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The Society for the Advancement
of Material and Process Engineering

Design for Inspection: A Formalized Approach
to Evaluating the Inspectability of Aerospace
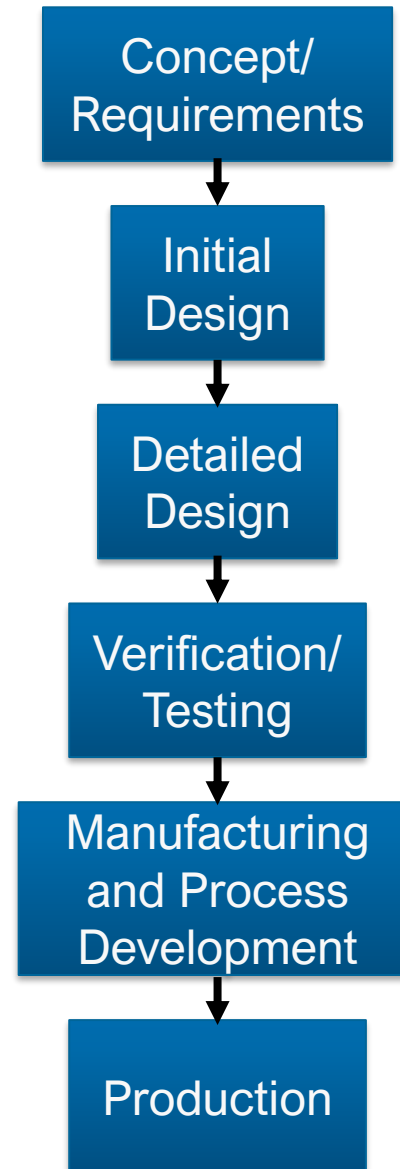Structures Early in the Design Process

Design for Inspection: A Formalized Approach to Evaluating the Inspectability of Aerospace Structures Early in the Design Process
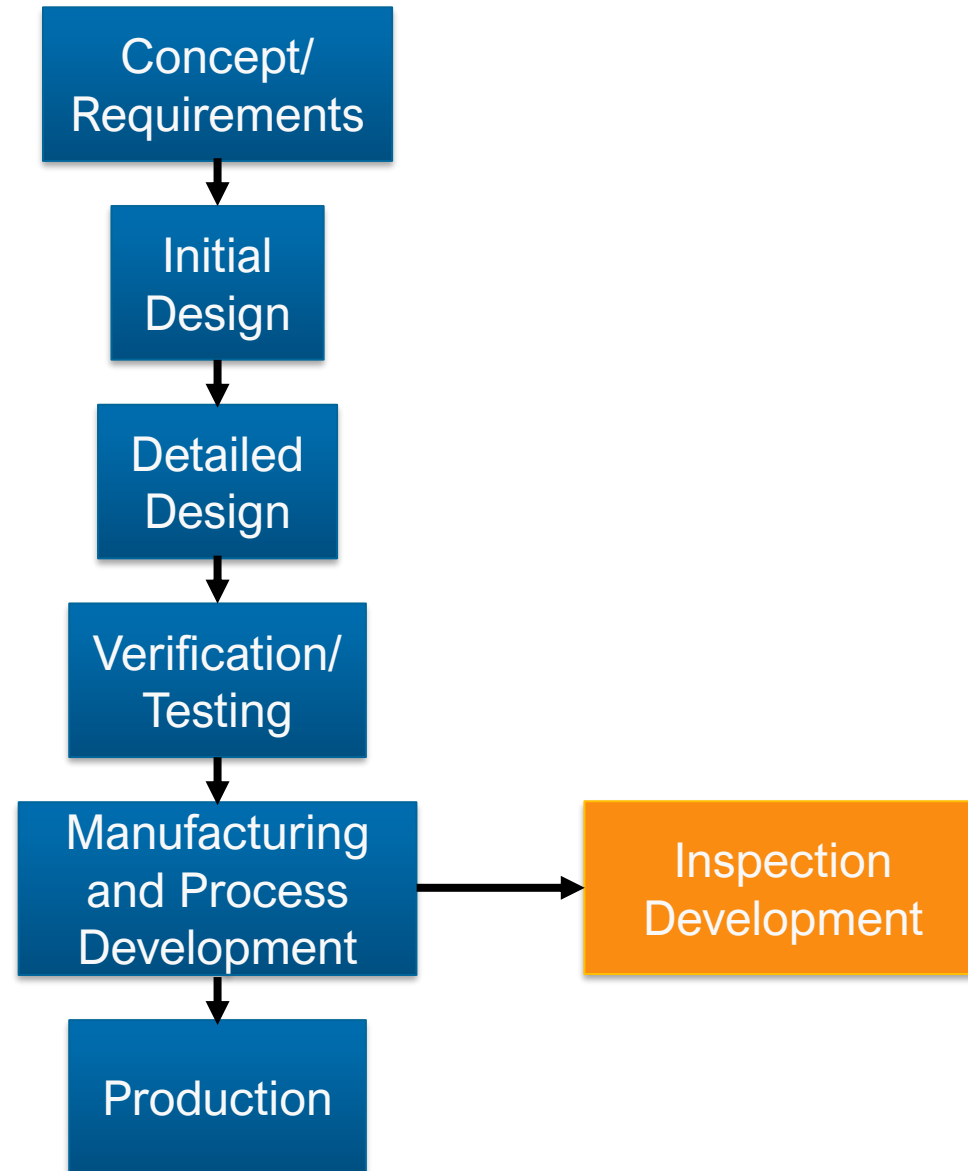
Peter Juarez[1], Starr Dauria[2], Sébastien Lonne[2], Bastien Clausse[2], Hong Tat[3], Jill Bingham[3]

