ORS 2020 - Research Interest Group

F.A.I.R.ness and Credibility in Computational Biomechanics:

Introductory remark

Shady Elmasry, PhD
Hospital for Special Surgery

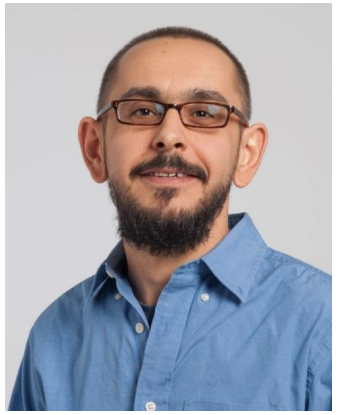
HSS

Who are we?

Kevin Shelburne, PhD
University of Denver

Peter Laz, PhD
University of Denver

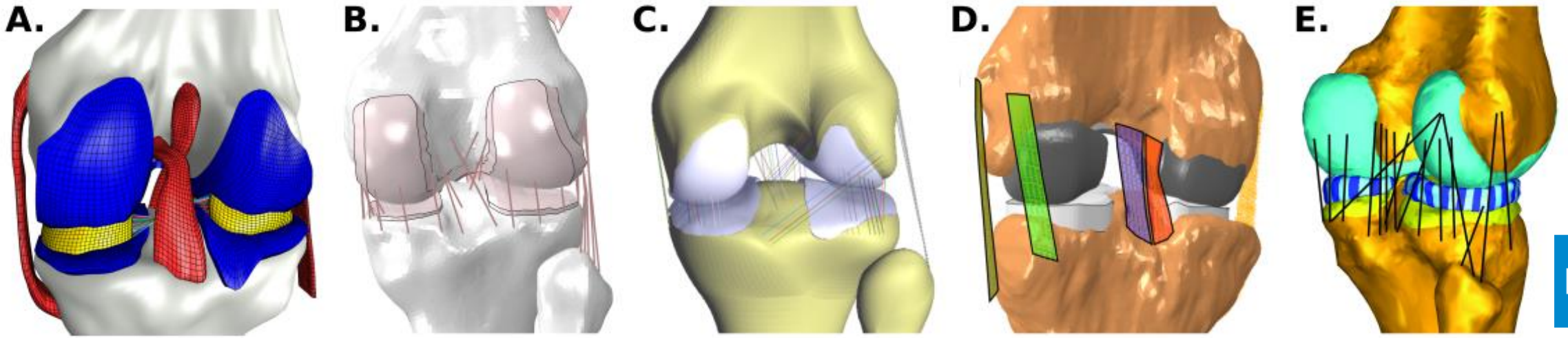
Thor Besier, PhD
University of Auckland



Ahmet Erdemir, PhD
Cleveland Clinic

Jason Halloran, PhD
Washington State University

Carl Imhauser, PhD
Hospital for Special Surgery



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Enhancing Reproducibility

NIH plans to enhance reproducibility

Francis S. Collins and **Lawrence A. Tabak** discuss initiatives that the US National Institutes of Health is exploring to restore the self-correcting nature of preclinical research.

nature
International journal of science

VOL 505 | 30 JANUARY 2014

- Reviewer checklist for sound study design
- Scientific premise in NIH Grants
- Greater transparency and data sharing

ANNOUNCEMENT

Reducing our irreproducibility

398 | NATURE | VOL 496 | 25 APRIL 2013

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- Checklist for rigor in methods and statistics
- Increased space for methods
- Include numbers populating figures

National Institute of Biomedical Imaging and Bioengineering

SimTK

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Reproducibility in simulation-based prediction of natural knee mechanics

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- Are knee models reproducible?

