WHAT IS SUSTAINABILITY FROM A LARGE MULTIPHYSICS SOFTWARE PERSPECTIVE
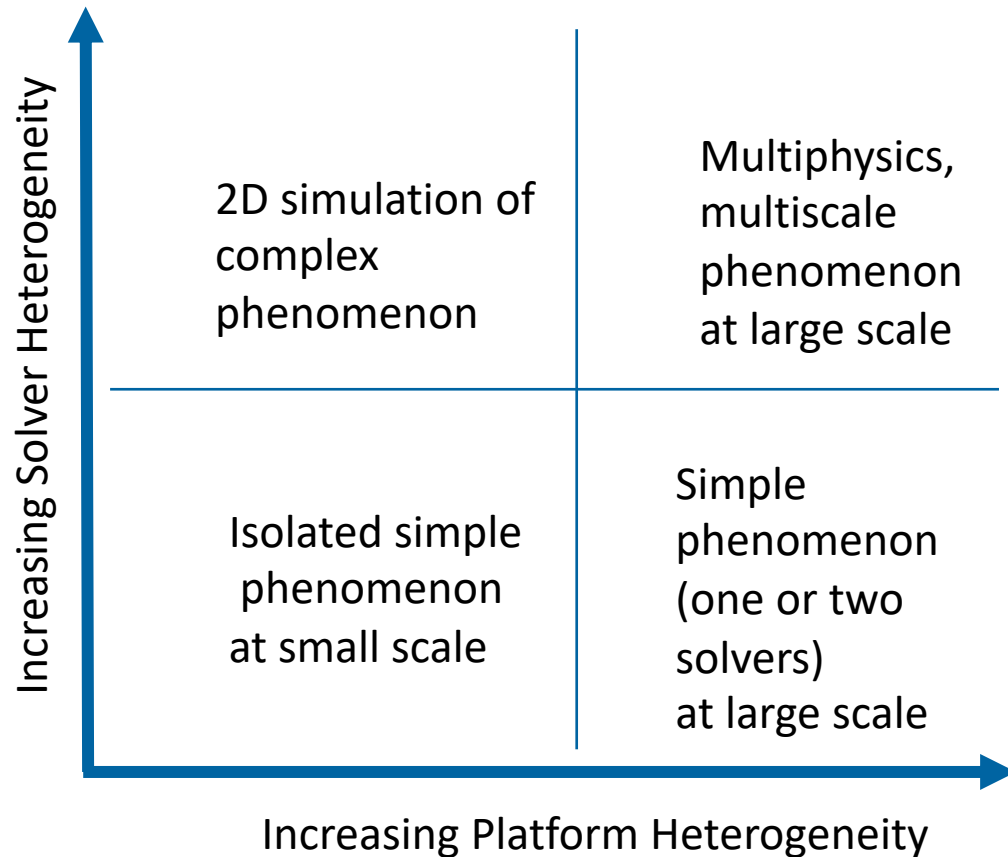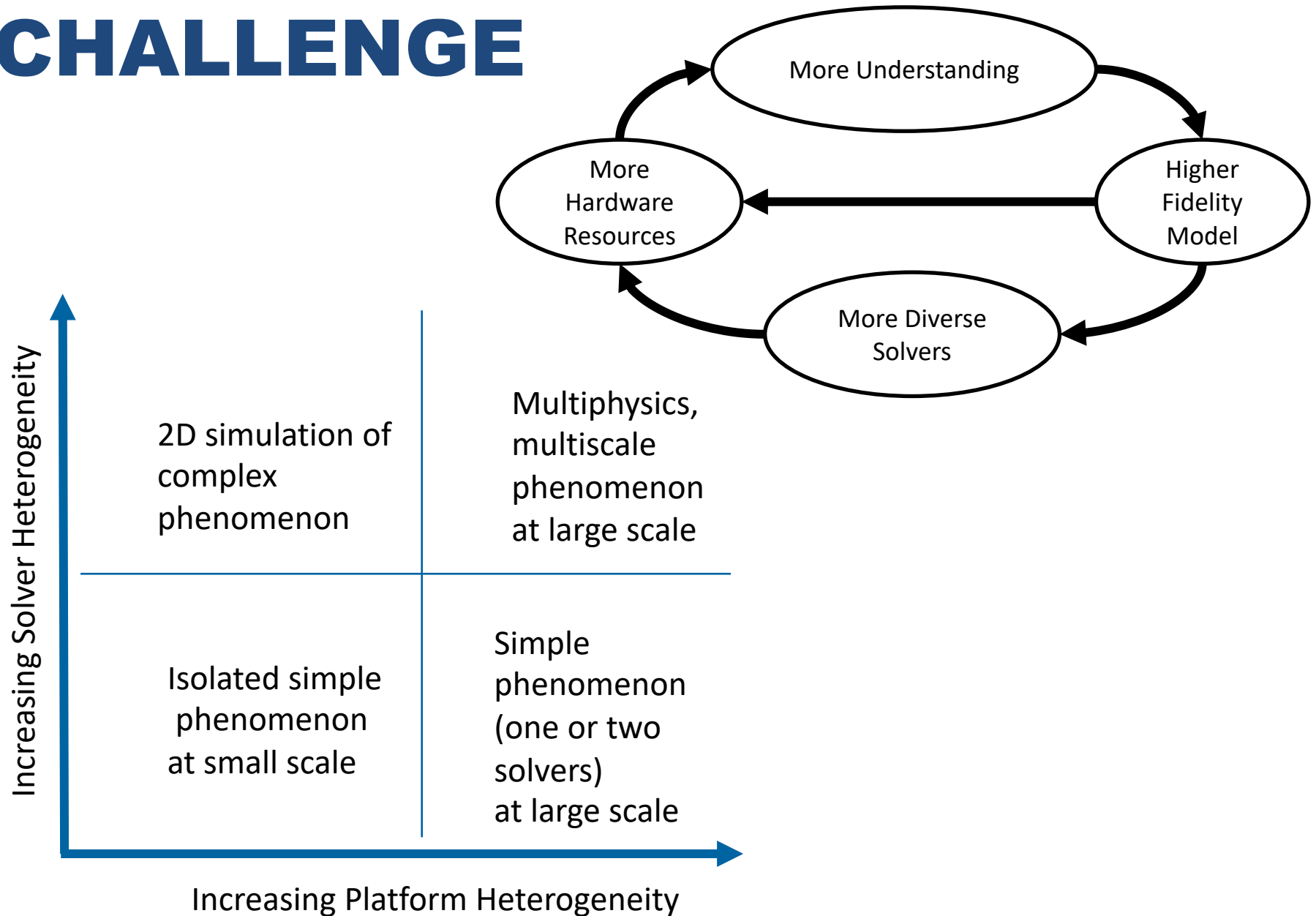