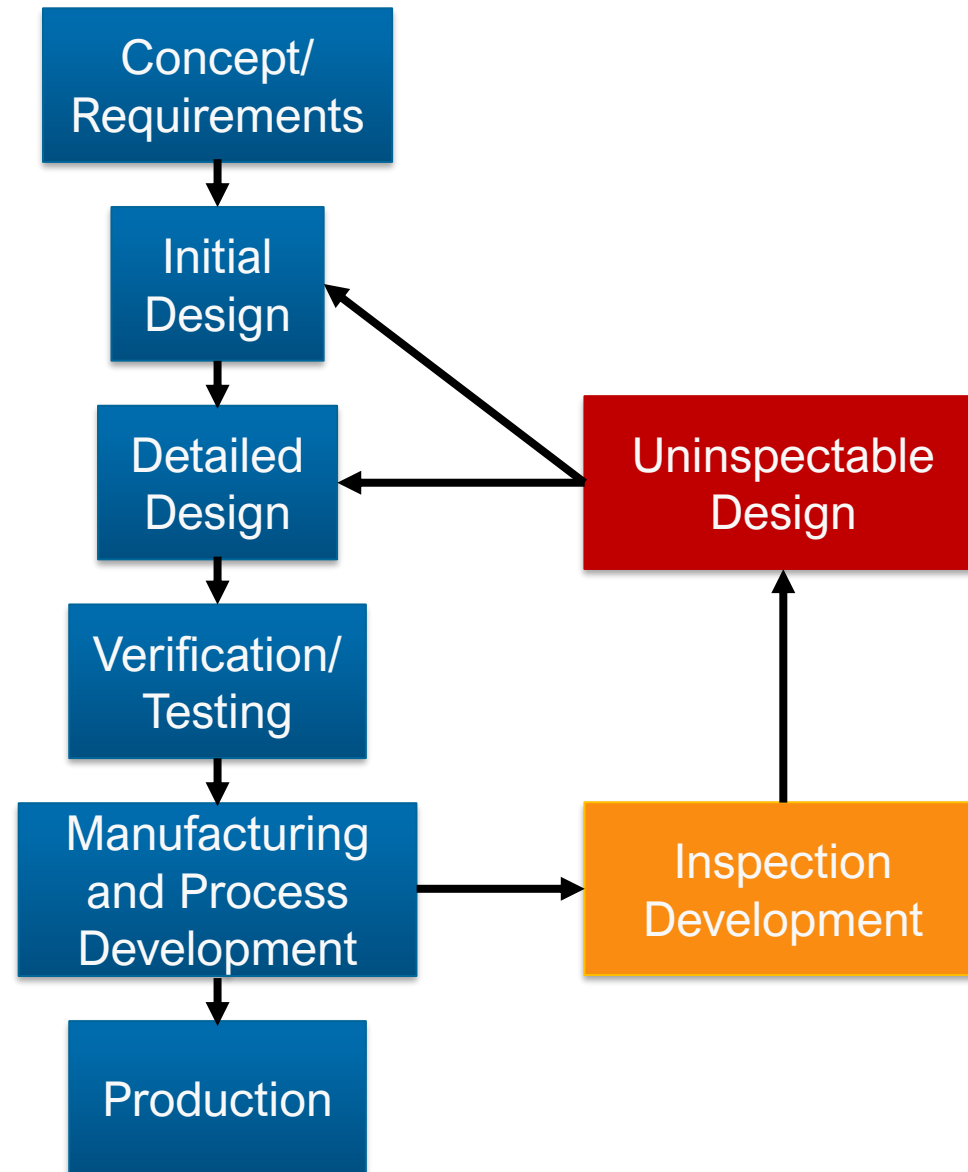[1]NASA Langley Research Center, [2]Extende, [3]Boeing
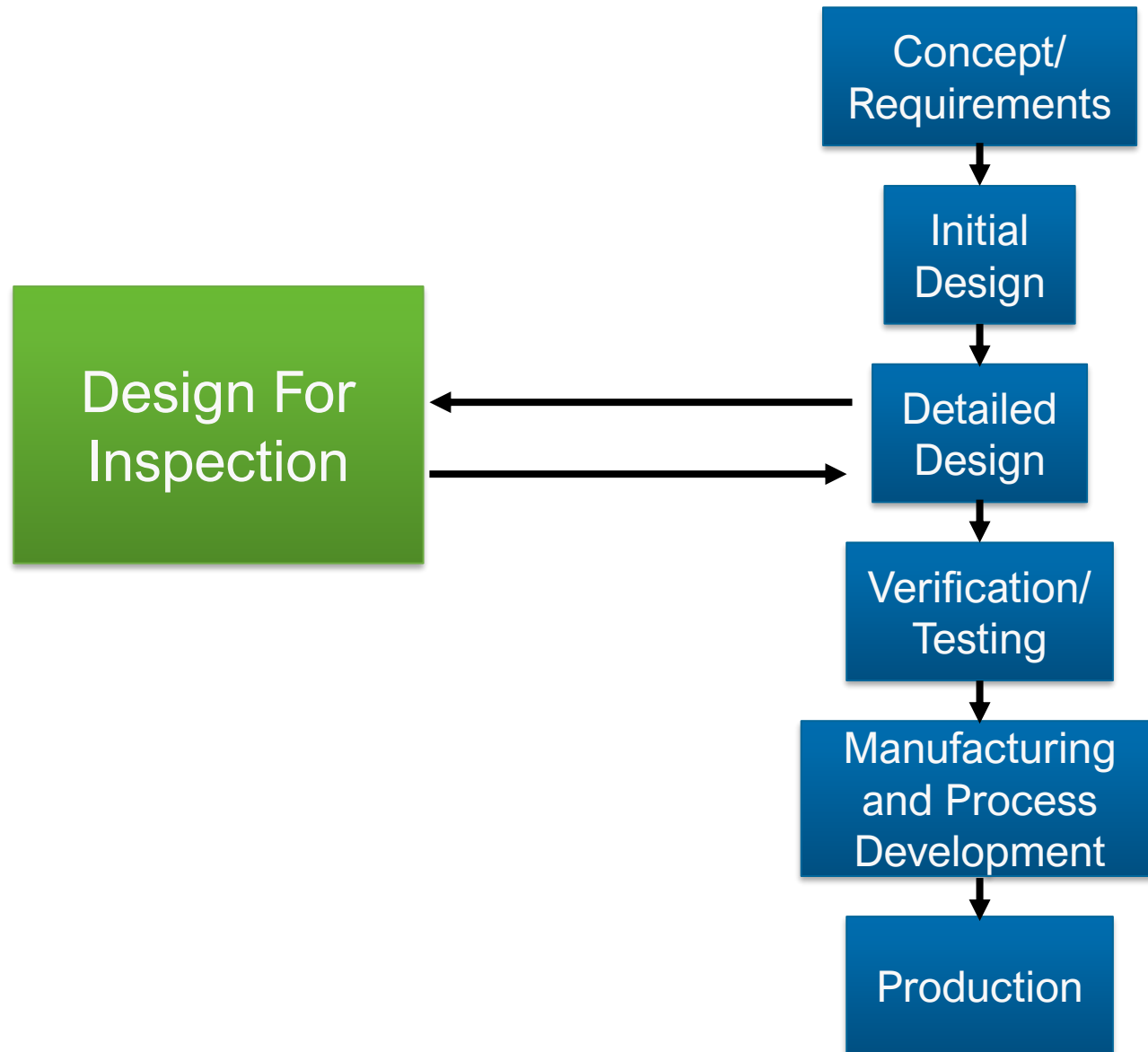
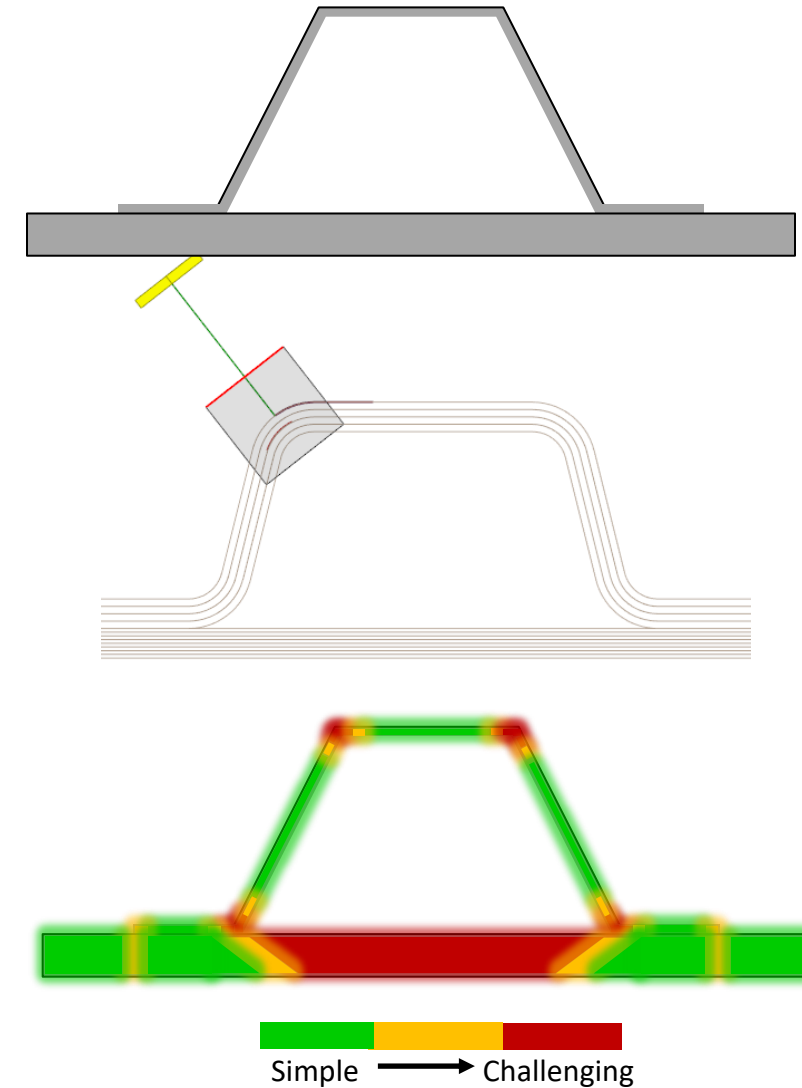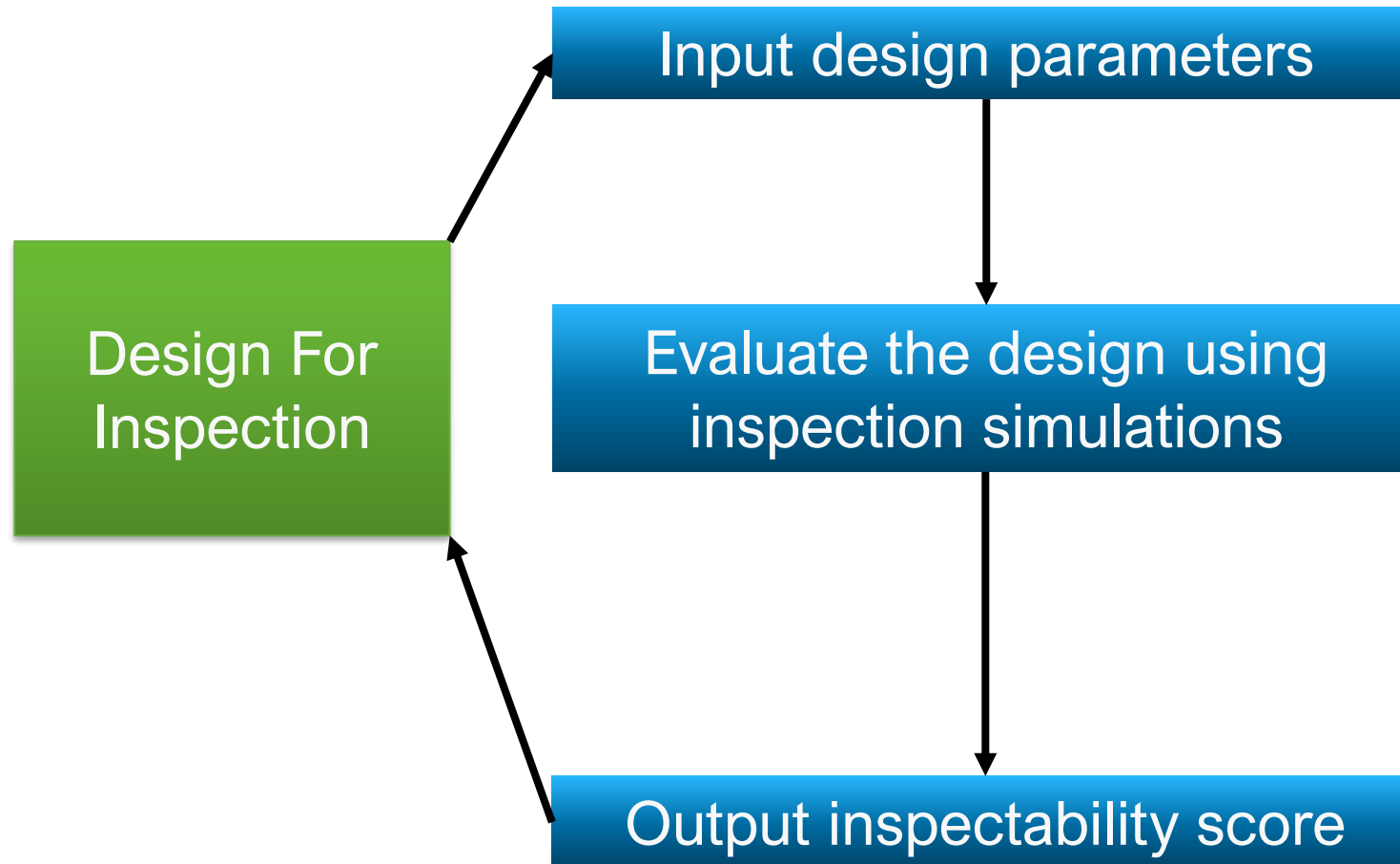www.nasampe.org