https://simtk.org/projects/kneehub

Cleveland Clinic

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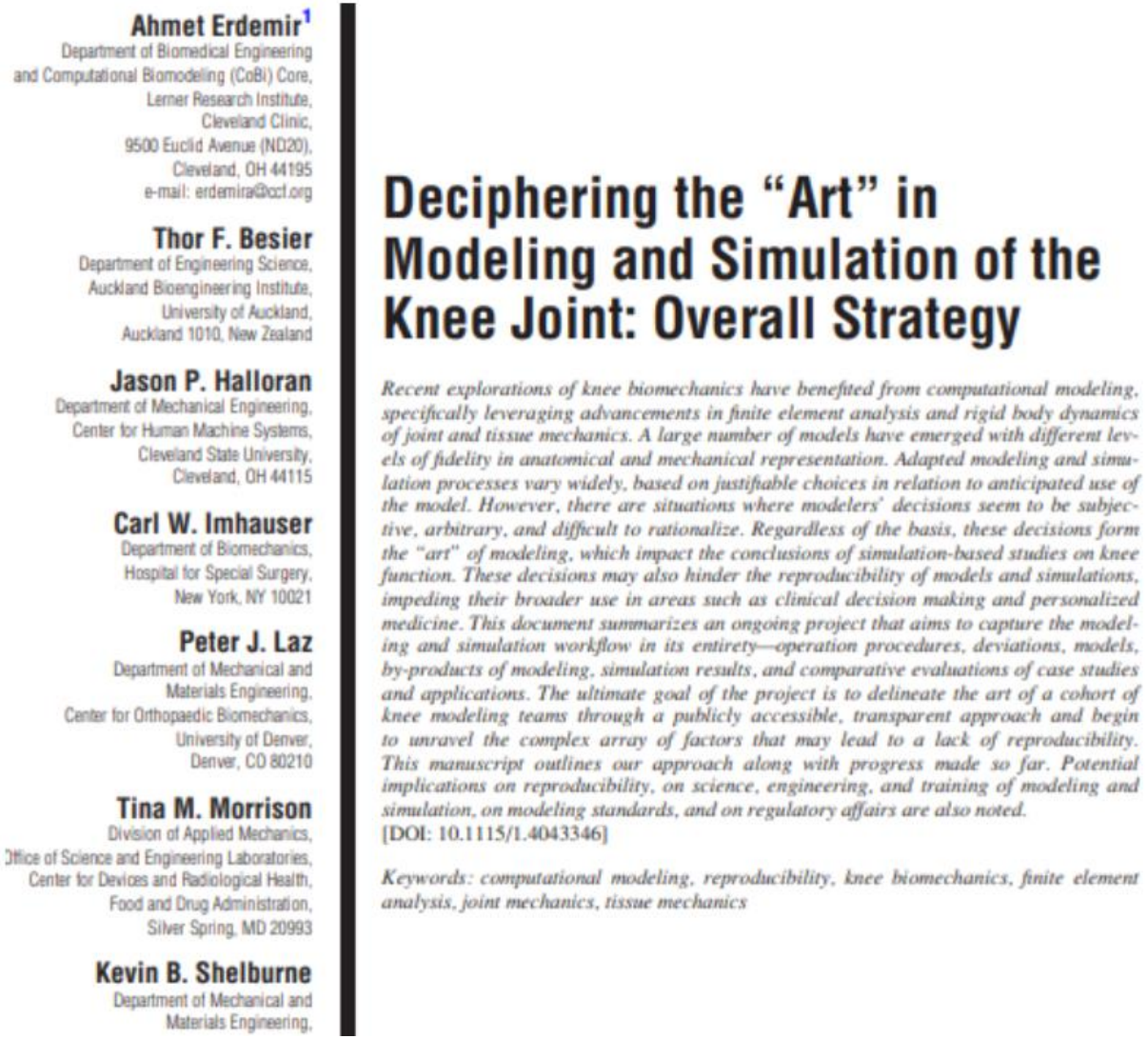
Overarching Question

- Do the predictions of natural knee biomechanics depend on the modeling decisions of separate development teams when using the same target simulation scenarios and source data to build models?



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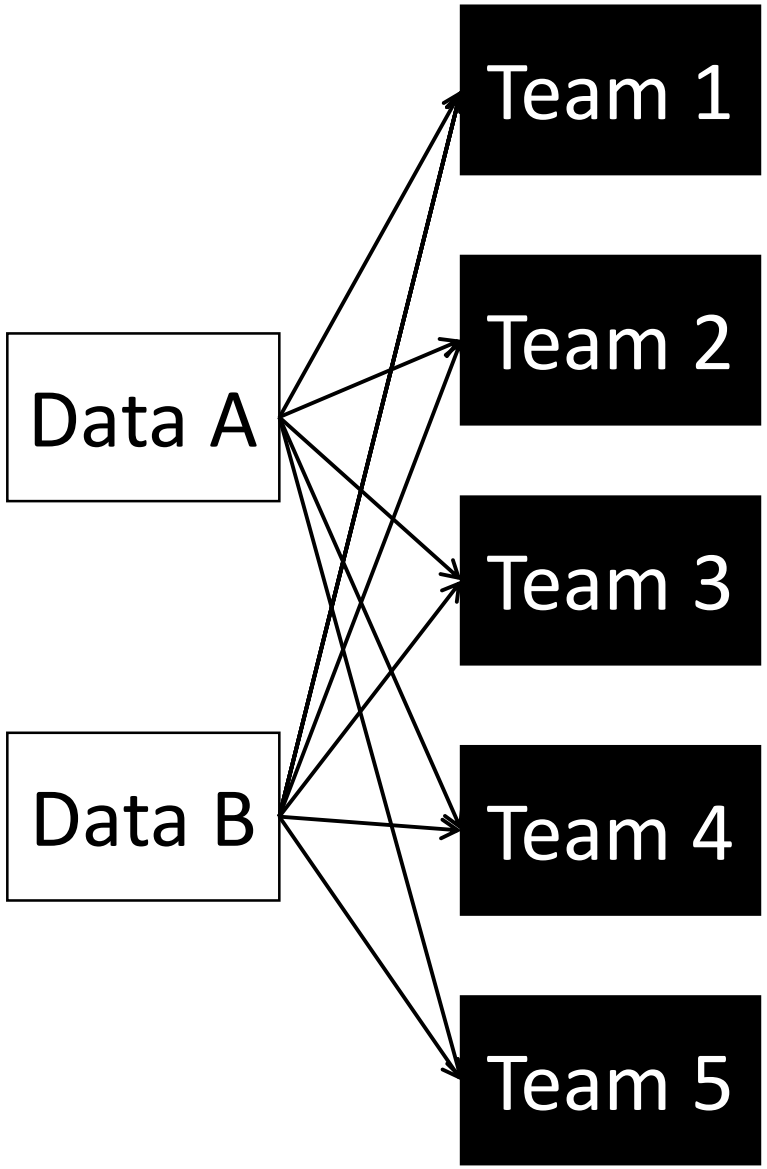
Deciphering the "Art" in Modeling and Simulation of the Knee Joint: Overall Strategy

