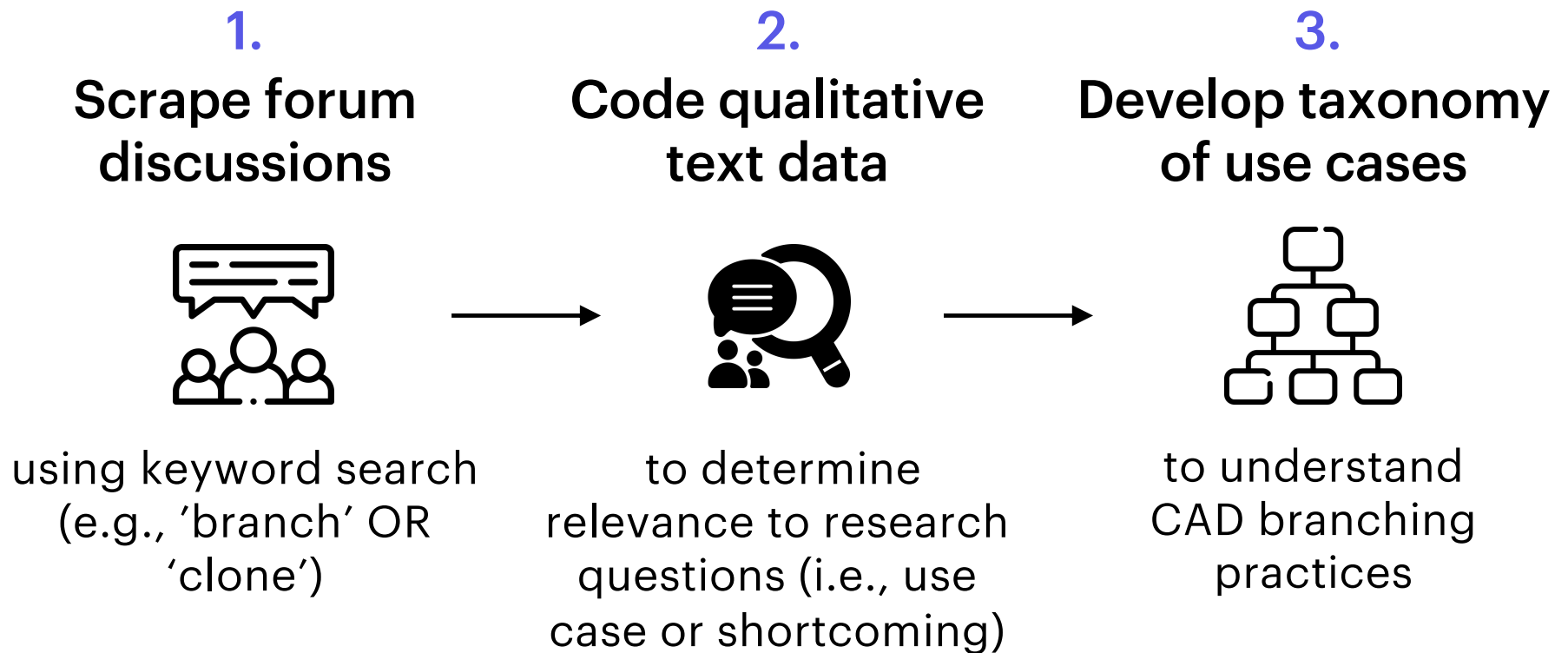
General platform-
agnostic forums



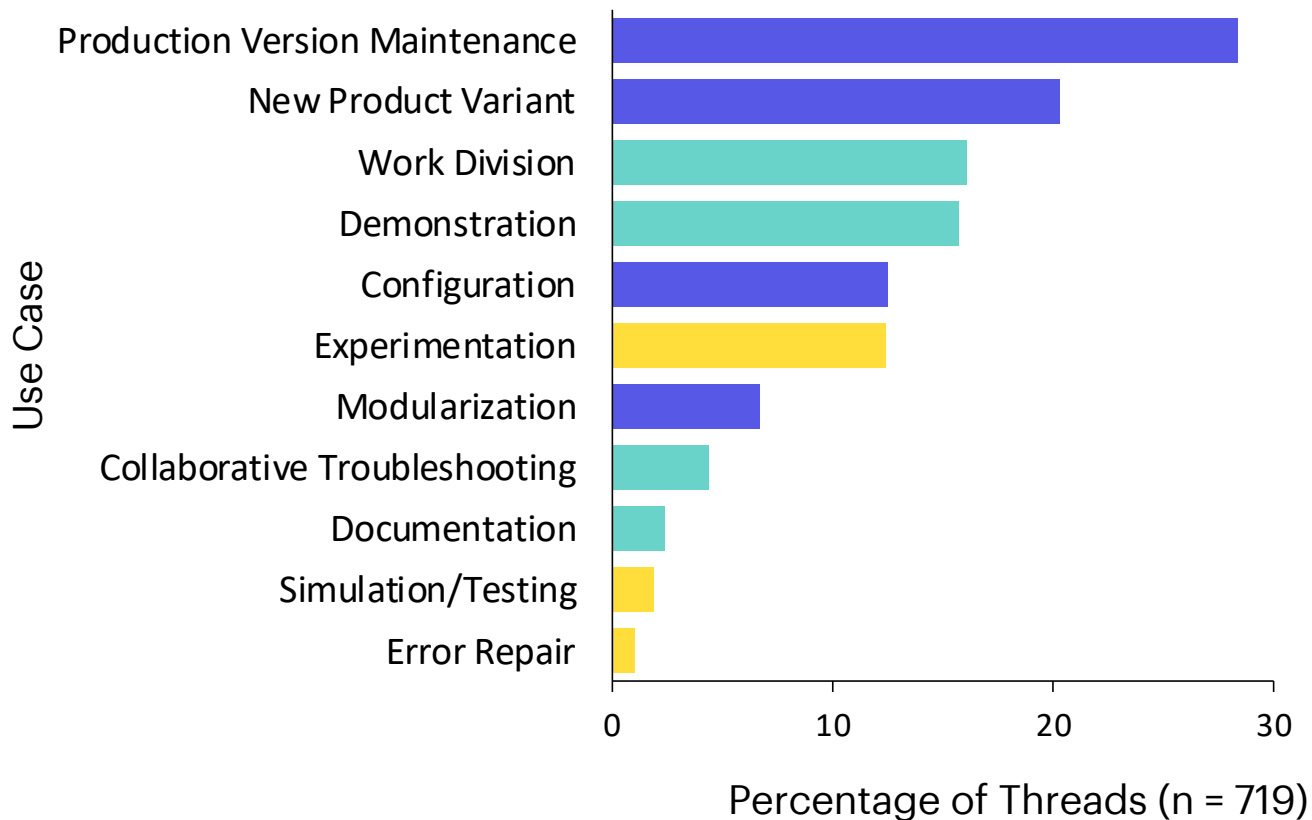
Our dataset included 719 discussion threads



