Towards identifying the elements of the minimum information model

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Introduction

- This research focused on information elements required in different workflows within an organization.
- The information elements that we sought to capture were called the minimum information elements.
- The research methodology employed a survey of industry participants.

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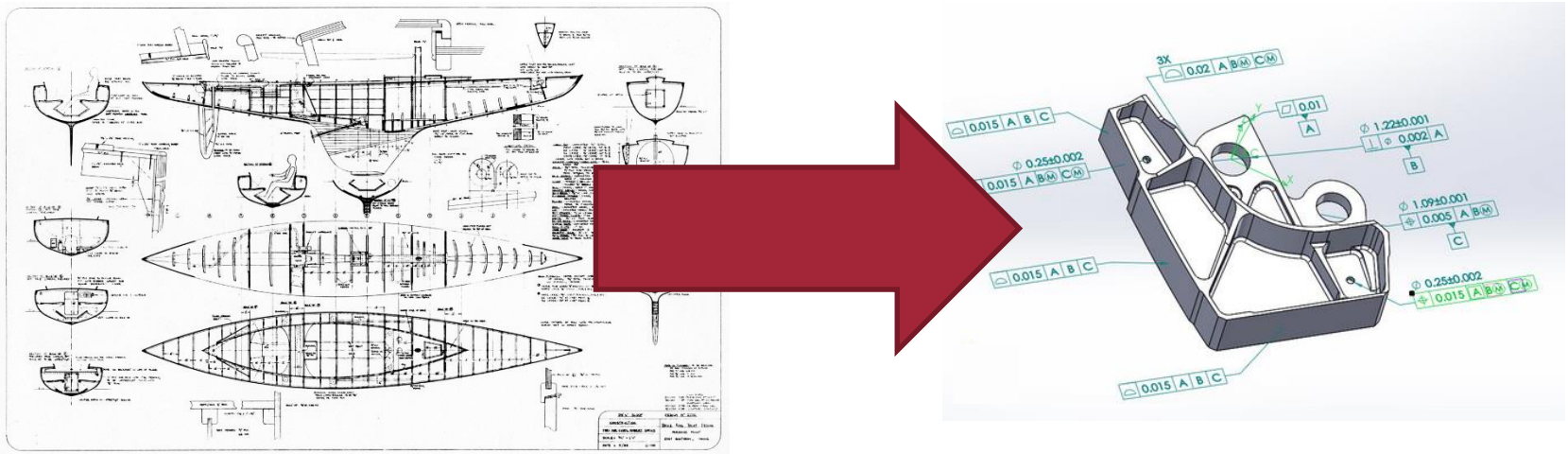
Motivation

- Industry has begun to widely adopt Model-based definition

- A better understanding of model-based definition requirements is needed for robust MBD adoption

What should go into a model-based definition?



Historically, drawings contained both implicit and explicit information. Context was important for understanding.

However, CAD tools require explicit definition of information.

Methodology

Survey Mechanism

- Study targeting industry professionals
  - Various sectors: aerospace, automotive, medical, consumer goods, etc.
  - Various positions: engineer, management, sales, etc.
  - Various locations around the world
- Goal to identify items and elements in various workflows to help establish the Minimum Information Model
  - Concept to prototype workflow
  - Prototype to detailed product definition workflow
  - Detailed product definition to manufacturing workflow
  - Manufacturing to inspection workflow

Research Study Stage One

Survey Mechanism

- Study targeted industry professionals
  - Sectors: aerospace, automotive, medical, consumer goods, etc.
  - Position titles: engineer, management, sales, etc.
  - Global

- Objective: Identify primary information elements in various workflows to help establish the common information model and minimum information model

Workflows Targeted

Survey Mechanism

- Concept to prototype workflow
- Prototype to detailed product definition workflow
- Detailed product definition to manufacturing workflow
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Information Focus

Minimum Information Model

These items are common across the phases of the lifecycles

These items are specific to a given workflow and its actors

The resulting model is what is necessary to replace a drawing in a given workflow

Stage One Conclusions

- Models could be used as master or supplemental information in a majority of participant processes.

- The theme in responses indicates the model itself is not necessarily the inhibitor.

- There is a need for research targeting data flow.

Delphi Study Round Two

- Used to evaluate the importance of each element inside of and outside of the workflows that the participant selected
- Asked to rate elements on a scale of 1-Not Important to 7-Very Important
- Elements of a MBD mean different things to different users
- Only specific elements are necessary, many elements can fit into a few
- Narrowed down the results to twelve key terms for use in round three
- 42 responses total

Round 2 Conclusions

- MBD has a steep learning curve
- Training is a very important factor for MBD
- Elements in MBD and MBE can have different meanings based on context and culture
- Education is a major factor in understanding and adopting MBD
- Not all elements in a lifecycle are crucial to every workflow