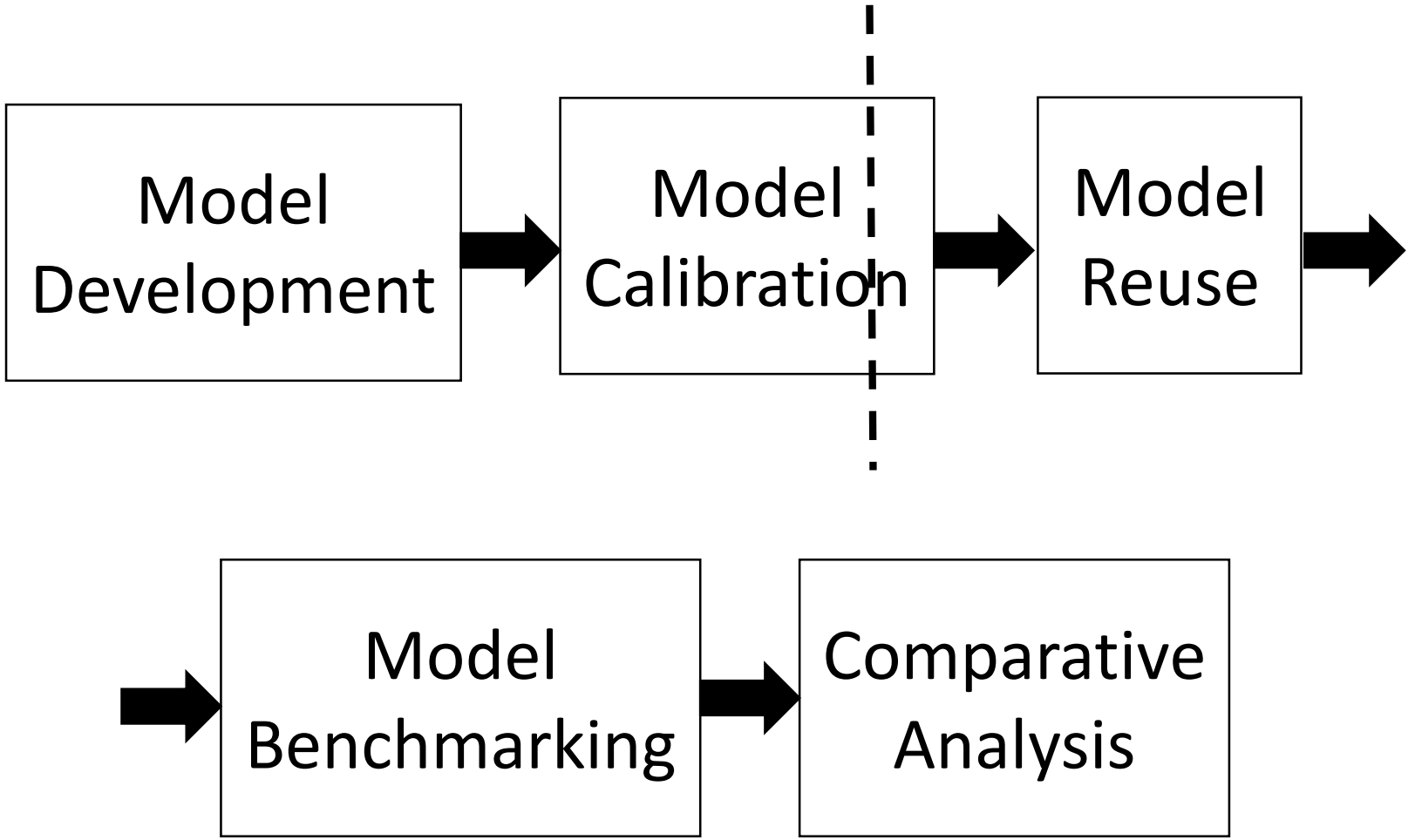
Recent explorations of knee biomechanics have benefited from computational modeling, specifically leveraging advancements in finite element analysis and rigid body dynamics of joint and tissue mechanics. A large number of models have emerged with different levels of fidelity in anatomical and mechanical representation. Adapted modeling and simulation processes vary widely, based on justifiable choices in relation to anticipated use of the model. However, there are situations where modelers' decisions seem to be subjective, arbitrary, and difficult to rationalize. Regardless of the basis, these decisions form the "art" of modeling, which impact the conclusions of simulation-based studies on knee function. These decisions may also hinder the reproducibility of models and simulations, impeding their broader use in areas such as clinical decision making and personalized medicine. This document summarizes an ongoing project that aims to capture the modeling and simulation workflow in its entirety—operation procedures, deviations, models, by-products of modeling, simulation results, and comparative evaluations of case studies and applications. The ultimate goal of the project is to delineate the art of a cohort of knee modeling teams through a publicly accessible, transparent approach and begin to unravel the complex array of factors that may lead to a lack of reproducibility. This manuscript outlines our approach along with progress made so far. Potential implications on reproducibility, on science, engineering, and training of modeling and simulation, on modeling standards, and on regulatory affairs are also noted.