Current Aerospace Workflow
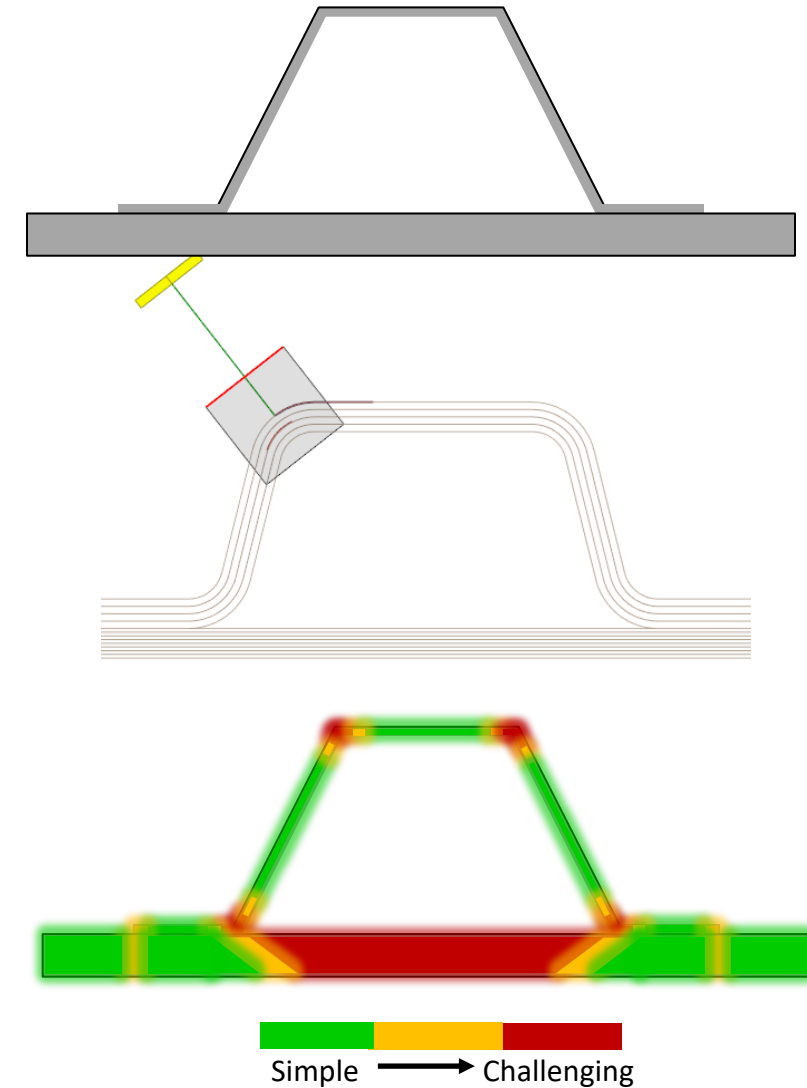
Current Aerospace Workflow