Stage Two Rounds 1 and 2 Breakdown

Key Elements Identified

3D Geometry

Dimensional Information

Detailed Product Geometry

Revision/Version History

Geometric Dimensions and Tolerances

Materials Specifications/Definitions

Surface Finish/Characteristics

Engineering Notes

Bill of Materials

Referenced/Related Appropriate Standards

Change Management Data

Product Specifications

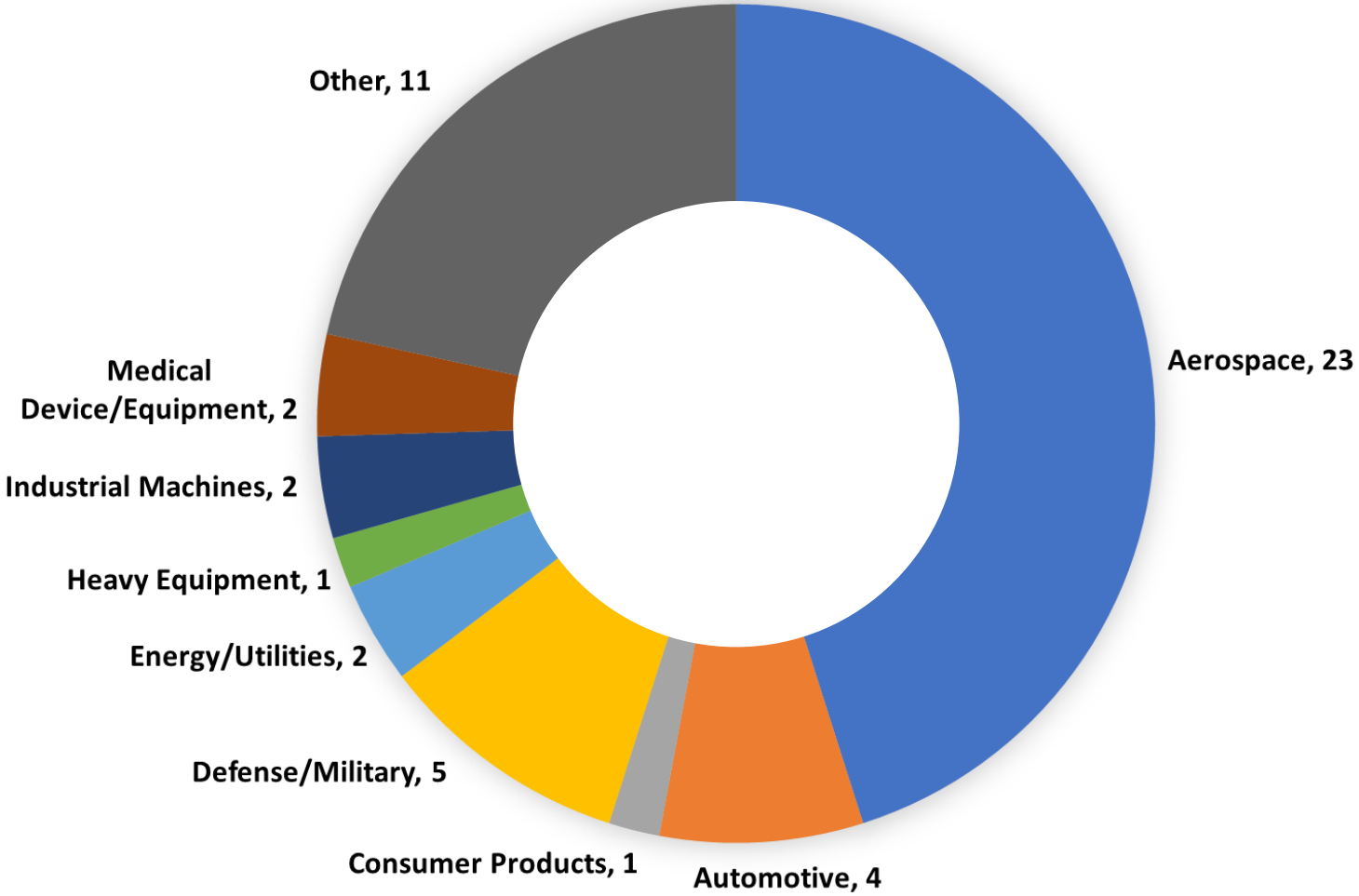
- 12 key elements found from Stage One and Delphi rounds one and two
- There is a lack of consensus about the meanings of elements
- Difference between minimum and common information often confused

Delphi Study Round Three

- Used to verify importance of elements found and to gain understanding of current industry views on MBD/MBE
- Asked to rate elements on a scale of 1-Not Important to 7-Very Important
- Scrutinized the validity of the 12 elements found prior and sought to understand similarities and differences between common elements
- 53 responses total

Stage Two Delphi Study Round 3 Data

Q2 - Which industry sector best represents your company or the division of the company where you work?



Stage Two Delphi Study Round 3 Data

Q20 - If you could only select one item, which do you believe is the most important? (select only one)