[DOI: 10.1115/1.4043346]

Keywords: computational modeling, reproducibility, knee biomechanics, finite element analysis, joint mechanics, tissue mechanics

Research Plan





Reproducibility in simulation-based prediction of natural knee mechanics

Documents

- Auckland Bioengineering Institute
- Cleveland Clinic
- Cleveland State University
- Hospital for Special Surgery
- University of Denver

Auckland Bioengineering Institute

DU02 ABI Calibration phase specifications document.pdf
Dec 12, 2019 Author: Ahmet Erdemir
Model Calibration Specifications - Natural Knee Data (release)

DU02 Calibration phase specifications document.docx
Dec 12, 2019 Author: Ahmet Erdemir
Model Calibration Specifications - Natural Knee Data (source)

Model Specifications ABI - Natural Knee Data.docx
Sep 9, 2018 Author: Ahmet Erdemir
Model Development Specifications - Natural Knee Data (source)

Model Specifications ABI - Natural Knee Data.pdf
Sep 9, 2018 Author: Ahmet Erdemir
Model Development Specifications - Natural Knee Data (release)

ORS 2019 workshop
Reproducibility in Modeling and Simulation

Andy Baumann, Ph.D.
FDA

Cheryl Liu, Ph.D.
Stryker

Carl Imhauser, Ph.D.
HSS

5 Minute Flash Opinions

B.J. Fregly, Ph.D.
Rice University

Nico Verdonschot, Ph.D.
Twente University

Jeffrey Bischoff, Ph.D.
Zimmer Biomet

- Inadequate model sharing is the biggest hurdle to reproducibility
- First, one must define what outputs you are trying to reproduce
- We must understand how to interpret model predictions
- Ranking outputs may be more valuable than actual magnitude
- Complexity and high number of model parameters may hinder reproducibility
- Reproducibility depends on skill of modeler

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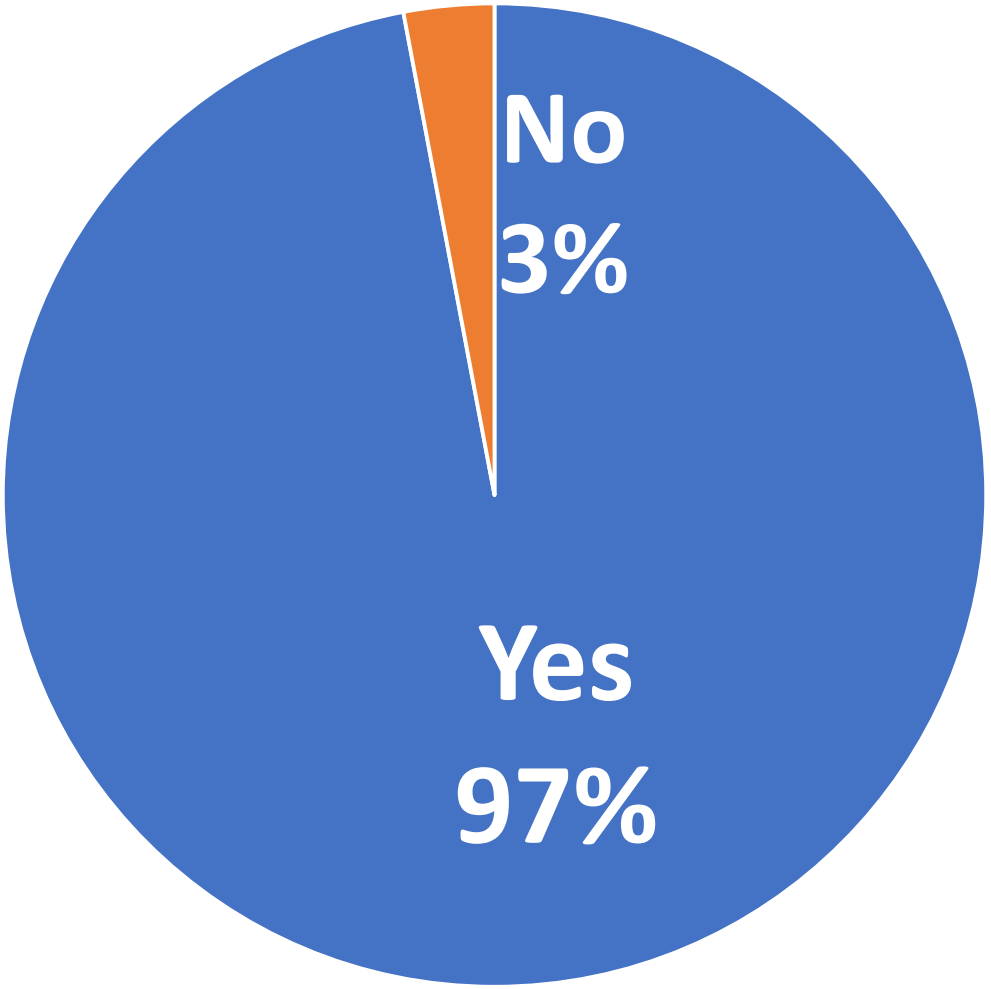
2019 Workshop: Survey Summary