Current Aerospace Workflow

Proposed Aerospace Workflow

Design For Inspection Framework

Design For Inspection

Input design parameters

Evaluate the design using inspection simulations

Output inspectability score

Simple → Challenging

Design For Inspection Framework

Design For Inspection → Inspectability Metric

Simple → Challenging

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Question DFI is trying to answer

How well can we find a defect in this design?

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Question DFI is trying to answer

How well can we find a defect in this design?

How much does the design change the physics of detecting a defect?

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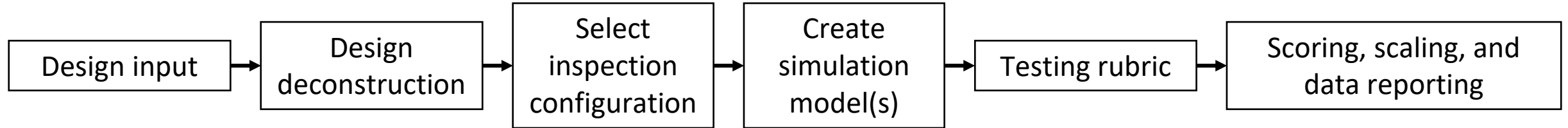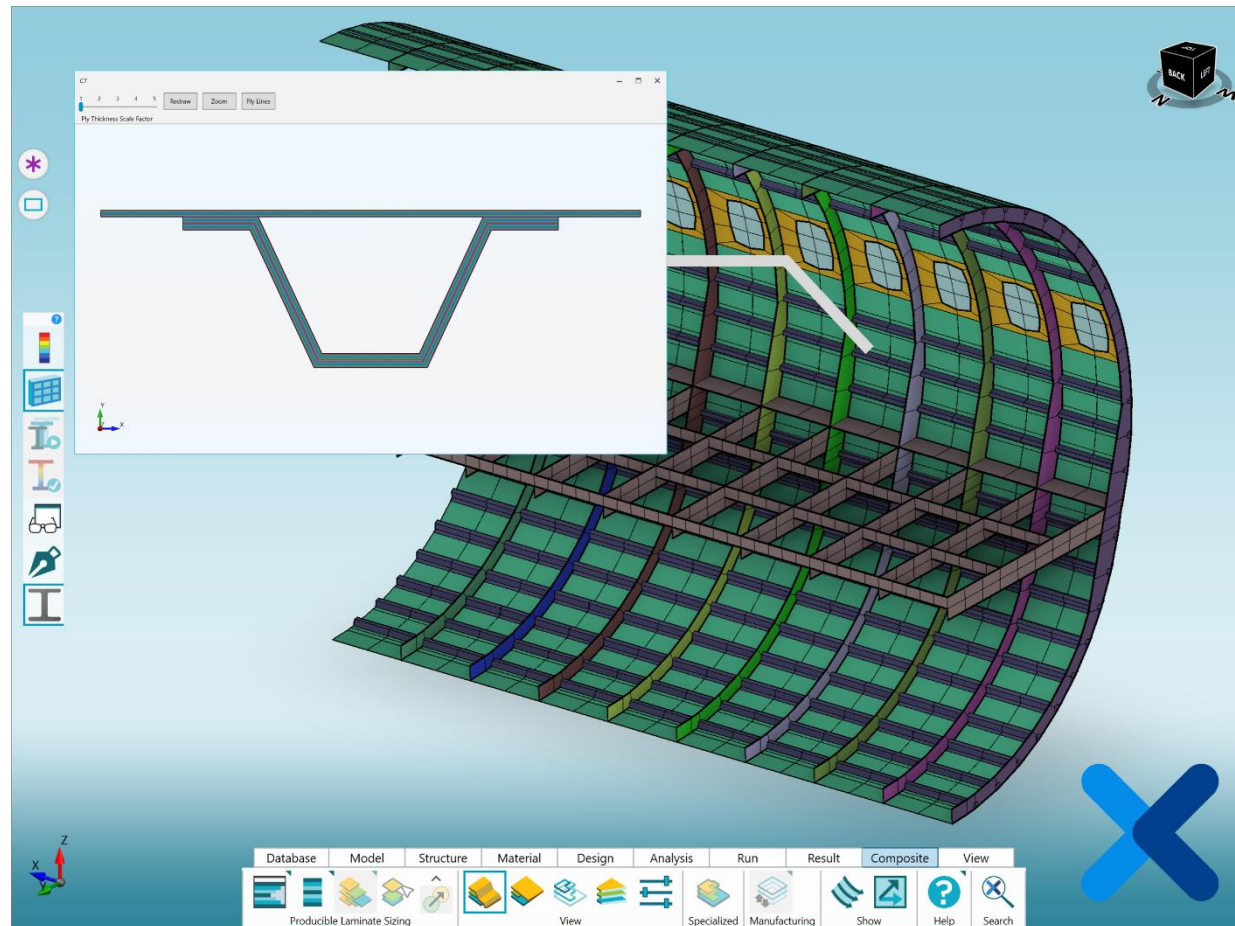
Inspectability Metric Tenets