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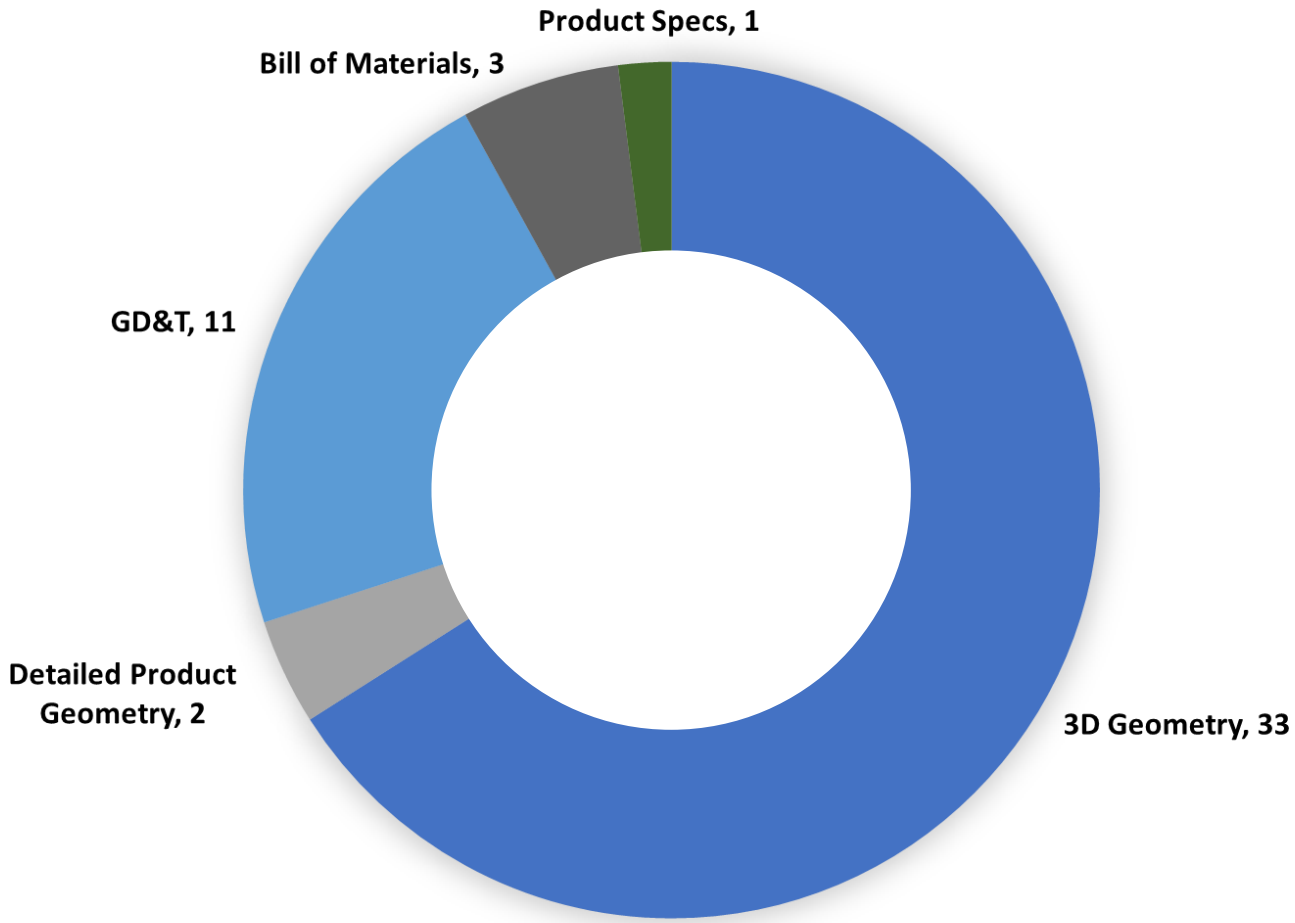

Stage Two Delphi Study Round 3 Data

Interview Round 3 Data:

N = 6

- 3D Geometry in any form is the most important, regardless of the presence of supporting information
- Due to the stage most companies (OEMs as well as Suppliers) are at, 2D geometry is still extremely relevant.
  - Downstream users may not have access to CAD software or have the capabilities to view 3D Geometry, so for some users 2D Geometry or Sketches are very important
- All twelve elements previously identified were described as being imperative
- The cost of adopting MBD is extremely high when thought of in terms of infrastructure, training, software, etc.
- Deliverables for MBD are not mature enough, not everyone has access to a CAD application
- Training and education factor into the cultural barrier preventing adoption of MBD/MBE
- There isn't always a direct need to move to MBD/MBE

IDEFO Workflow Representations

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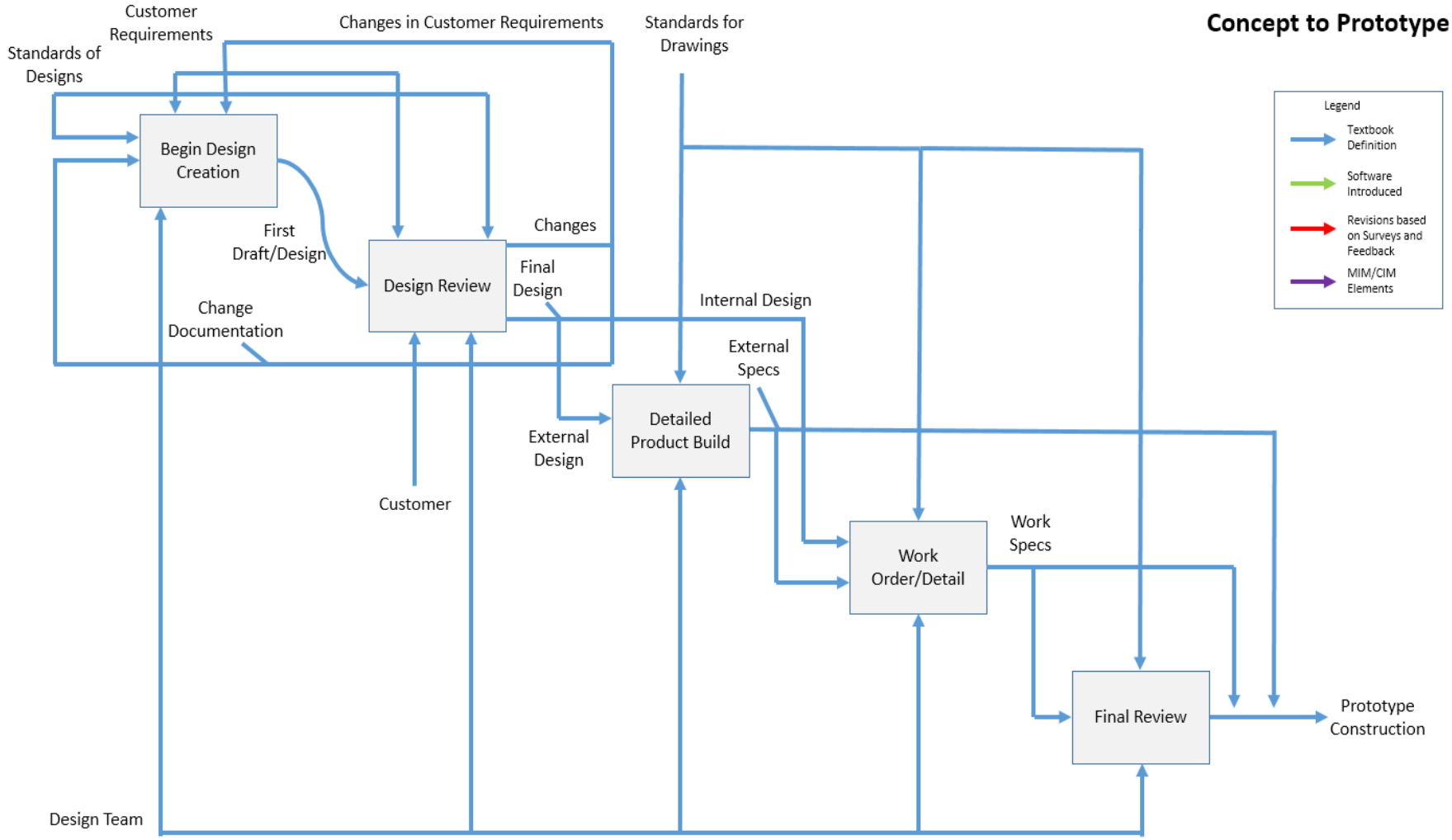