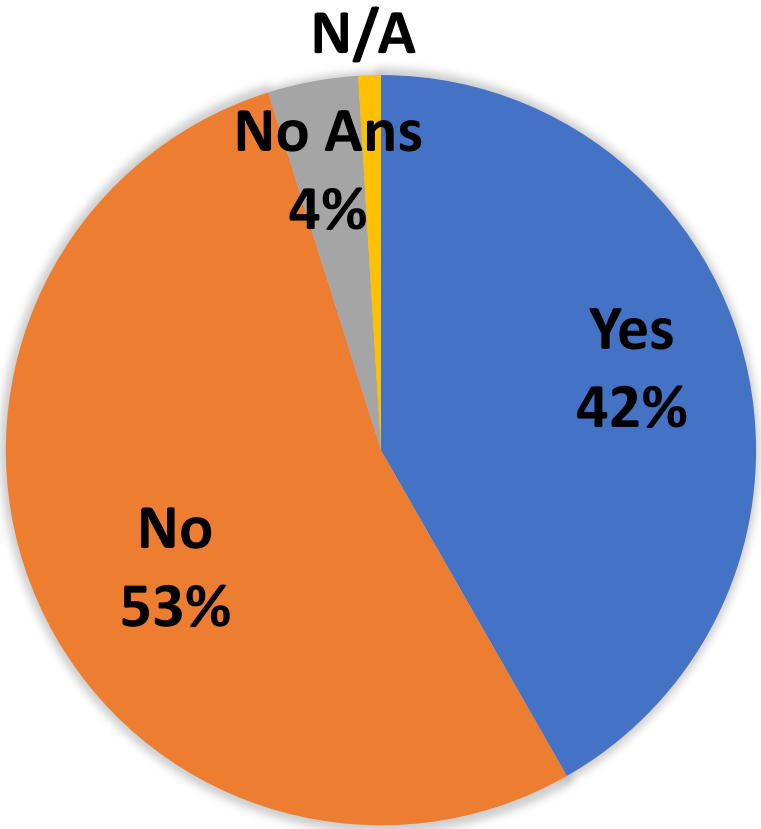
ORS Orthopaedic Research Society
2019 ANNUAL MEETING
February 2–5, 2019
Austin Convention Center
Austin, TX

102 surveys completed

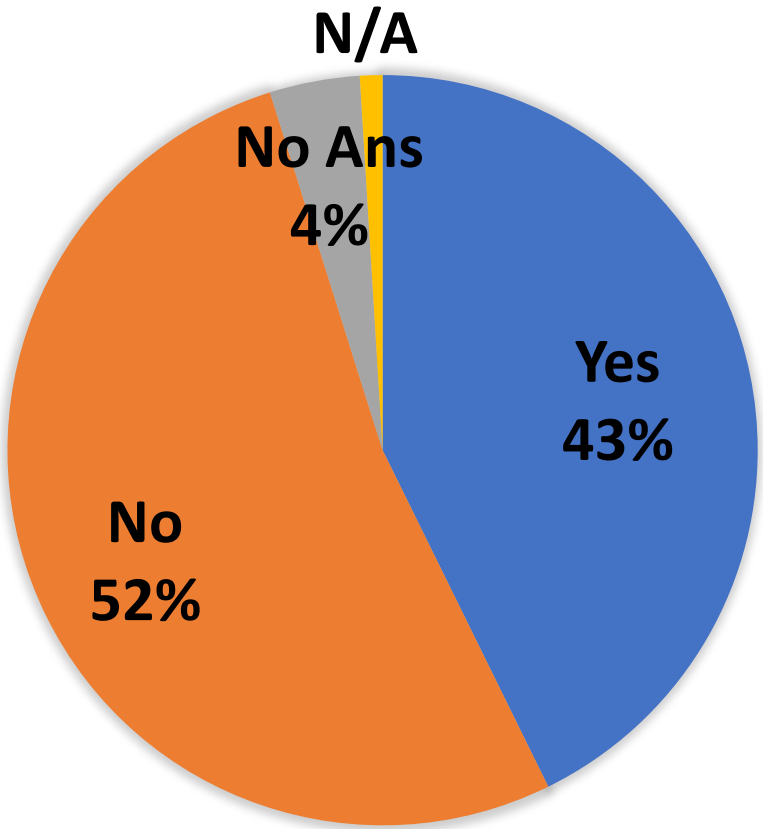
Do you consider reproducibility of Knee M&S to be an important issue?