Agile

Versatile

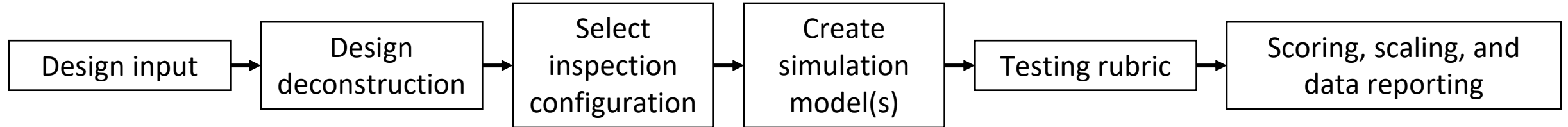Communicable

Inspectability Metric Overview

Inspectability Metric Overview

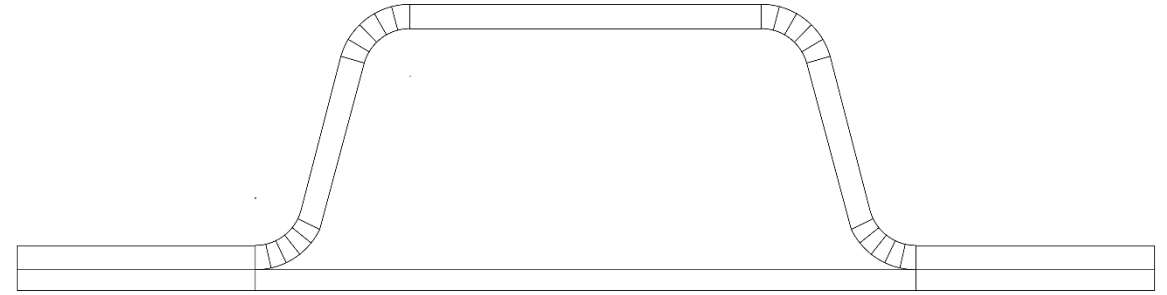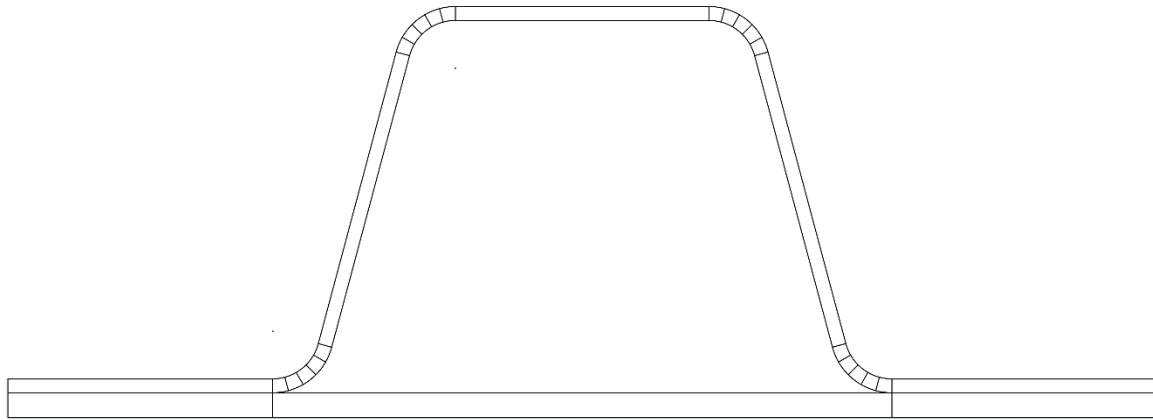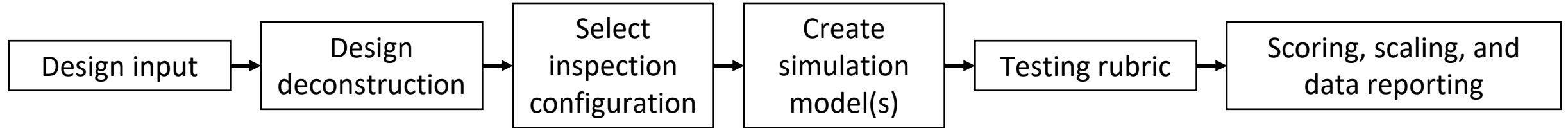Design input → Design deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting

Inspectability Metric Overview

Design input → Design deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting
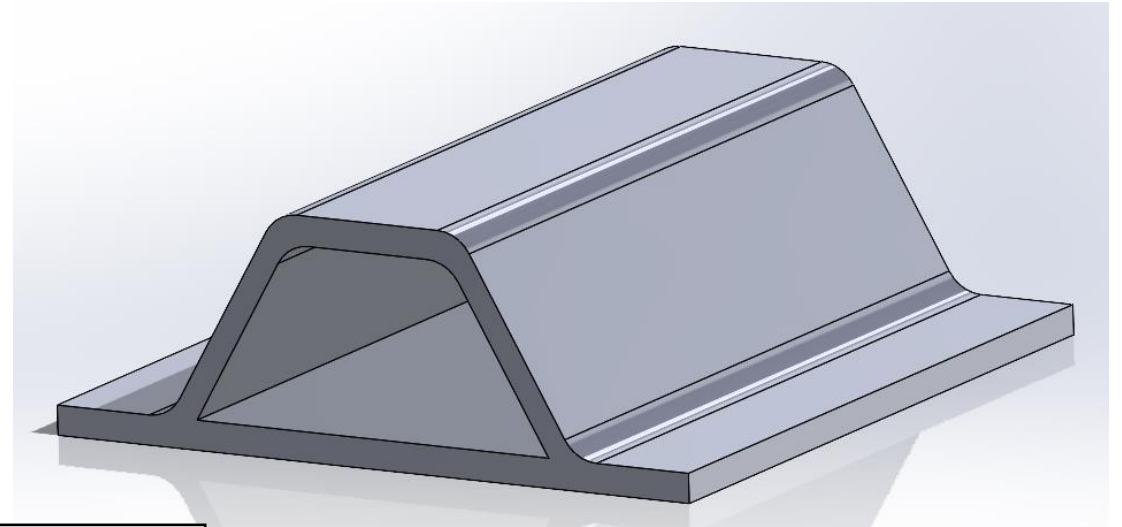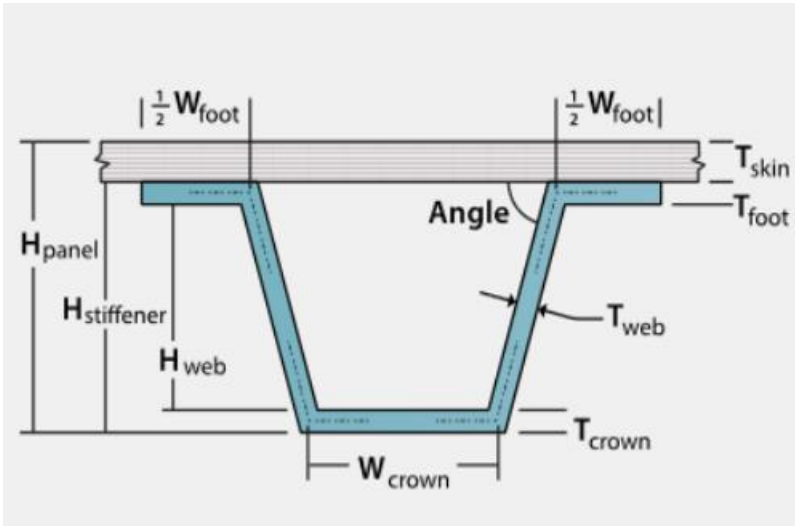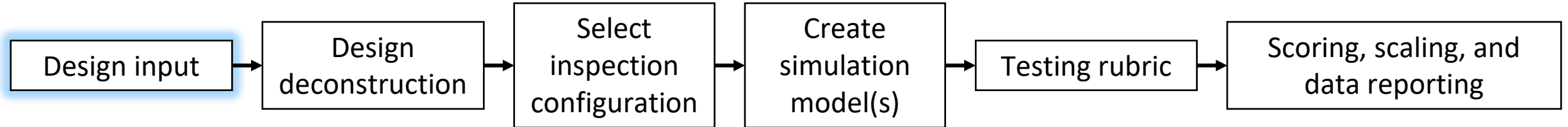