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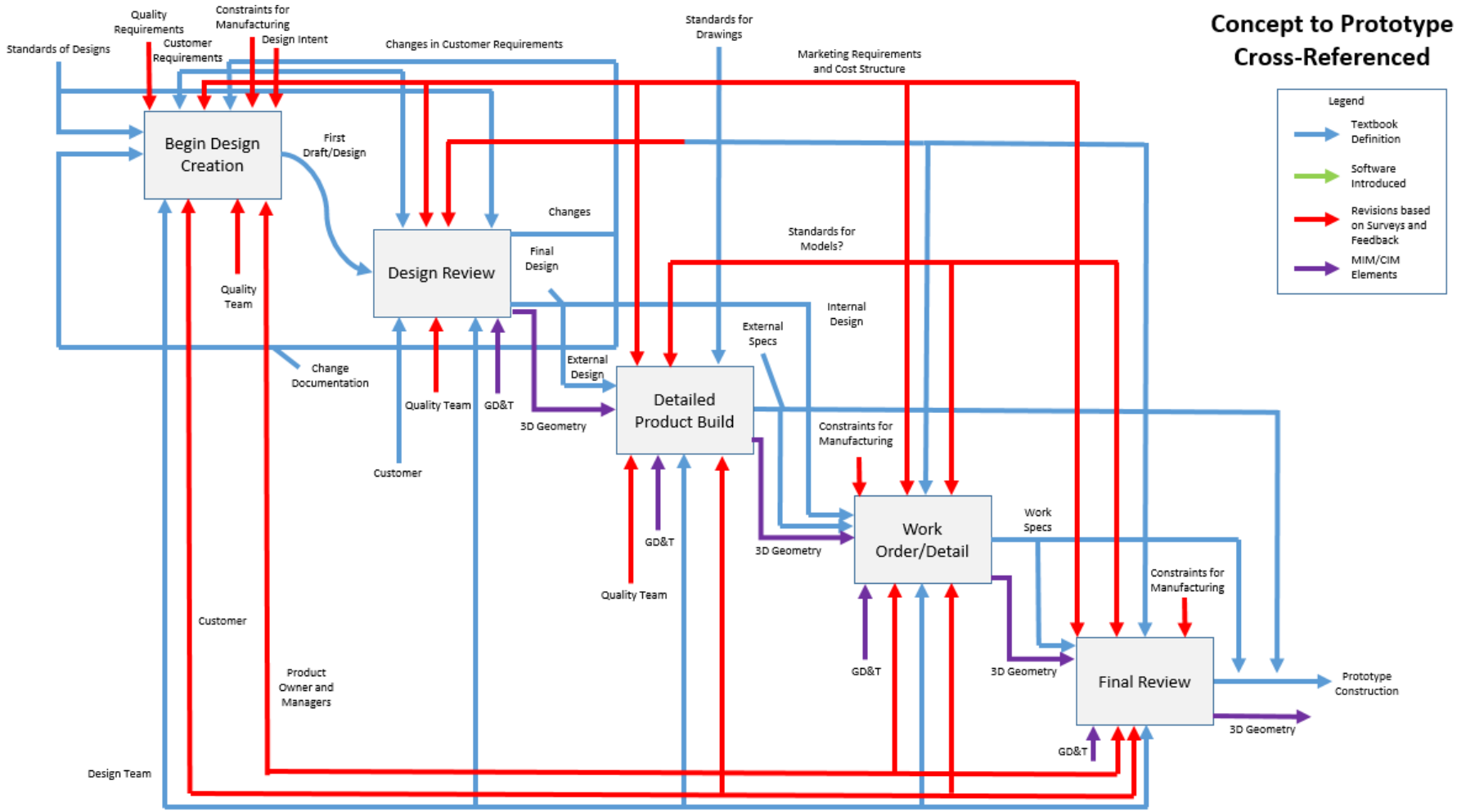