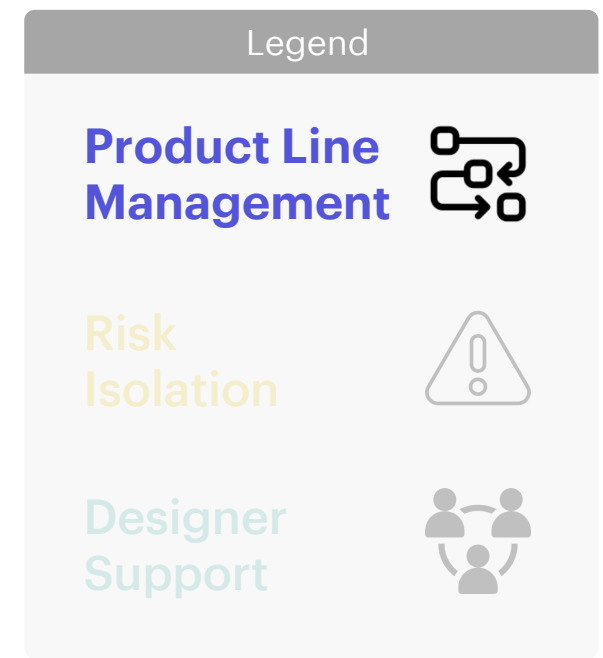
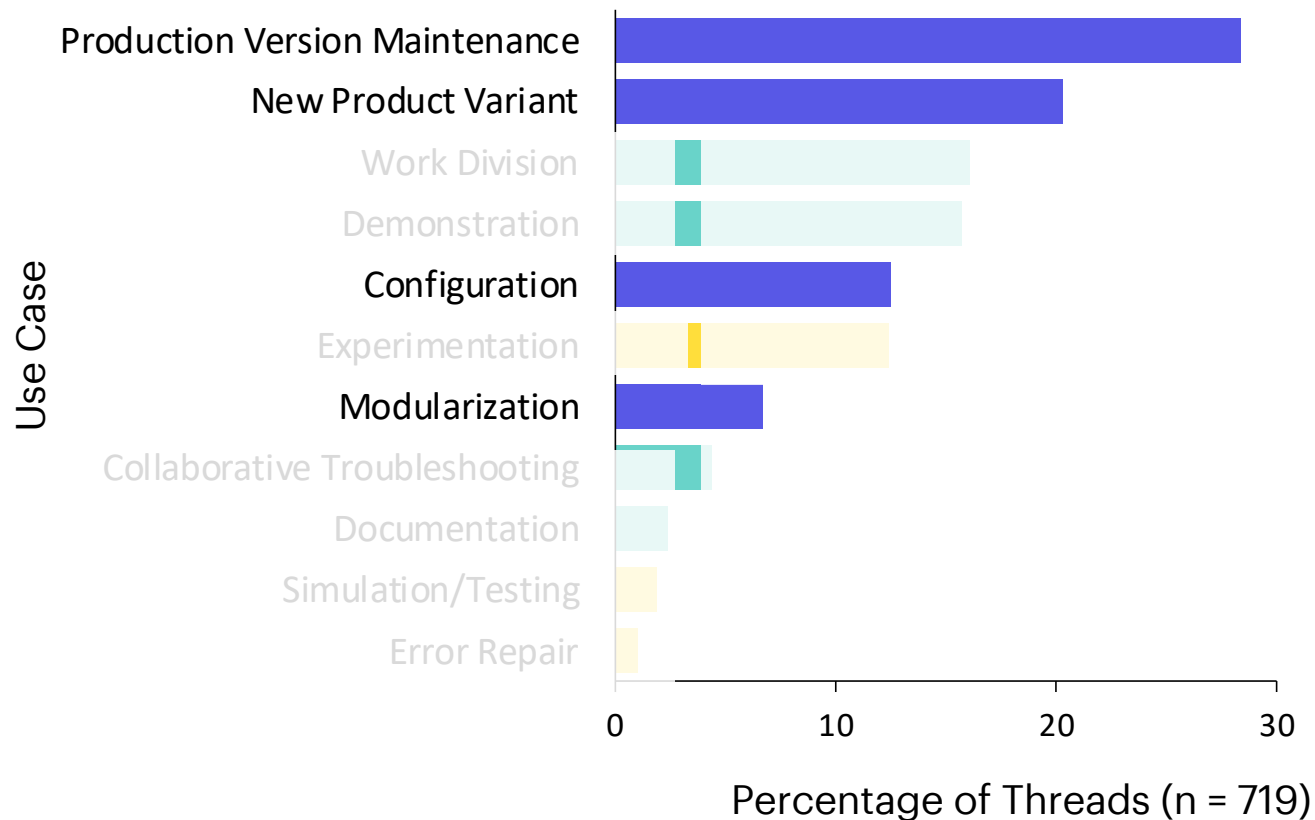
Analyzing forum threads was a multi-step process