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Inspectability Metric Overview

Design input → Design deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting
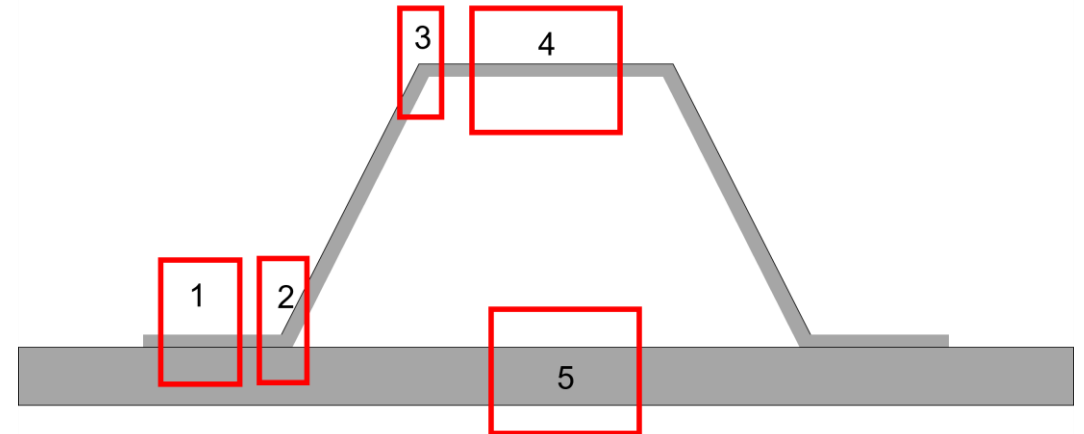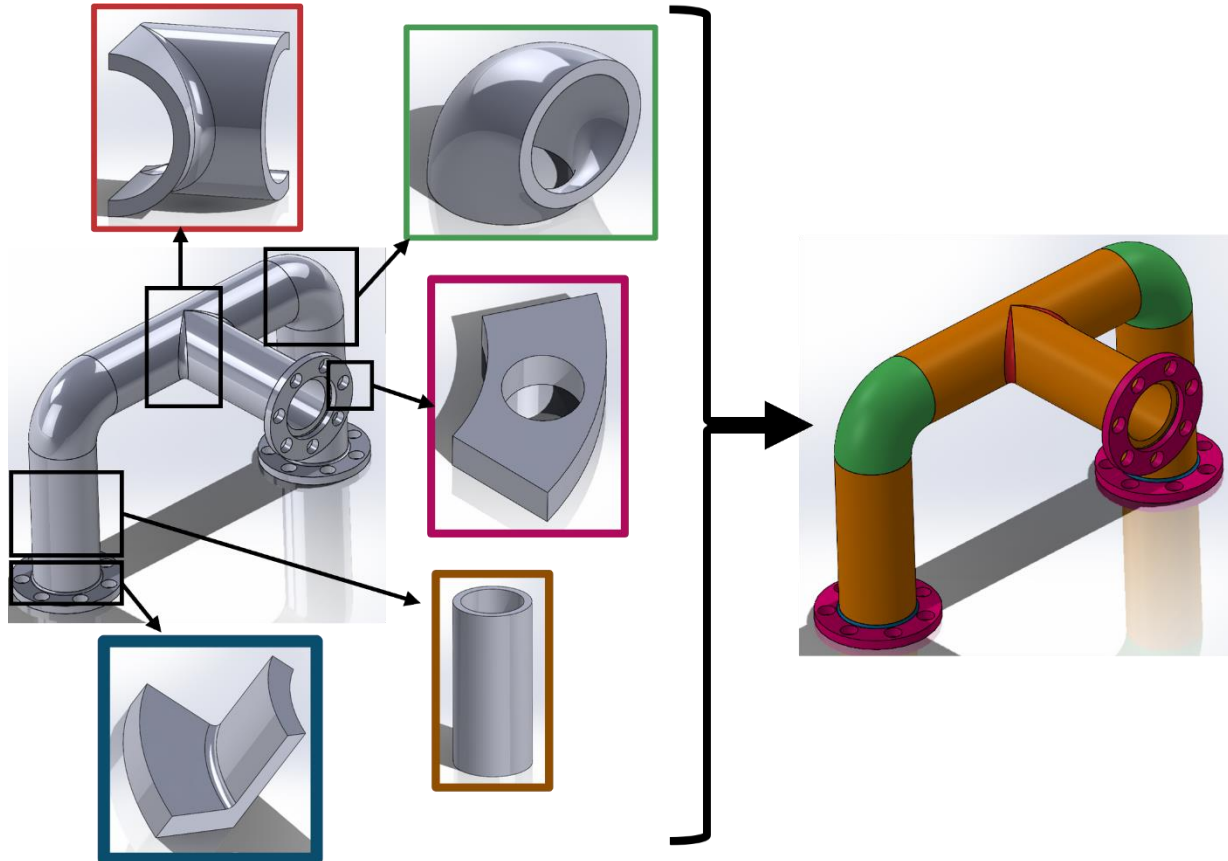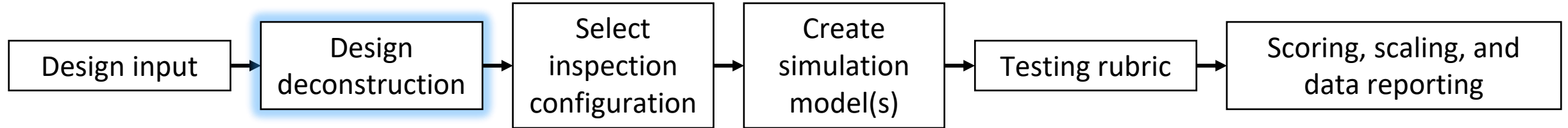