JULY 23, 2019
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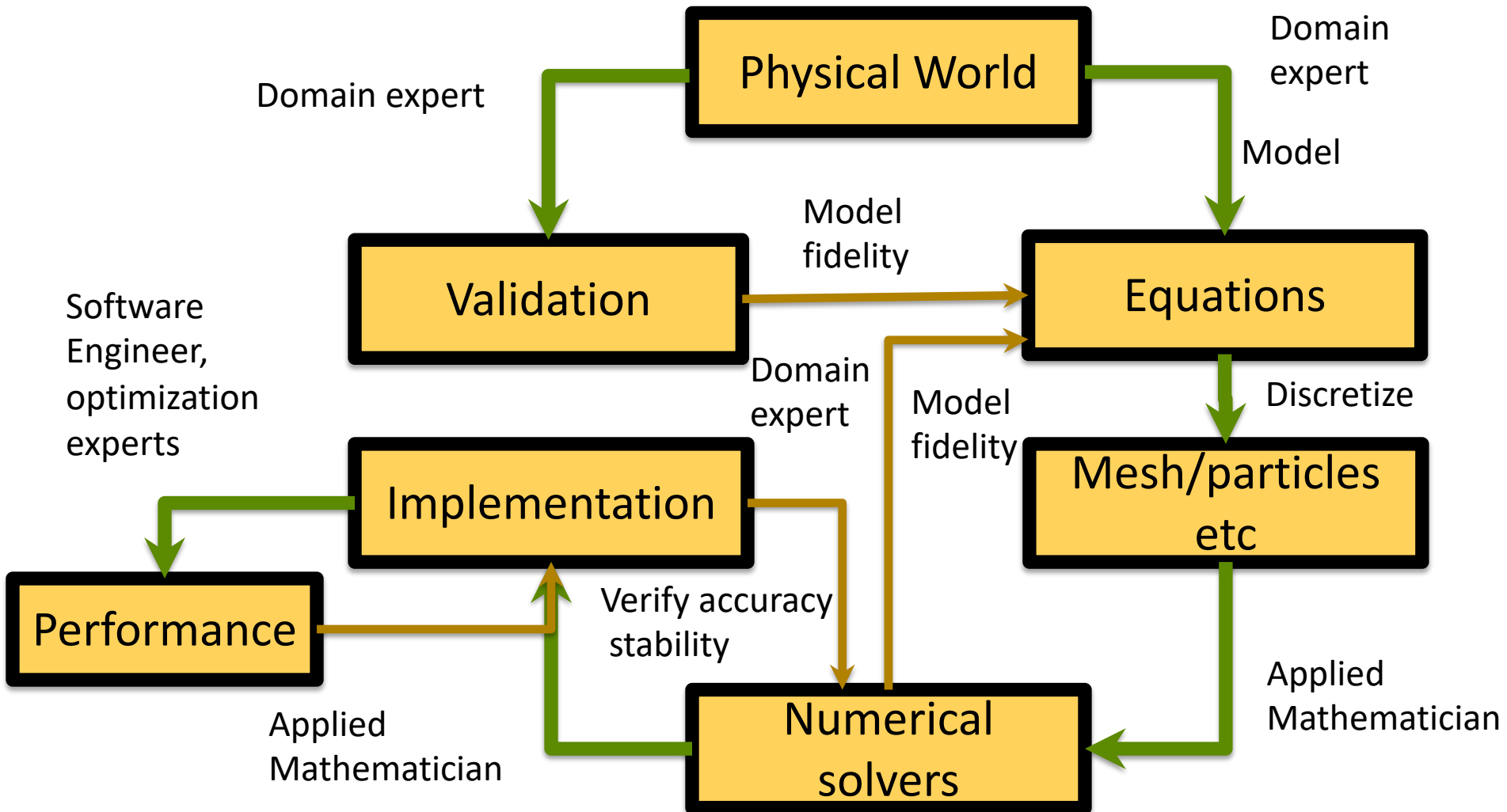# OUR SUSTAINABILITY CHALLENGE