RQ1: Use Cases for Branching



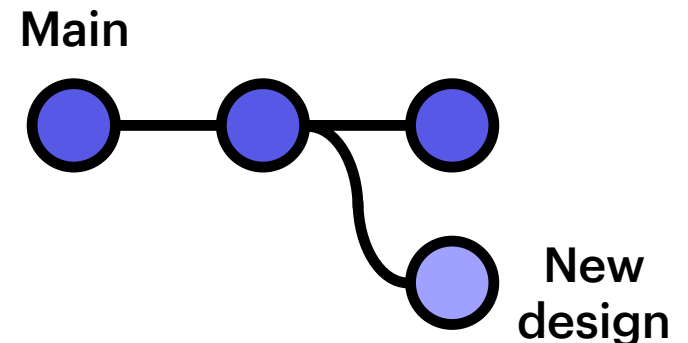
Product Line Management branches are used for supporting the production version design evolution



A use case of **Product Line Management** branching is for: creating a **new product variant**

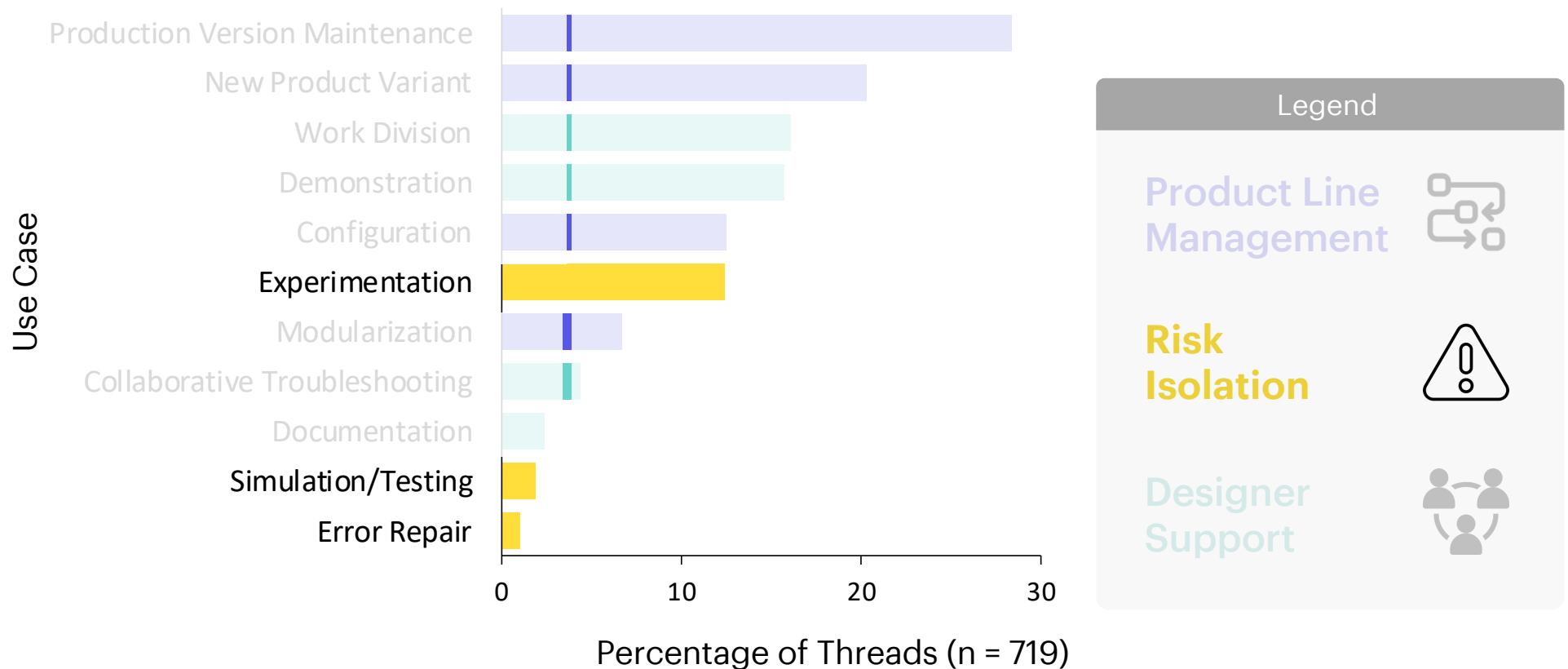
“I would like to add a completely new design without starting from scratch, but keep using the finished design for further enhancements to reach a new finished version and so on.”