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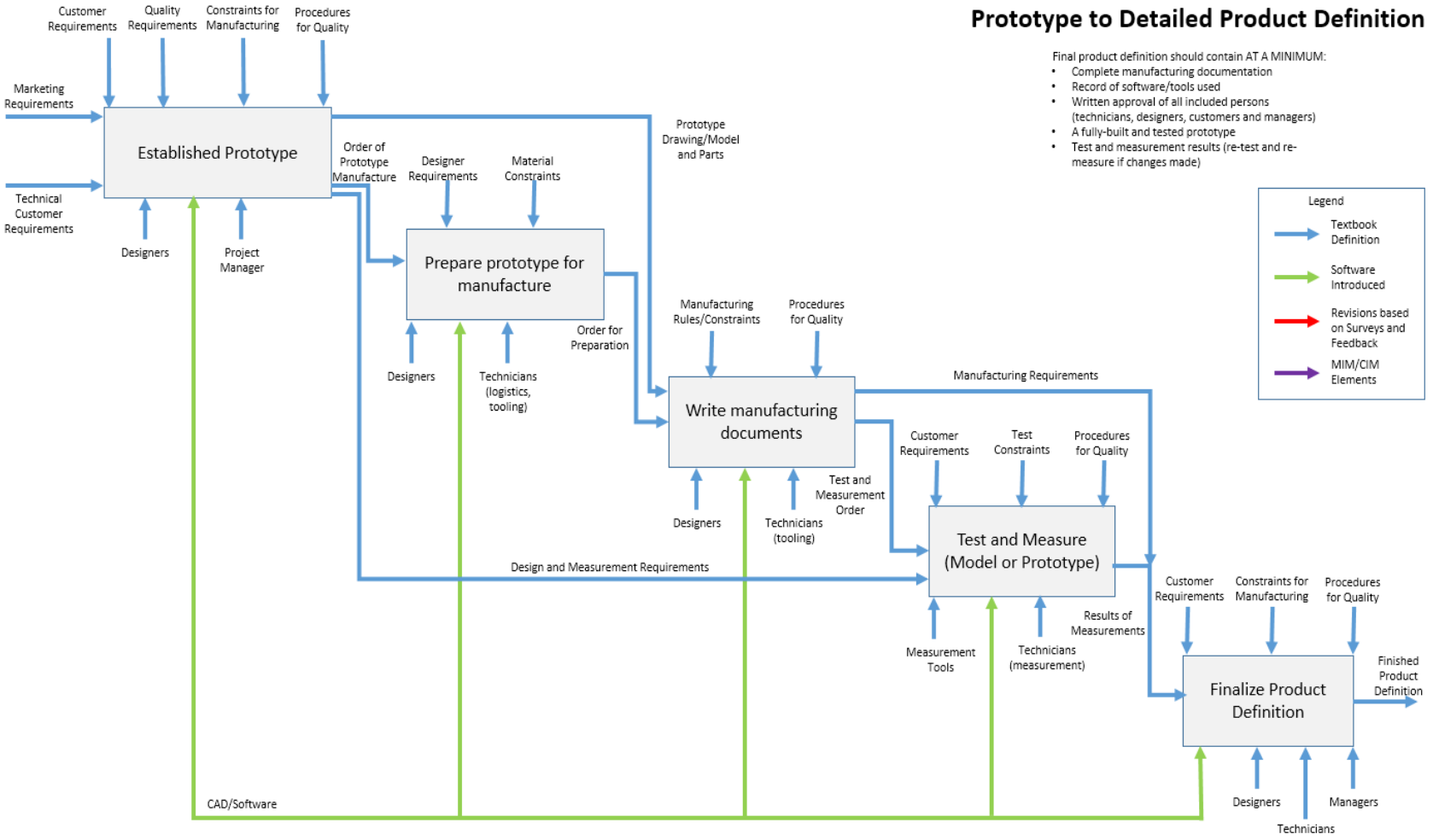

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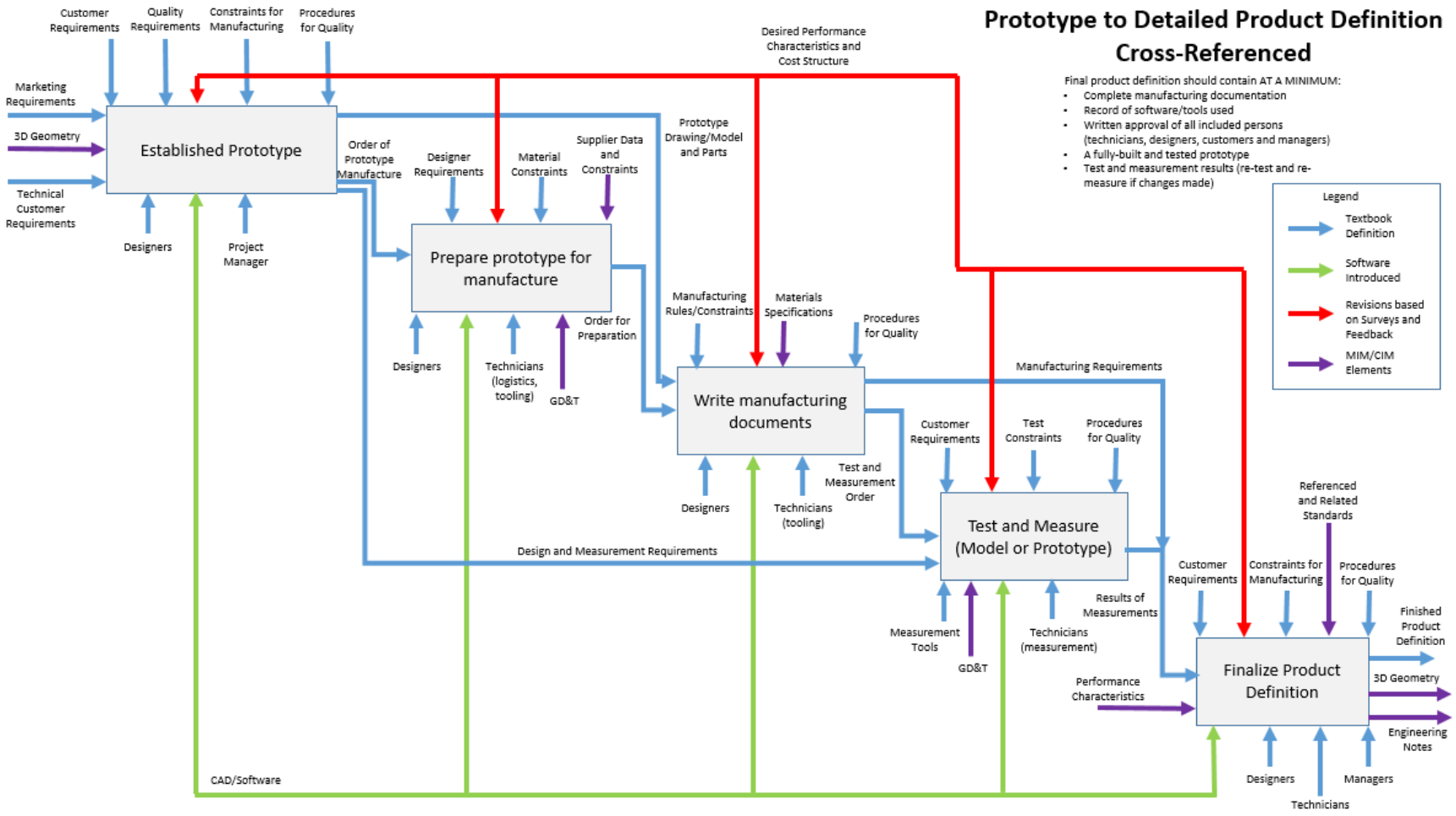