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More Understanding → Higher Fidelity Model → More Diverse Solvers → More Hardware Resources → More Understanding

Increasing Solver Heterogeneity (vertical axis)

Increasing Platform Heterogeneity (horizontal axis)

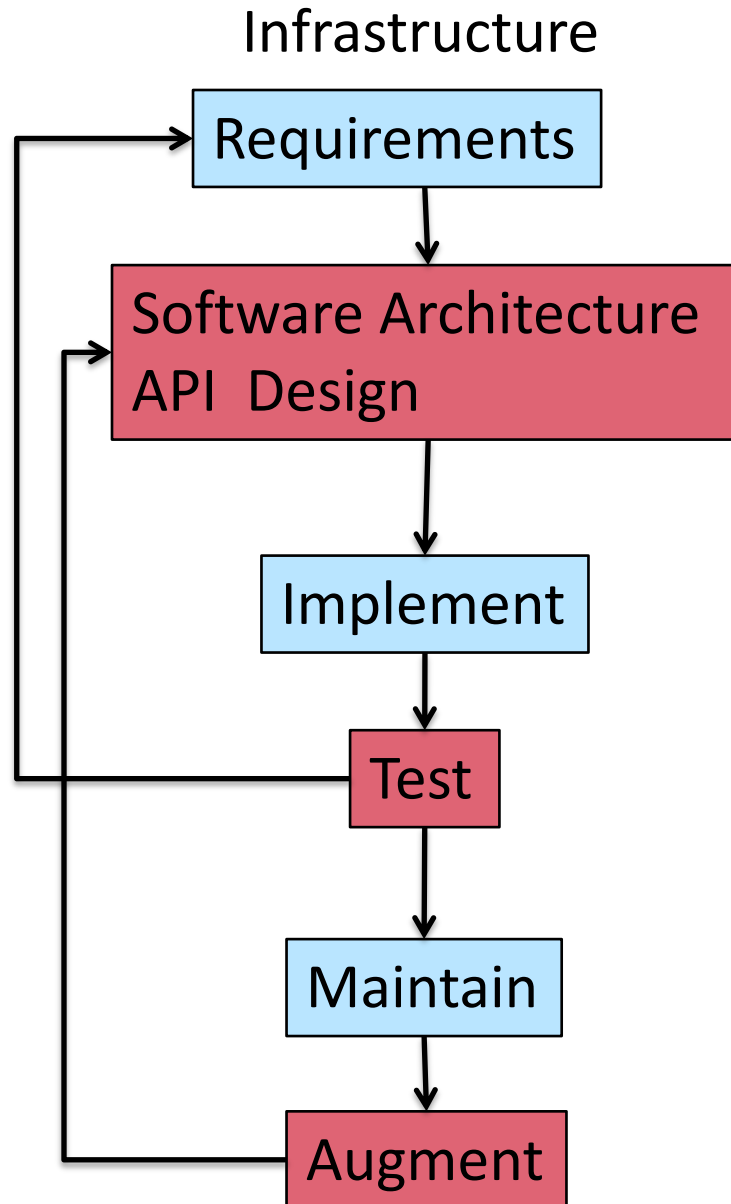|	
2D simulation of complex phenomenon	Multiphysics, multiscale phenomenon at large scale
Isolated simple phenomenon at small scale	Simple phenomenon (one or two solvers) at large scale

EXPERTISE MAP

HOW D0 WE MAKE IT WORK?