Autodesk (2021)



Analogous to “hard forking”
in software development

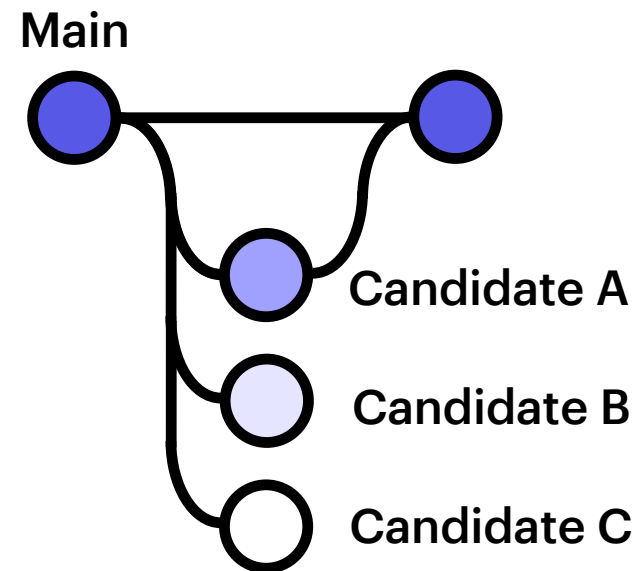
Risk Isolation branches are used for separating unapproved or unstable file changes



A use case of **Risk Isolation** branching is for: experimenting with candidate designs

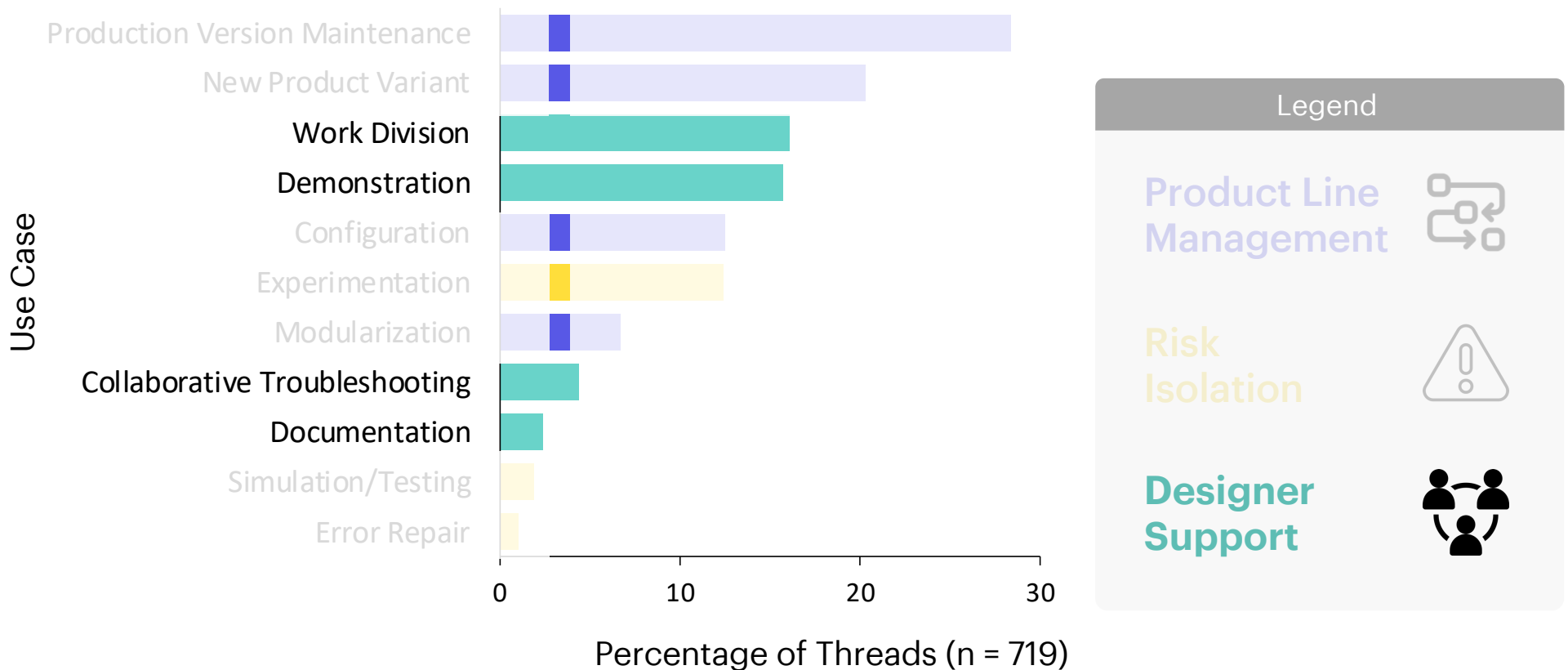
“Being able to make variations of a design and have them available if you need to change directions beats manual copies or playing with references.