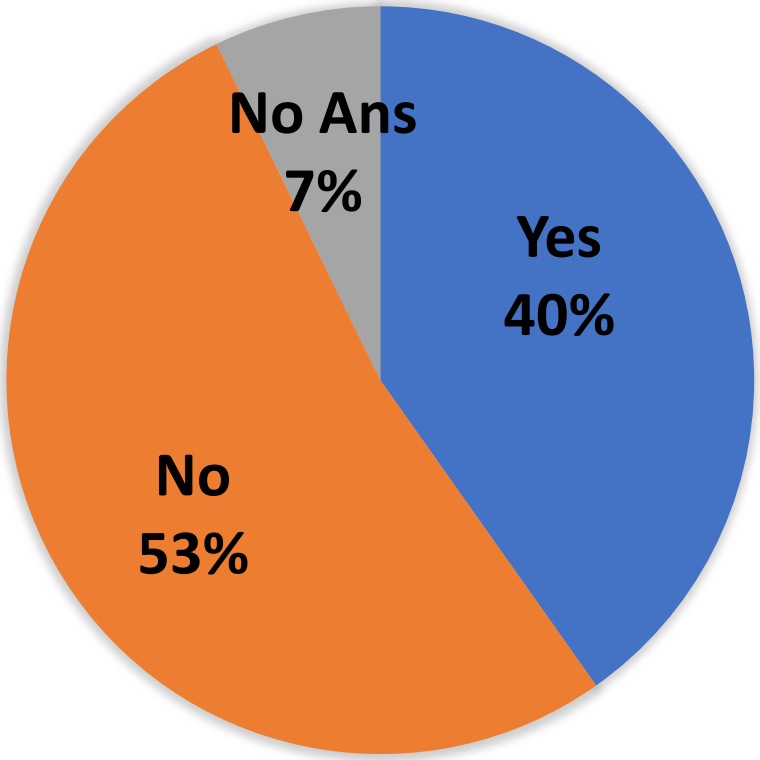
Does your lab have established procedures for reproducibility?



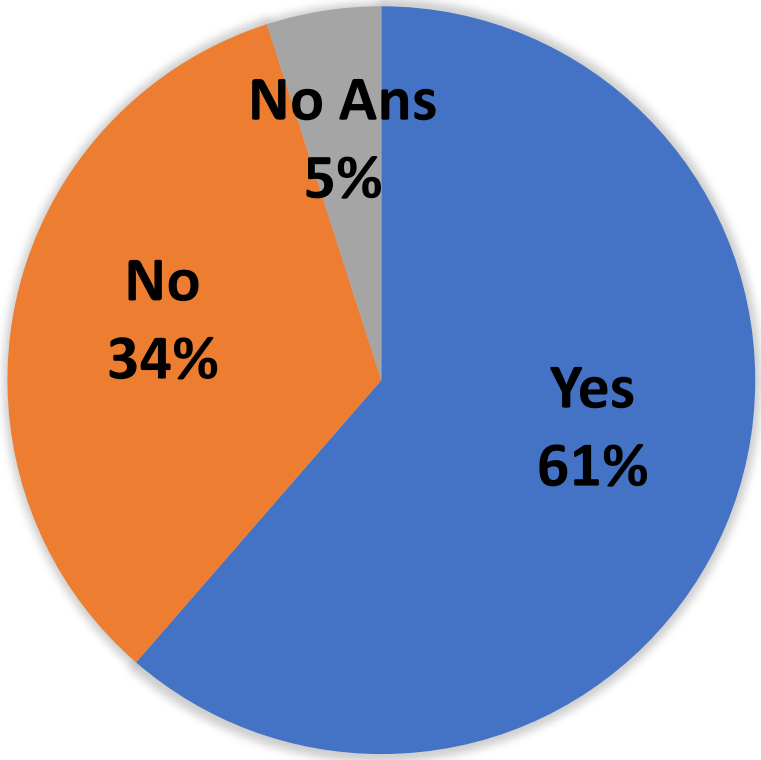
Have you tried to reproduce the work of others and failed?



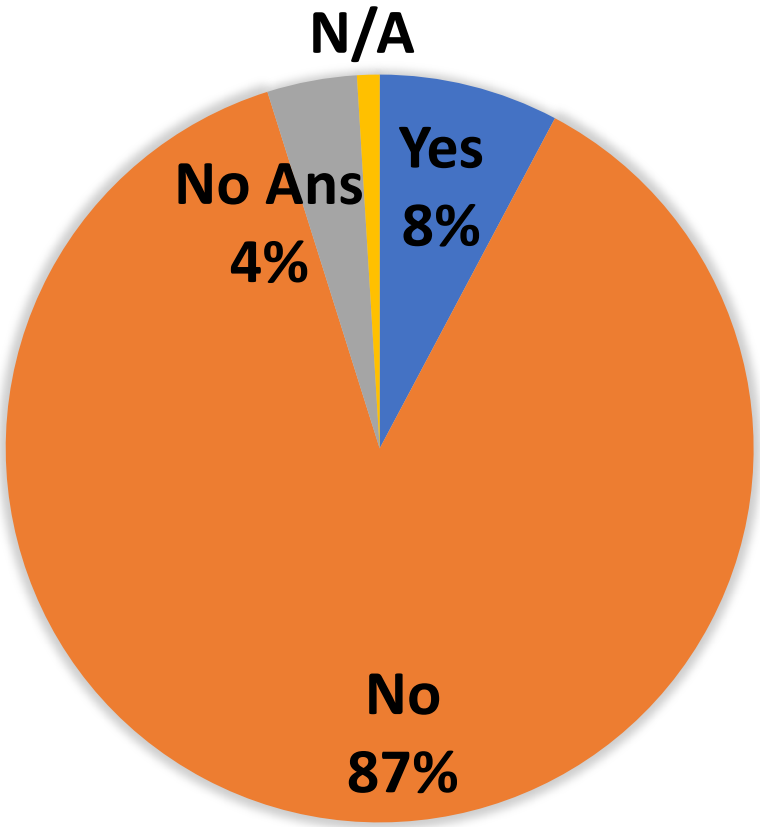
Do you think rigorous rules for reproducibility in Knee M&S will hinder progress/innovation?