❑ Two type of components

❑ Infrastructure

   ❑ stable

❑ Physics & numerics

   ❑ change with insights

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Infrastructure
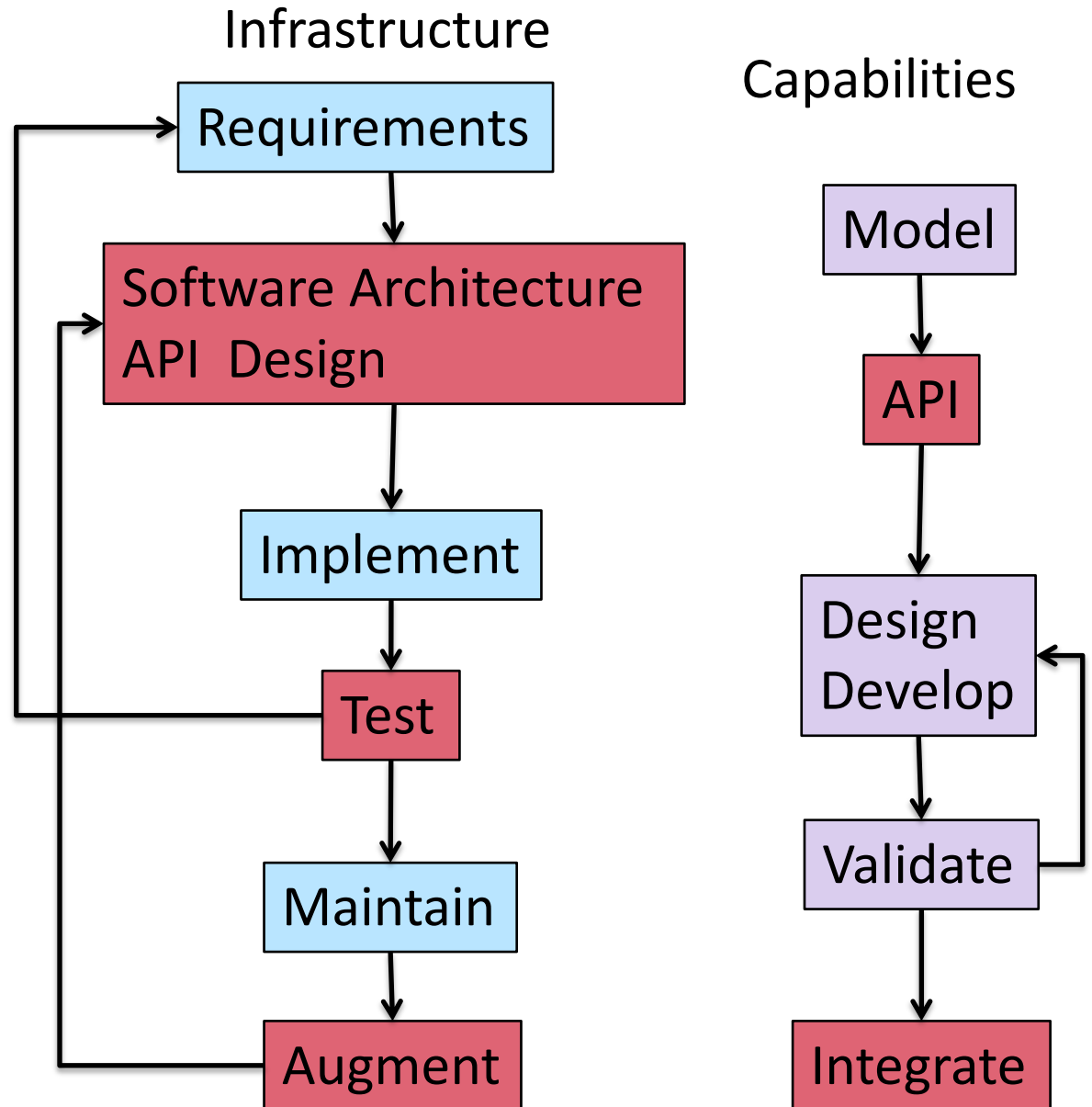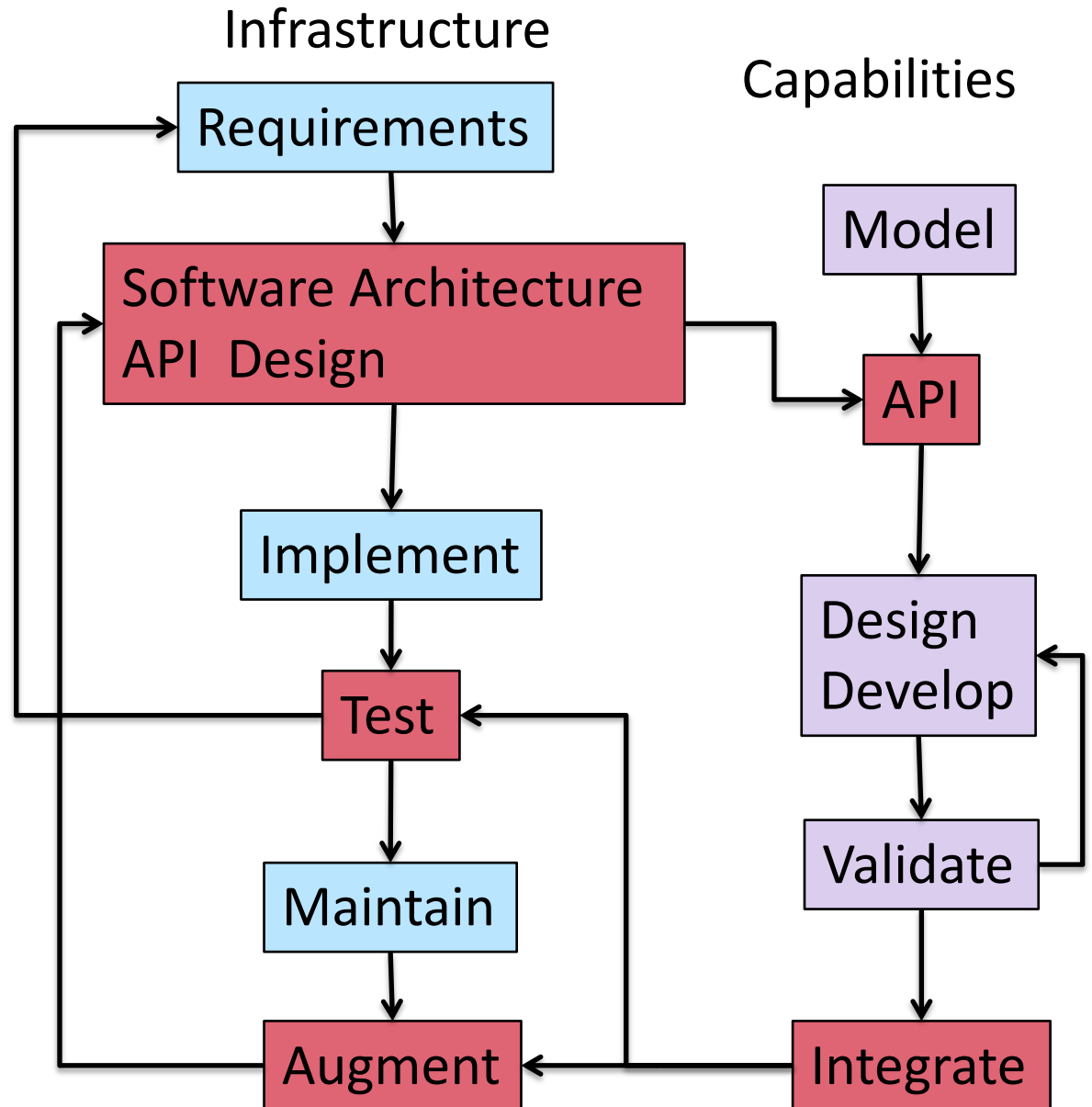
```
Requirements
      ↓
Software Architecture
API  Design
      ↓
Implement
      ↓
Test
      ↓
Maintain
      ↓
Augment
```