SolidWorks (2022)



Similar to exploratory programming

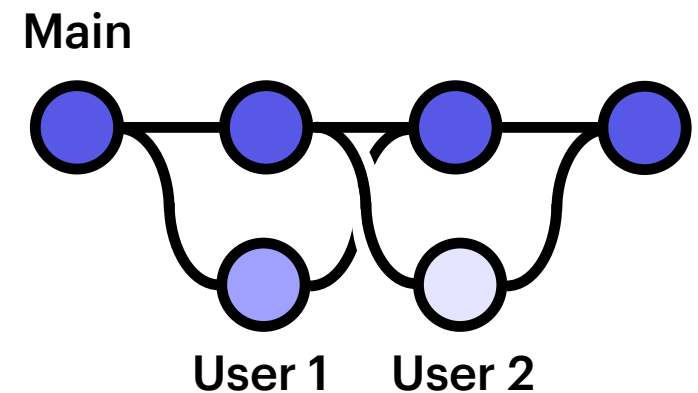
Designer Support branches are used for facilitating collaborative or non-technical needs



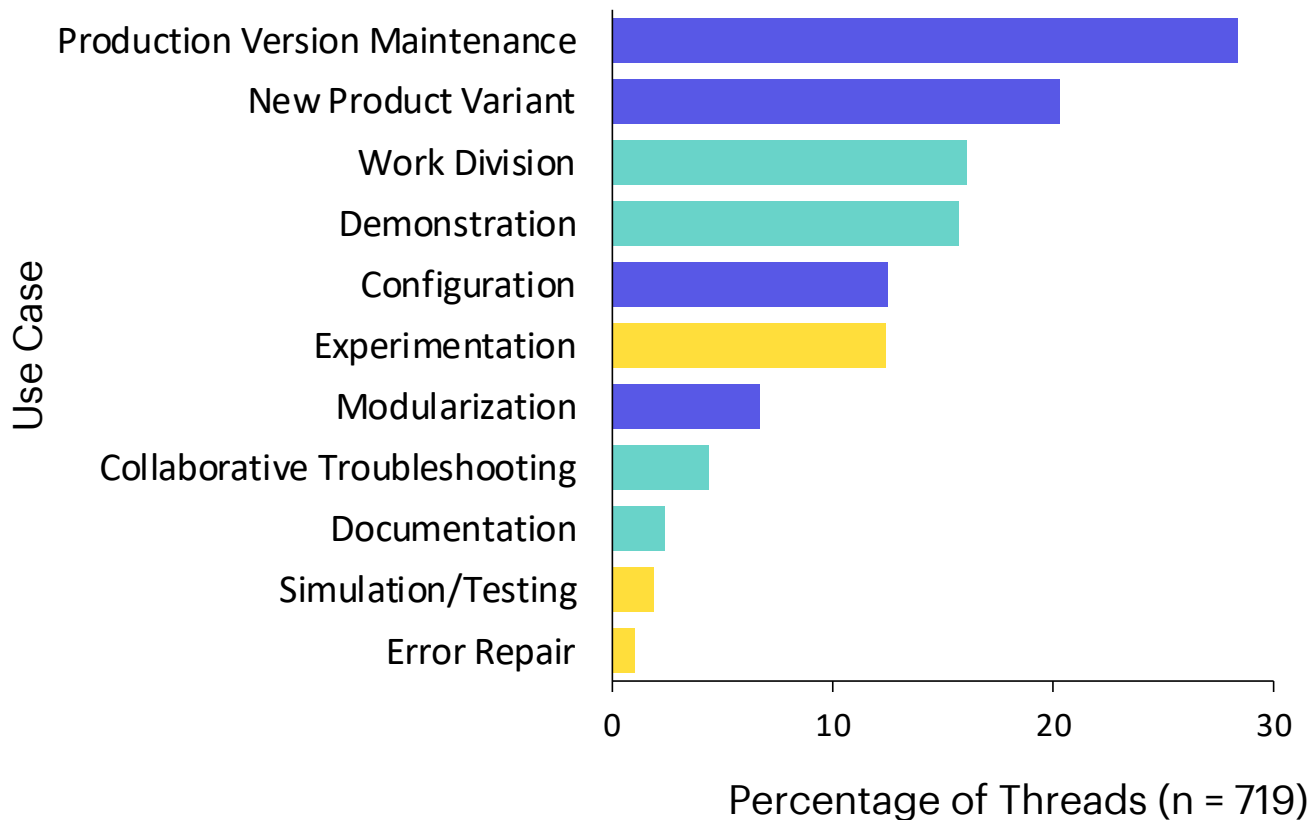
A use case of **Designer Support** branching is for: **dividing work between individuals**

“User 1 creates a branch and adds a hole. User 2 creates a branch and modifies the size of a cutout. Each branch gets merged back into the main workspace and updates the model at different times.”