Two generated designs meeting the same requirements

Inspectability Metric Overview

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Design input → Design deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting
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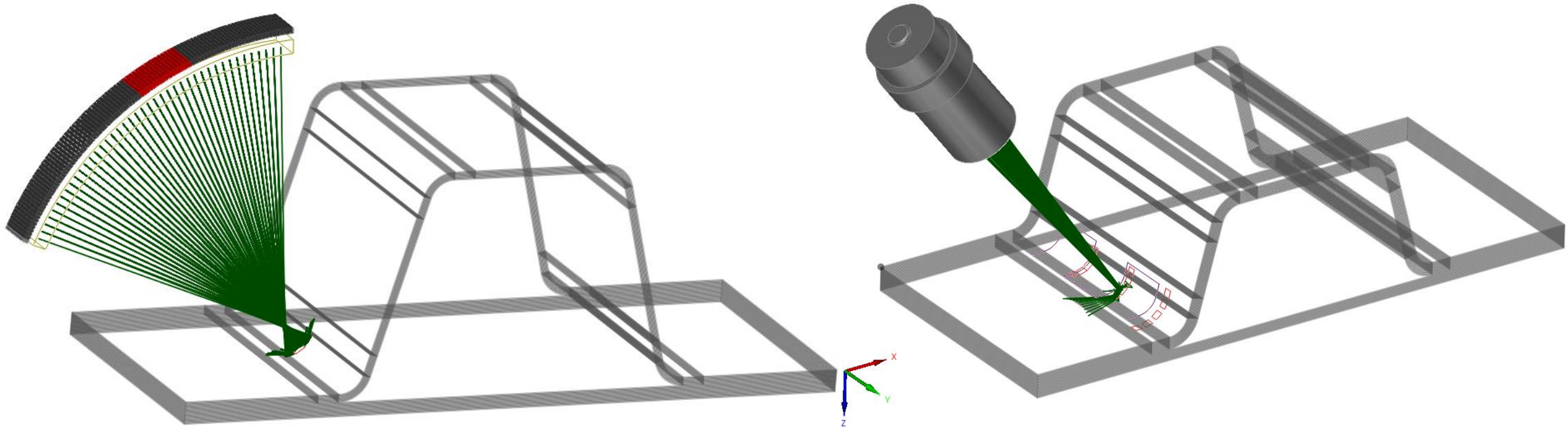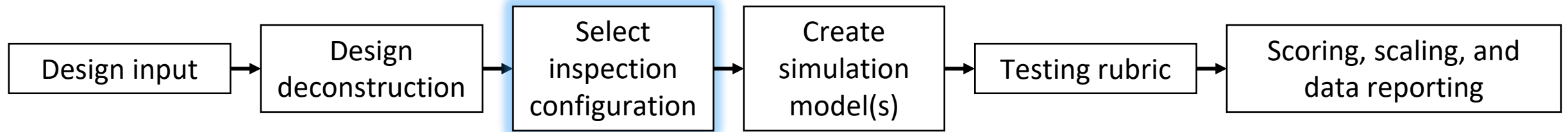

- Requirements (if known)
- Logistical considerations (accessible surfaces, clearance)
- Material properties
- Etc.

Inspectability Metric Overview

Inspectability Metric Overview

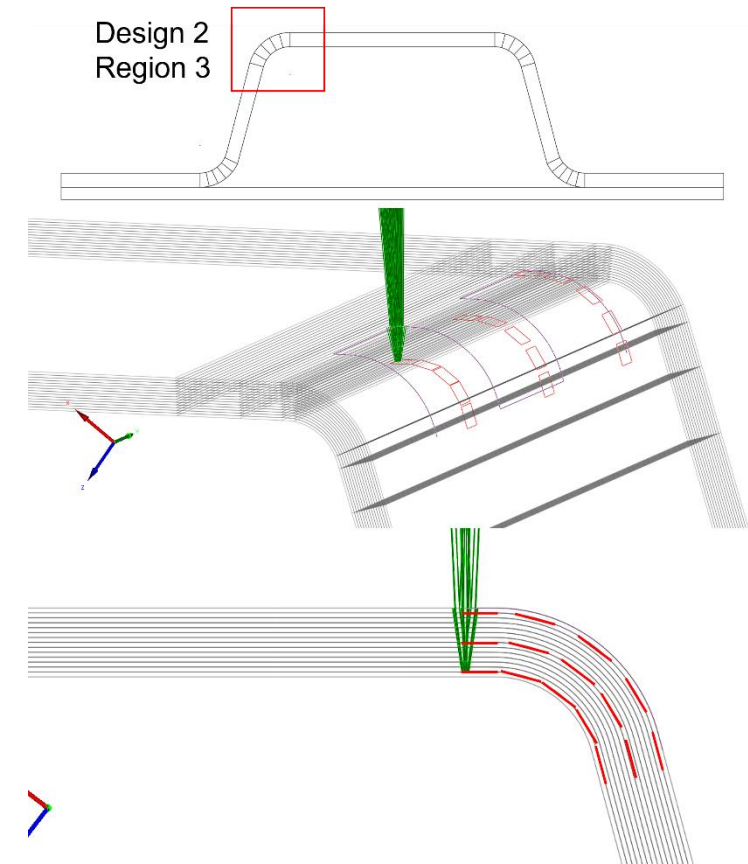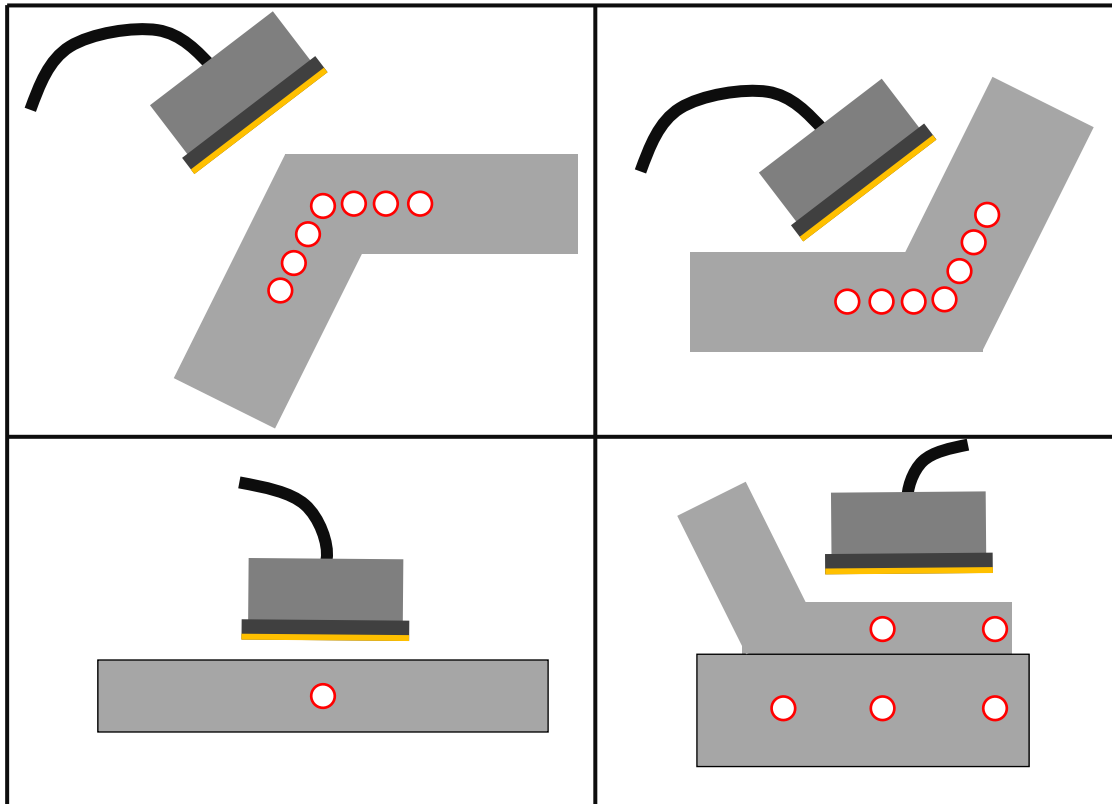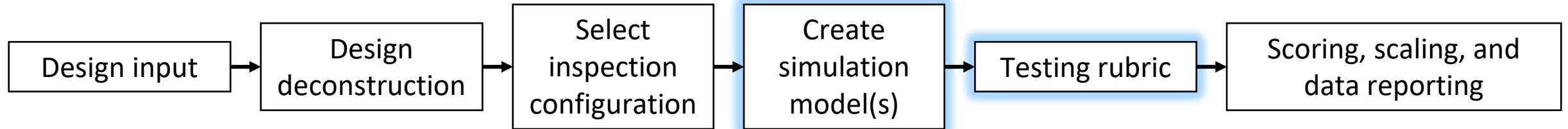Design input → Design and deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting

Inspectability Metric Overview

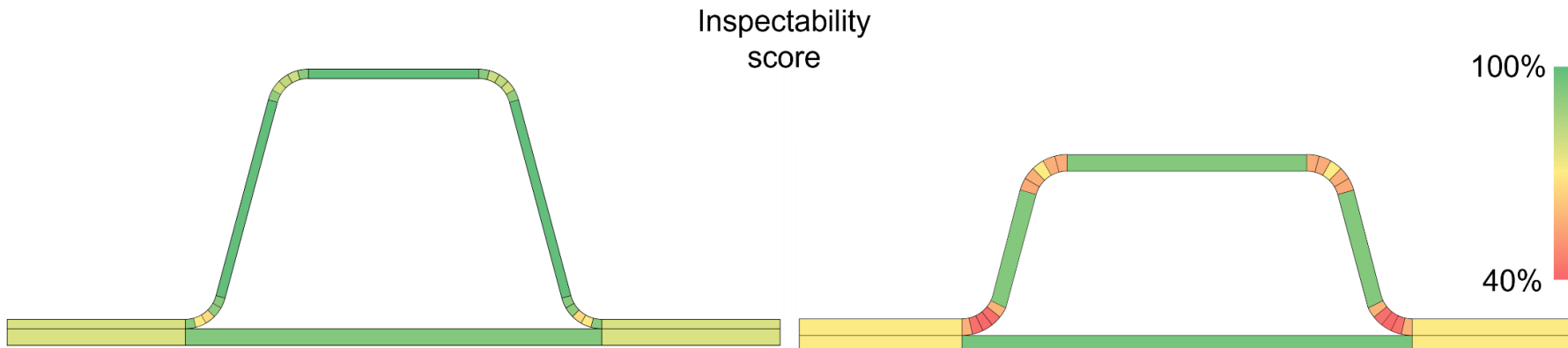Design input → Design and deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting

Design 2
Region 3

Inspectability Metric Overview

Design input → Design deconstruction → Select inspection configuration → Create simulation model(s) → Testing rubric → Scoring, scaling, and data reporting

Inspectability score

100%

40%

Inspectability Metric Overview
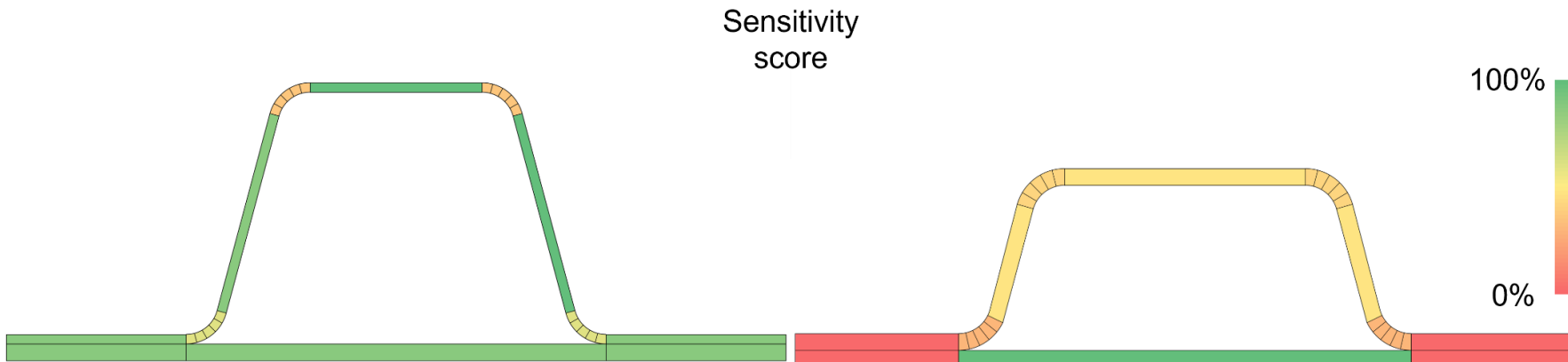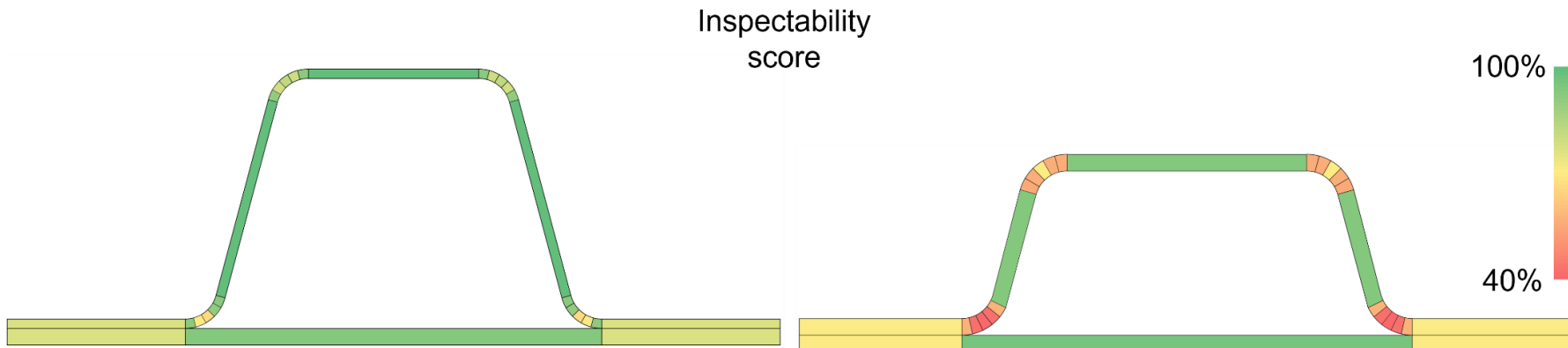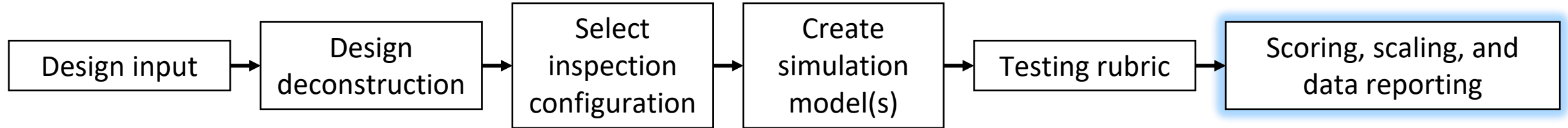
Summary and Future Work

- Demonstrated the principles of DFI and the inspectability metric

- Showed which of the two hat stiffener designs were more inspectable

- Showed what parts of the design influenced inspectability and why

Summary and Future Work

- Future work:
  - Continue automating the process
  - Apply to additive manufacturing, generative designs, and other modalities such as X-Ray CT