HOW D0 WE MAKE IT WORK?

- ☐ Two type of components
- ☐ Infrastructure
  - ☐ stable
- ☐ Physics & numerics
  - ☐ change with insights

Infrastructure

Requirements → Software Architecture API Design → Implement → Test → Maintain → Augment

Capabilities

Model → API → Design Develop → Validate → Integrate

HOW D0 WE MAKE IT WORK?

- ❑ Two type of components
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Infrastructure

Capabilities

Requirements

Software Architecture API Design

Model

API

Implement

Design Develop

Test

Validate

Maintain

Augment

Integrate

CHALLENGES

- ❑ Production Vs research code
  - ❑ Science needs production grade code
  - ❑ For applied math that is research tool
    - ❑ Insights come from production runs
    - ❑ Parameter exploration from convergence and validity perspective
  - ❑ At odds with clean code
- ❑ Co-existence of production and development
  - ❑ Simulation campaign from a branch
    - ❑ Modifications happen
    - ❑ Can be a long lived branch

WHAT DOES SUSTAINABILITY MEAN TO US

❑Years of experience and learning encoded in the code

❑A great deal of it still useful in foreseeable future

    ❑May change if mathematical foundation changes

❑Vagaries of hardware and software stack should not render it useless

    ❑Should not force us into a situation where we are always playing catch up

WHAT DOES SUSTAINABILITY MEAN TO US

❑ A software architecture that enables portability

❑ A software process that enables users to meet their needs

　　❑ And lets developers do their work

　　❑ And lets research proceed in code itself

❑ A respectful community that appreciates all kind of contributions

❑ A community where people with different interests and abilities thrive

❑ Results produced are credible because there is adequate verification and validation

❑ Tensions between competing priorities are resolved