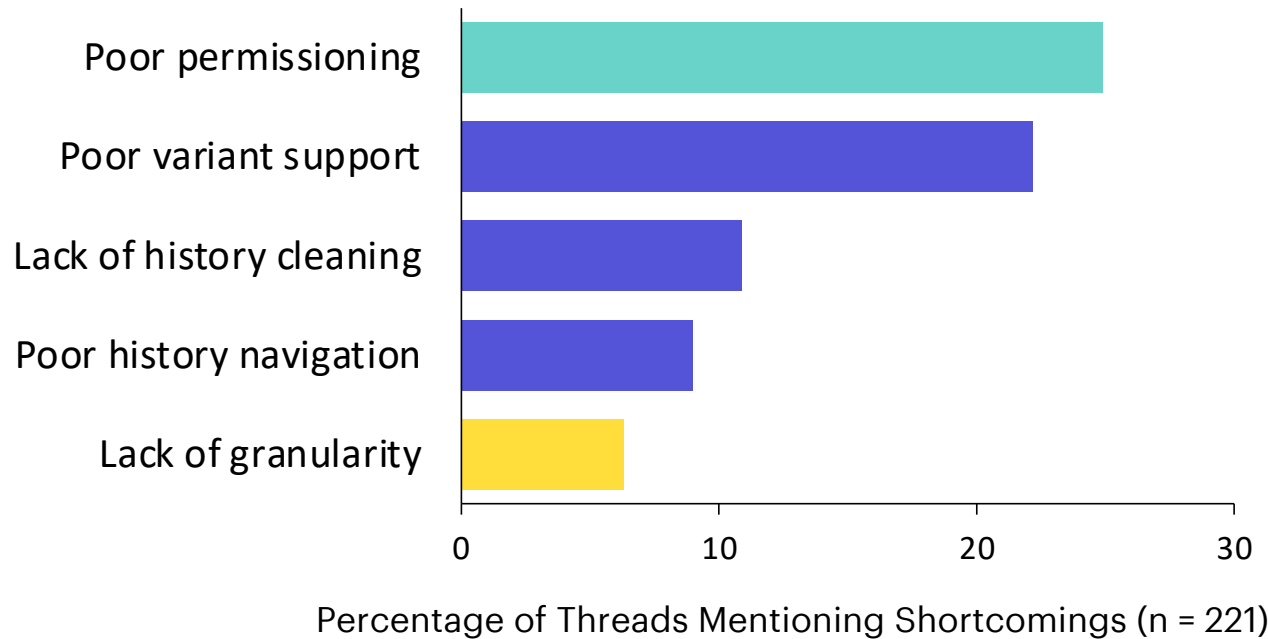
CAD Forum (2022)



RQ1: Use Cases for Branching



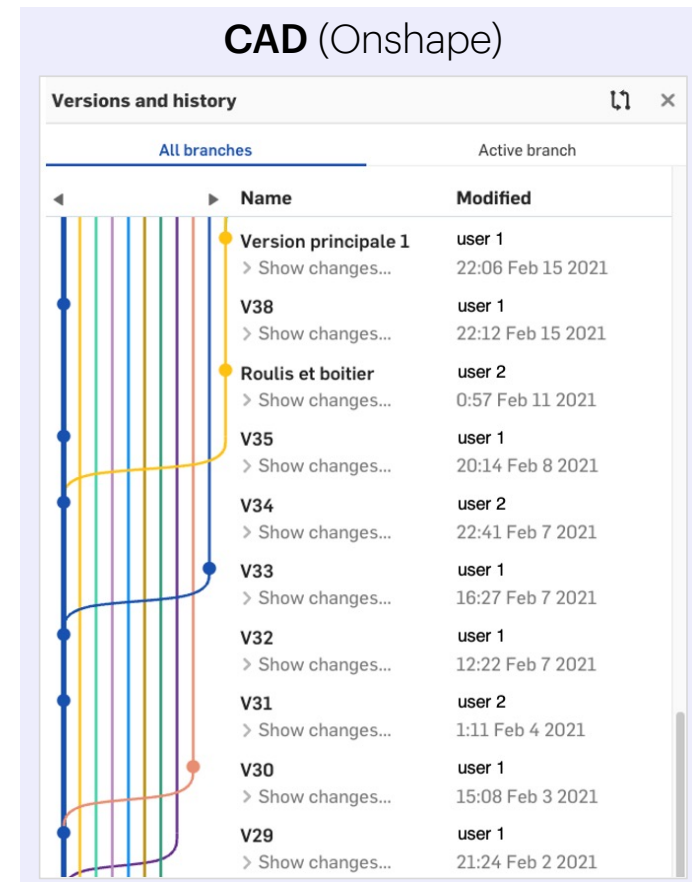
RQ2: Shortcomings of CAD Branching Tools