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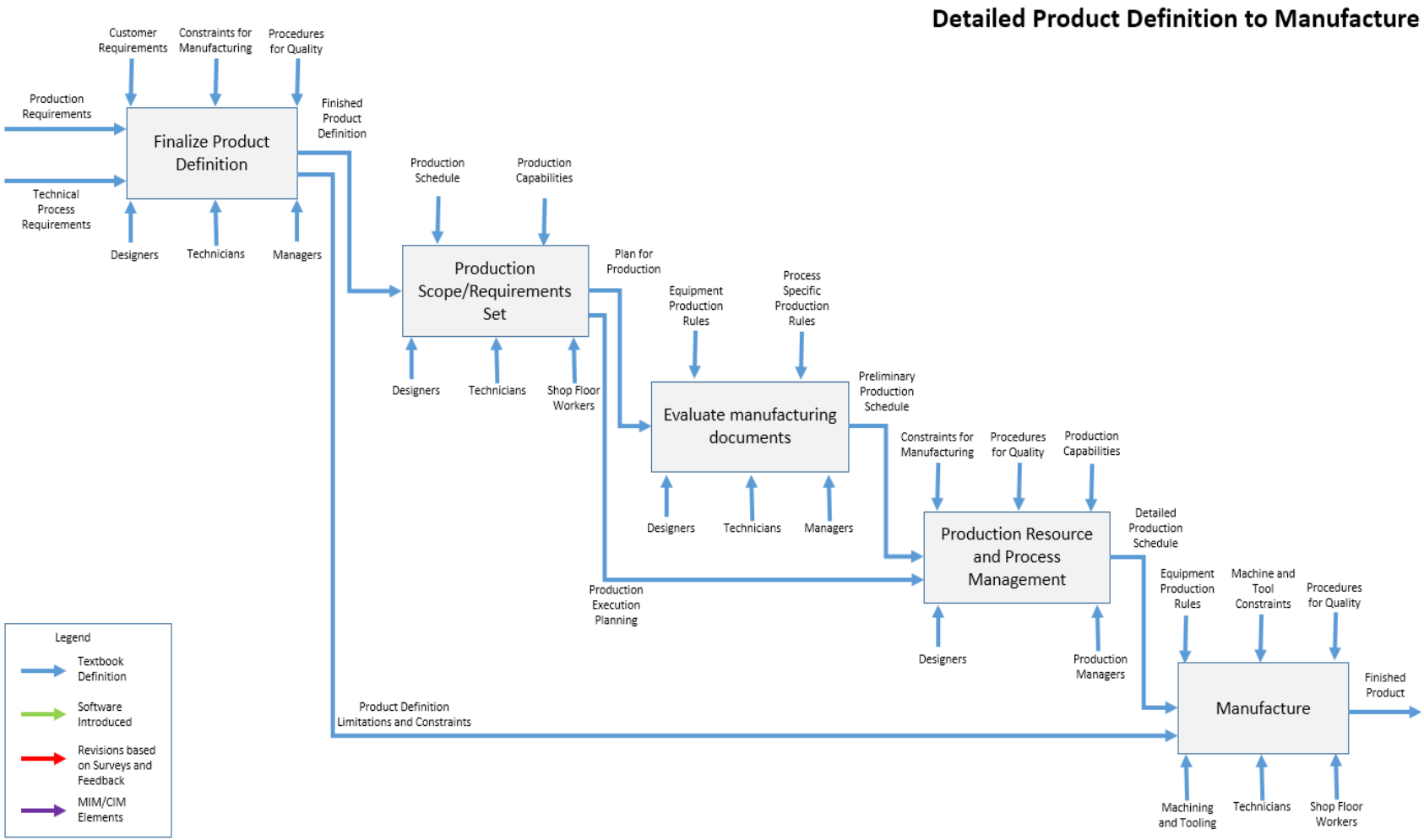