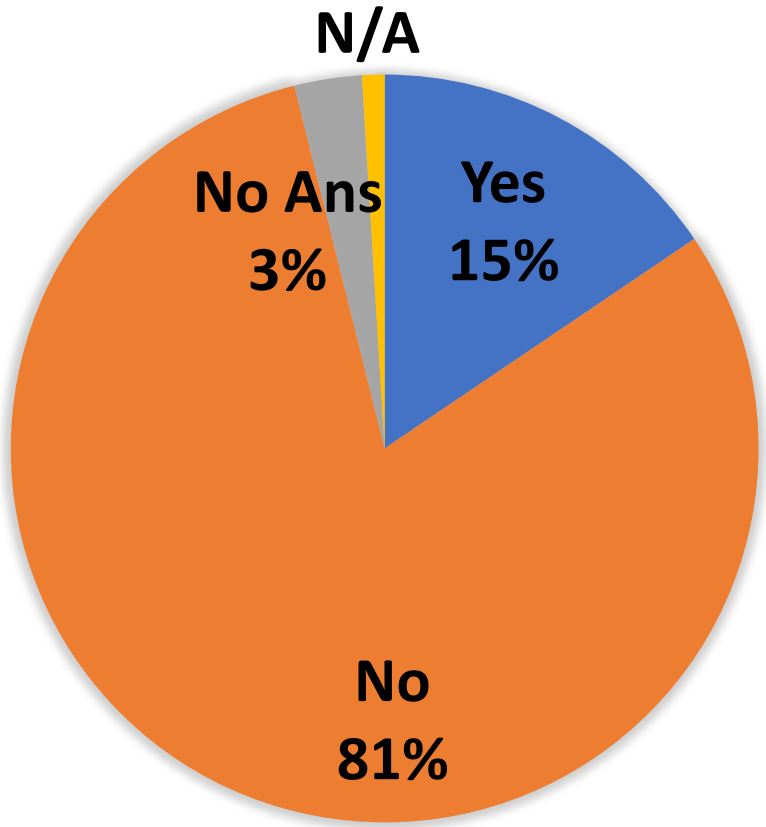
Should all Knee M&S publications provide access to primary (raw) data and modelling code?



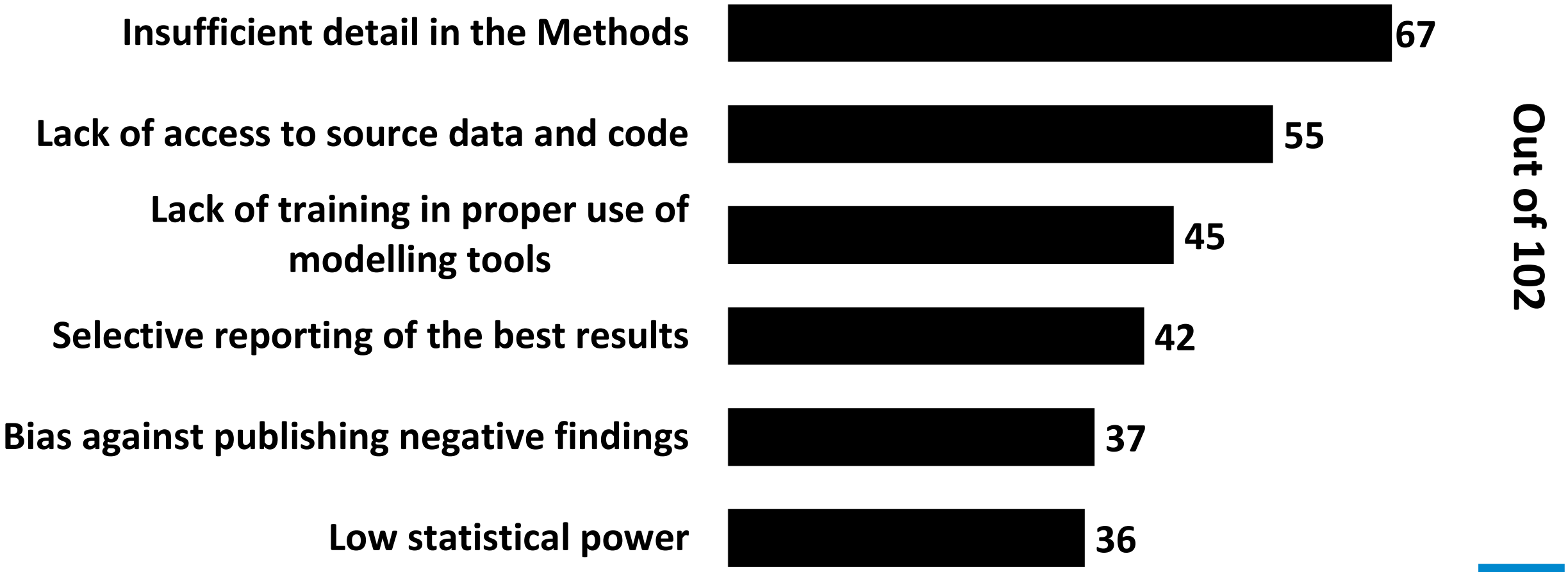
Have you ever tried to publish a reproduction attempt?