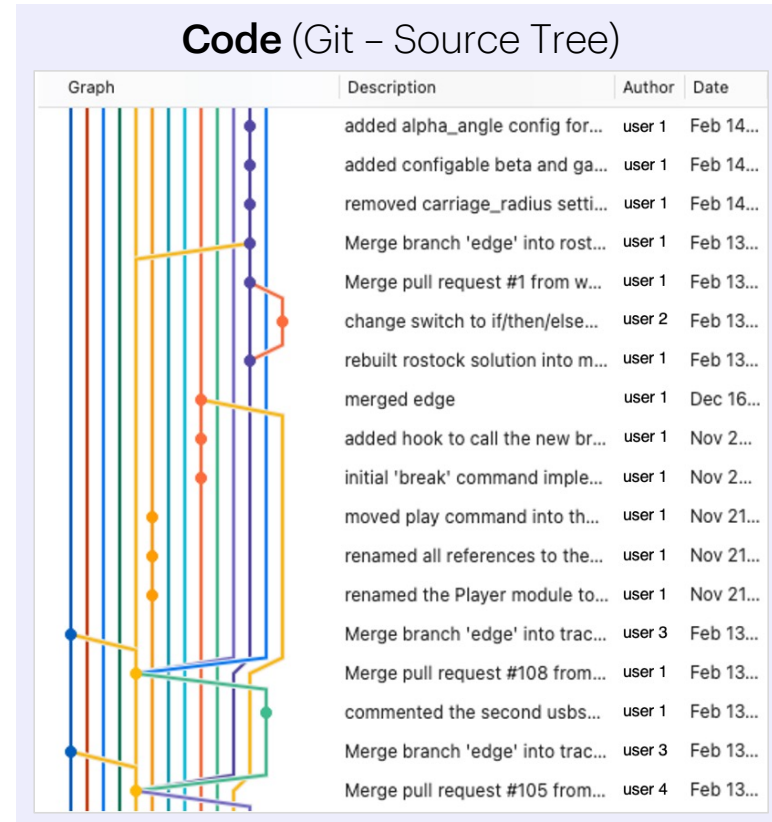
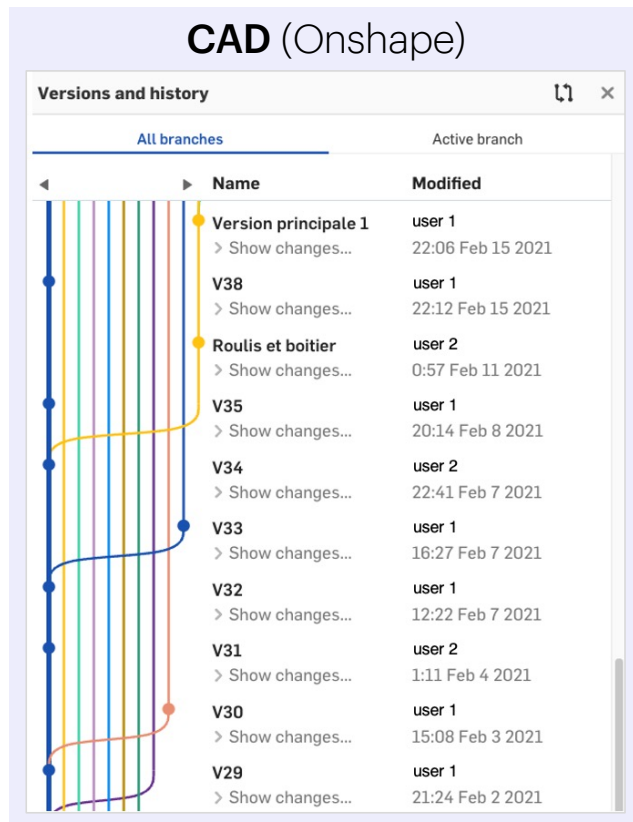
Branch history is messy and hard to navigate

“The animation displayed is like a personal nightmare, complete with a sensation of vertigo while viewing. It jumps off the screen almost. I hope to comprehend this tree and its long vine-like branches eventually.”

Onshape user (2016)



This problem exists in both CAD and code



Branching helps CAD designers with the 3Cs of collaboration

coordination

“the management of people, their activities, and resources”

Branches can organize personnel, timelines, resources, and tasks

communication

“the exchange of messages and information among people”

Branches allow a CAD model to act as a shared artifact

cooperation

“the joint production of members of a group within a shared space”

Branches enable collaboration in a separate, yet linked space

Our work can benefit branching in the broader CSCW community



Scientific workflow
management
systems

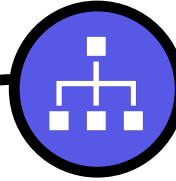


Open
collaborative
writing



Creative
practice

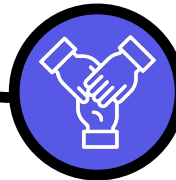
Key Takeaways



First-ever **taxonomy** of CAD branching use cases



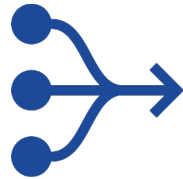
Future work to target shortcomings of CAD branching tools



Contributing to fundamental **theory** (3C model) in CSCW

Future work

Merging in CAD



Branching practices in
real-life design projects



Further parallels with
software & CAD



... multi-user
synchronicity

Interested in learning more?