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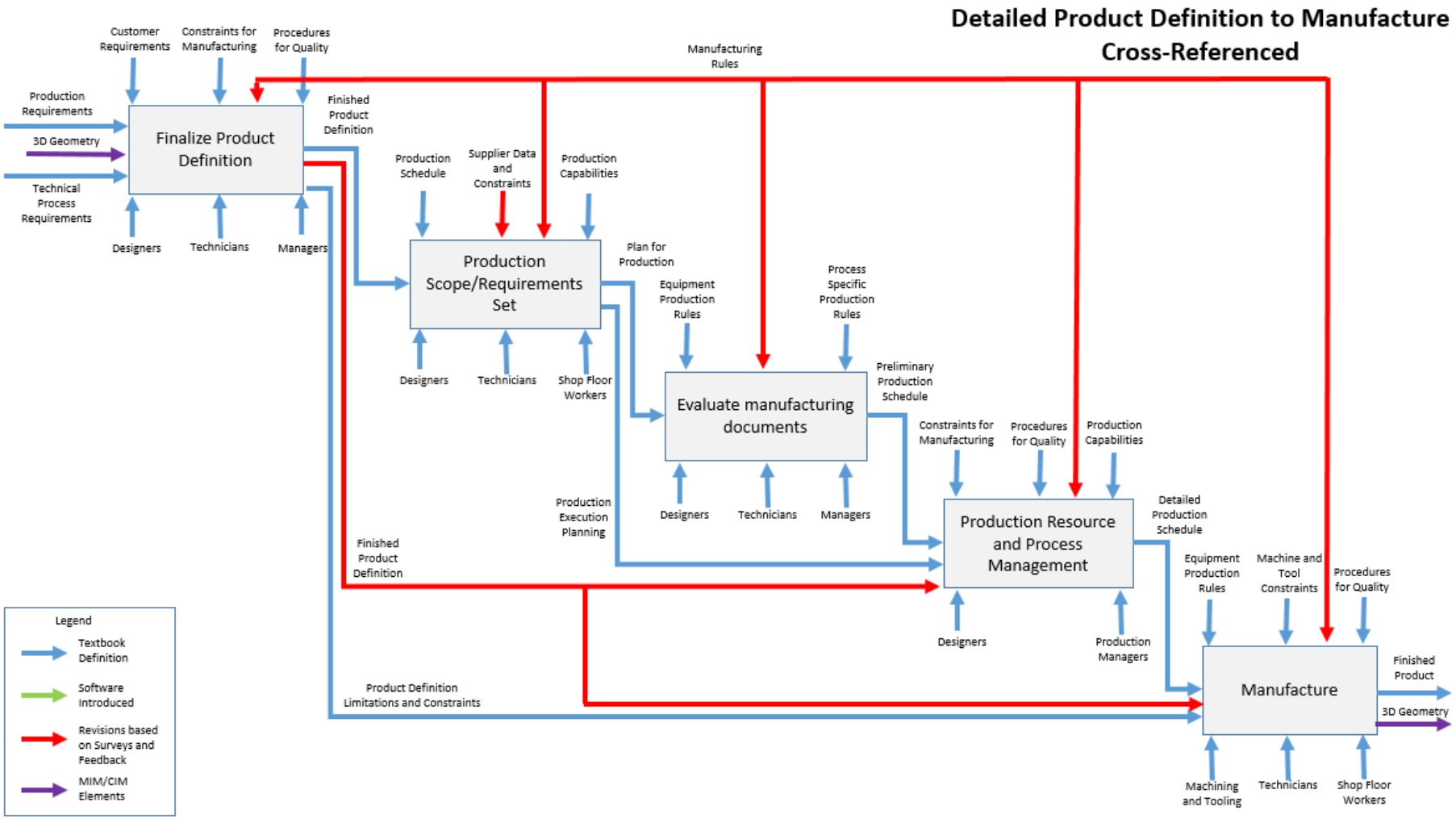

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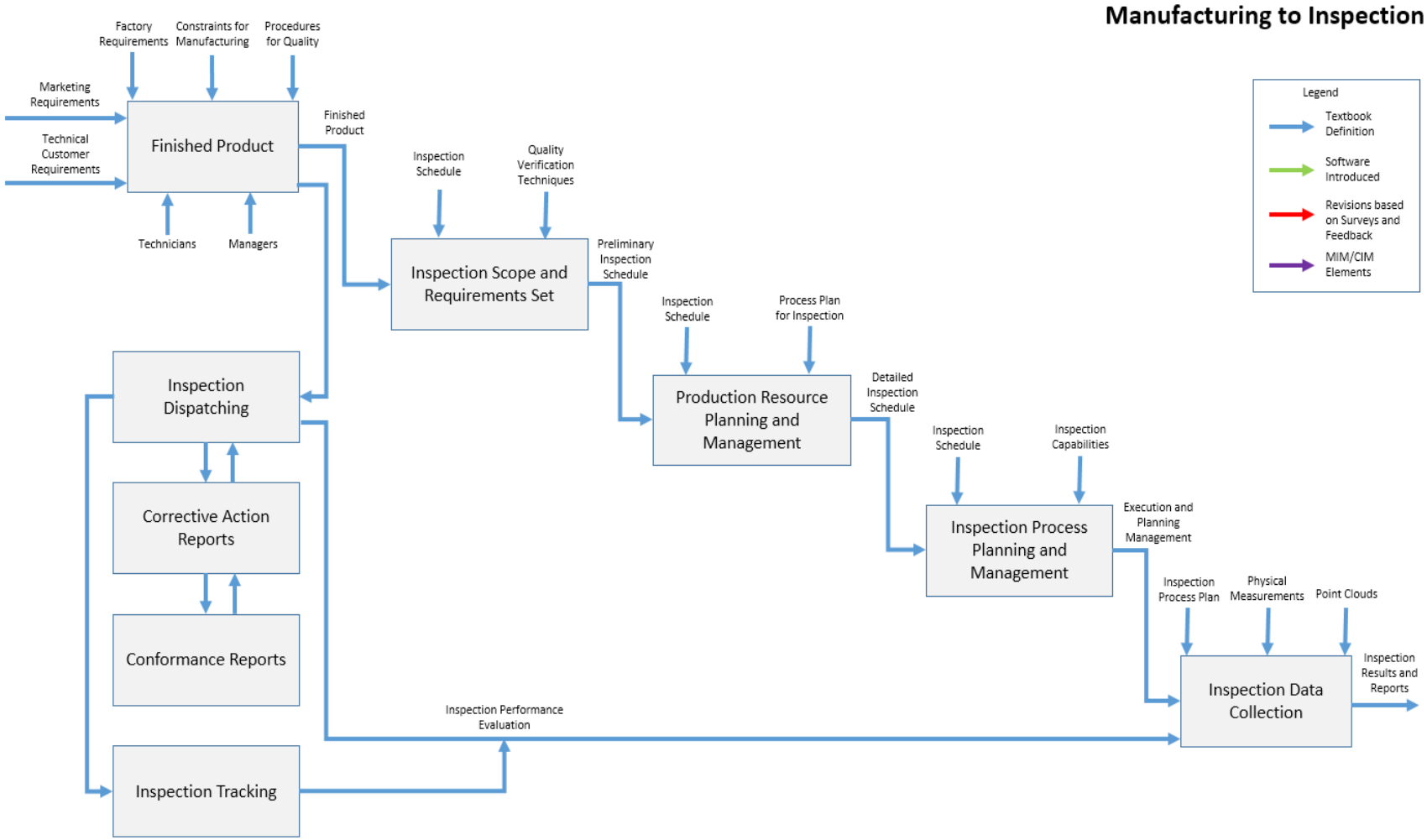