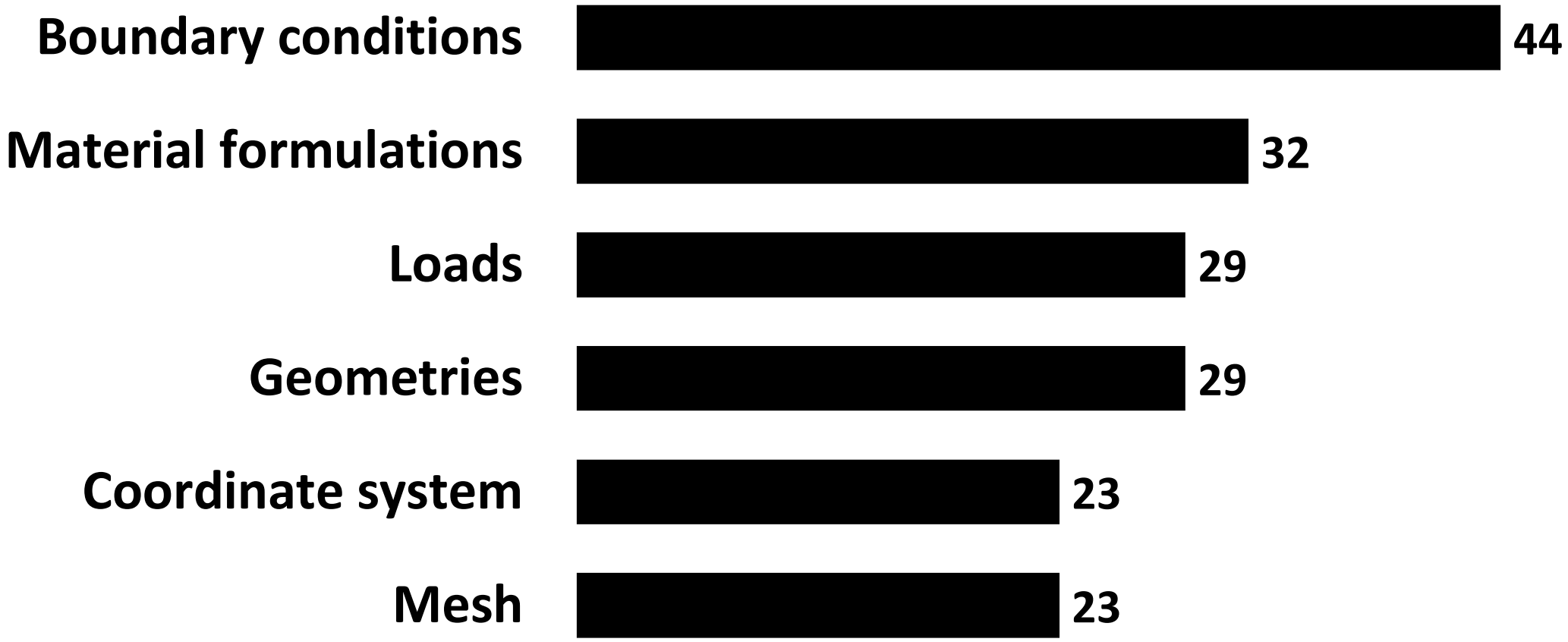
Have you ever been contacted by another lab that has tried to reproduce your work?



What are the biggest causes of irreproducibility in Knee M&S, in your opinion?



What aspect of developing a knee model do you find hardest to reproduce?



M&S community in ORS 2020

54 poster presentations

5 podium presentation

https://www.vectorstock.com/royalty-free-vector/cartoon-businessman-presentation

https://www.youtube.com/making_a_better_research_poster

Goals of this RIG

- To promote computational modeling as an indispensable tool in orthopaedics research
- To identify resources for more unified and effective computational modeling in orthopaedics
- To build a community of modelers in orthopaedics

What will happen in the next two hours?

- Talk: *F.A.I.R.ness and Credibility in Computational model*
- Panel Discussion
- Filling the feedback form

Thank you!