Session

Collaboration II

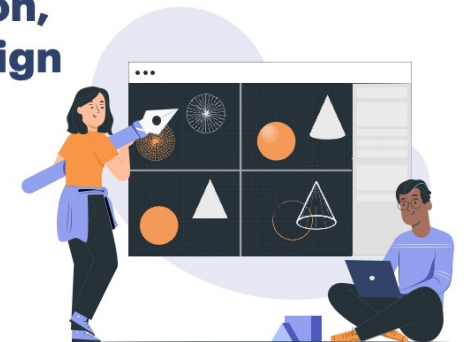
Wednesday, Oct 18

9:00AM – 10:30AM

Kathy Cheng

**In the Age of Collaboration,
the Computer-Aided Design
Ecosystem is Behind:
An Interview Study of
Distributed CAD Practice**

Kathy Cheng, Michal K. Davis, Xiyue Zhang,
Dr. Shurui Zhou, & Dr. Alison Olechowski



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2023

USER PERSPECTIVES ON **BRANCHING** IN **COMPUTER-AIDED DESIGN**

Thank you! Questions?

RQ1: How do CAD designers use branching?

RQ2: What are the shortcomings of CAD branching tools?



**Kathy
Cheng**



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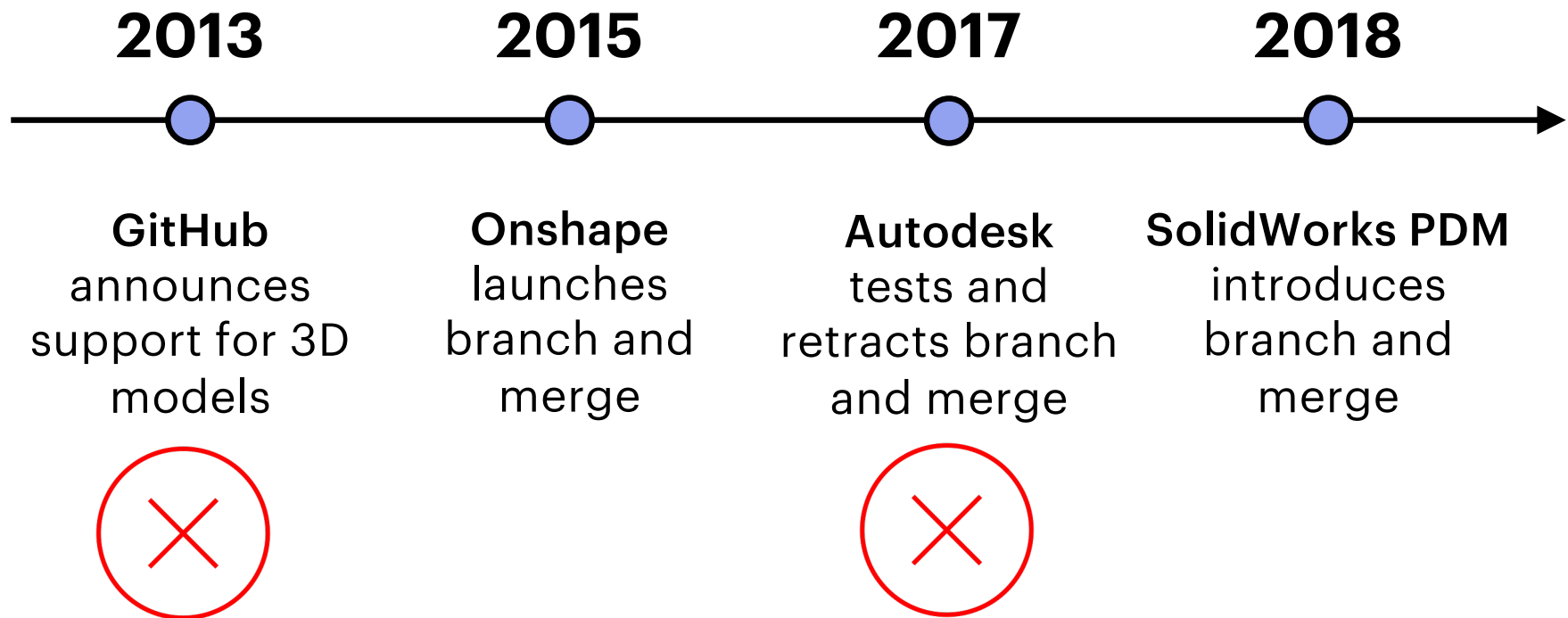


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Branching is still new to CAD



Previous releases of CAD branch & merge have failed



Spencer Wright
@pencerv

Replying to @hardi_meybaum

@hardi_meybaum Weird about that. Nobody designs in STL, so it's kind of inconvenient. Whoever does diffs for .ipt or .sldprt... that's cool.

10:25 PM · Sep 18, 2013 · TweetDeck



keqingsong 1433 Views, 0 Replies

03-08-2017 05:08 PM

BRANCH & MERGE - Getting Started



Branch & Merge Preview ending on July 15, 2017

- Based on feedback, how you're using it, how you expect it to work, and how we want to help you overcome challenges, we're ending the Branch & Merge Preview. We took a close look at what we've set out to solve, and instead of releasing the current experience it to the wild that doesn't really do the job quite right, we're going back to engineer a simpler and efficient solution. In the mean time, we're focusing on making sure that Fusion 360 has a robust set of **core data management tools**. Don't worry, it's not ending right away – you have till **July 15** to merge all your branches back to the master branch. If you're having trouble with it or are running into issue, feel free to reach out to us and we'll help you get it sorted out. Thank you for participating – together, we'll get to a better experience.

“Based on feedback,
we’re ending the
Branch and Merge
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