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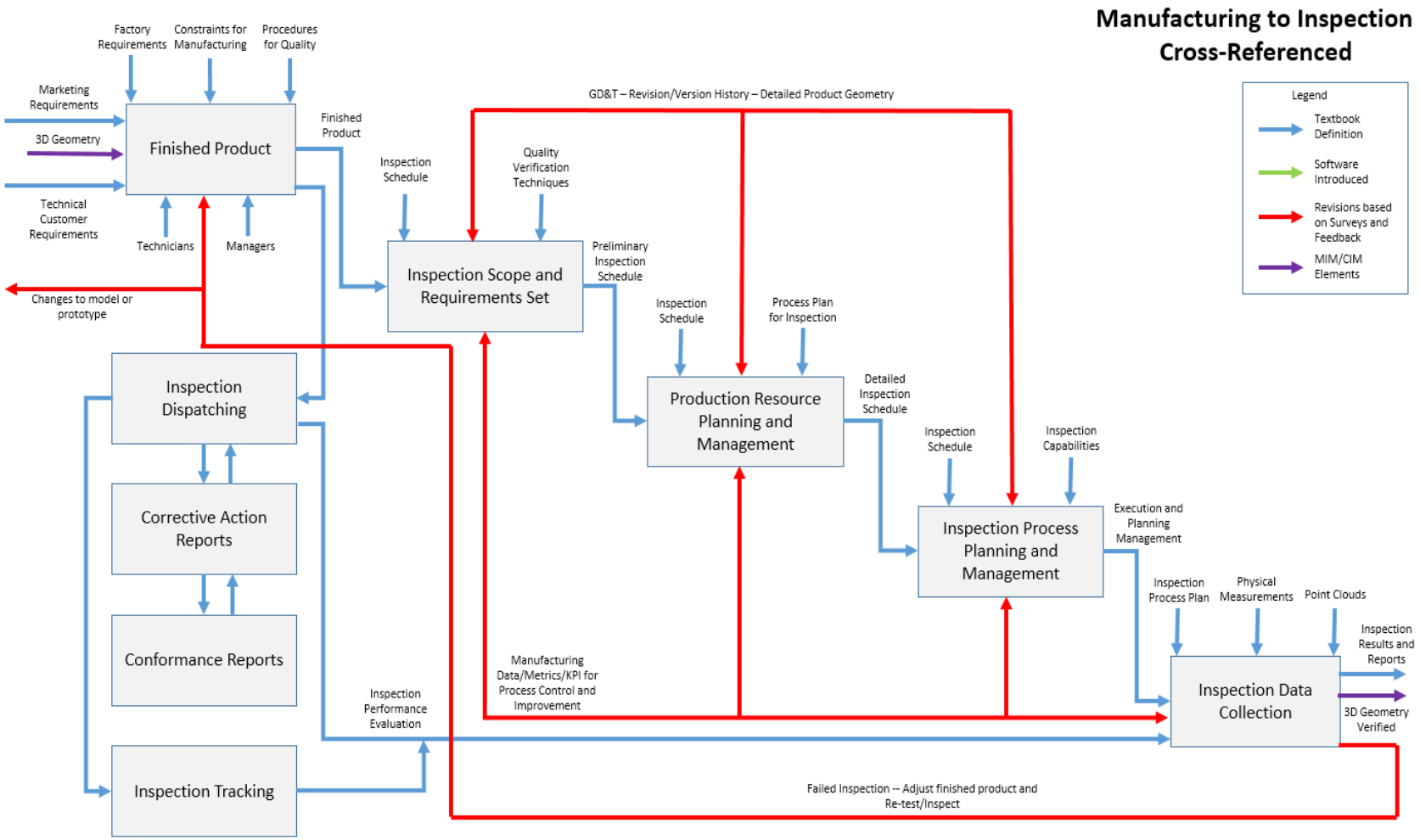

IDEFO Interview Feedback

N = 6

- A visual representation of where MIM is inserted into these workflows is very helpful
- Having a map to follow allows the tracking of information throughout the entire workflow, a more in-depth version of each workflow or even a broken-down version of each step inside of a workflow could allow for a deep-dive look at a company's process
- All of the workflows are tied together, not separate
- The earlier you can get the design and manufacturing teams involved, the better
- Manufacturing is moving towards an early-cycle appearance
  - If you can get the machinists, technicians and engineers to work with the design team early and often, it prevents errors down the line
- 3D Geometry is created as early as the ideation phase and extends well into and beyond the inspection phase
- Constraints should be imposed at all stages of the lifecycle for manufacturing, quality, etc.

Conclusion

- CIM and MIM are views of a model-based definition.
- The CIM will be a portion of all MIM.
- Adopting a MBE/MBD is a challenge
  - Lack of infrastructure
  - Lack of experience
  - Lack of willingness to change
- Understanding the MIM and CIM will help alleviate the stress of adoption
  - Knowing what you need to know is the first step

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MINIMUM INFORMATION MODEL