ptc

LIVEWORX

A NEW ERA IN PRODUCT LIFECYCLE INNOVATION

COMBINING ADDITIVE & AGILE METHODS FOR RAPID ROBOTICS INNOVATION

Matt Whelan

Engineering Director, Ocado Technology

May 17, 2023

LIVEWORX.COM | #LIVEWORX

600

TODAY'S BUZZWORDS

Agile Hardware Development

Deployable Prototyping

Industrial **DevOps**

Time to part

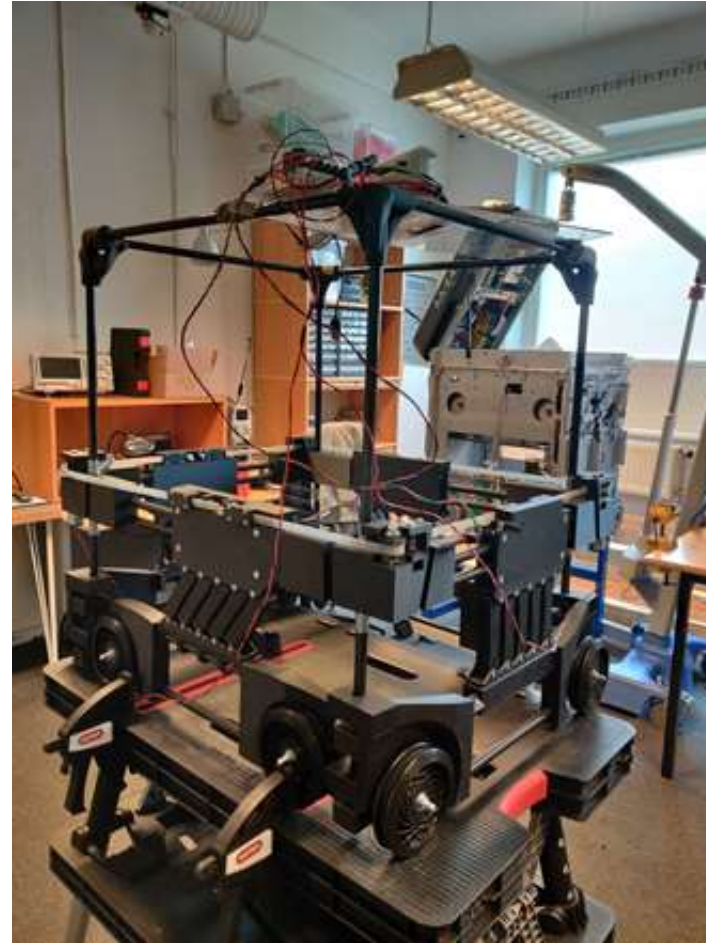**Time** to market

THE OCADO SMART PLATFORM

Pioneering the future of online grocery

The Ocado Smart Platform (OSP) is the most advanced ecommerce, logistics and fulfilment platform for groceries in the world.

OSP leverages the latest advances across robotics, artificial intelligence, machine learning and data science and more.
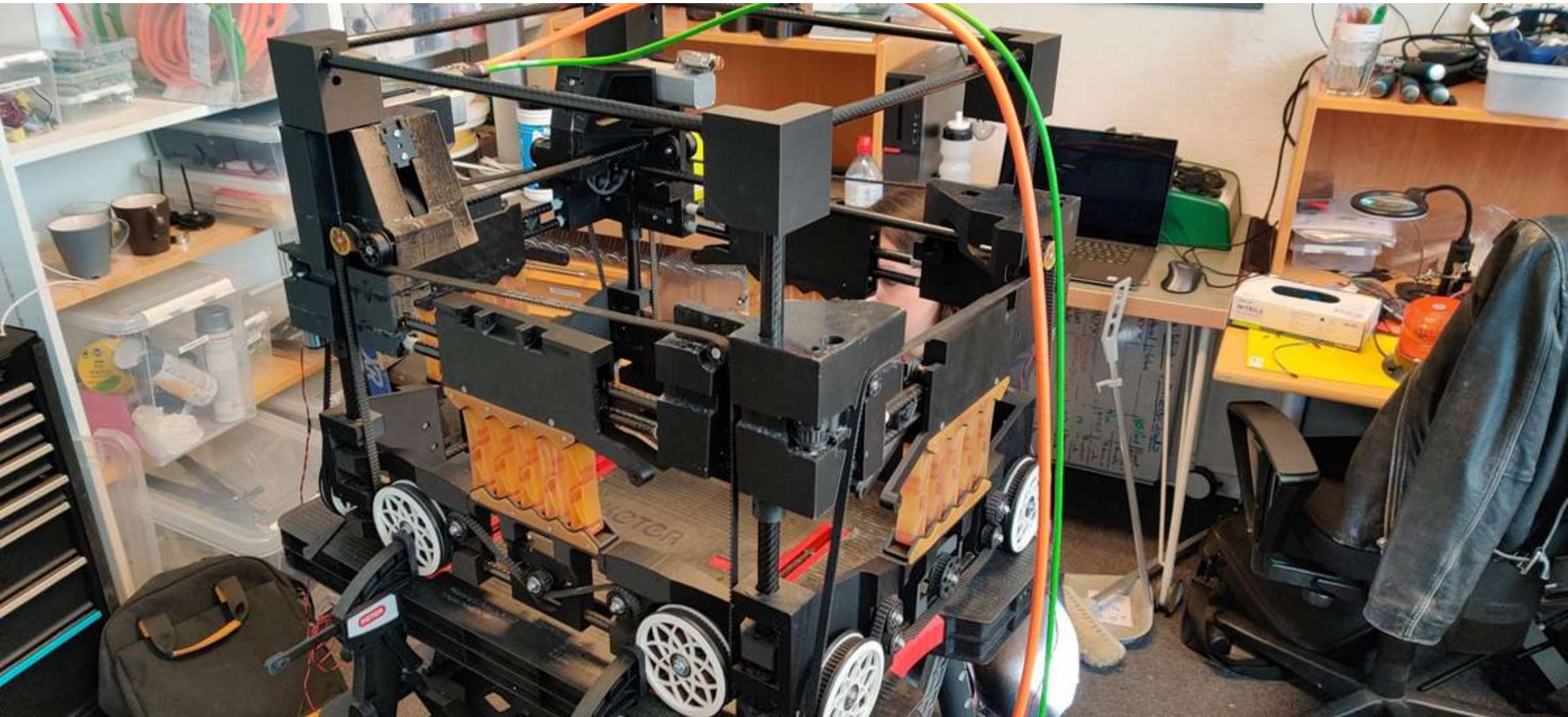
We've developed a flexible ecosystem of products and services to suit the unique needs of our partners across the globe.
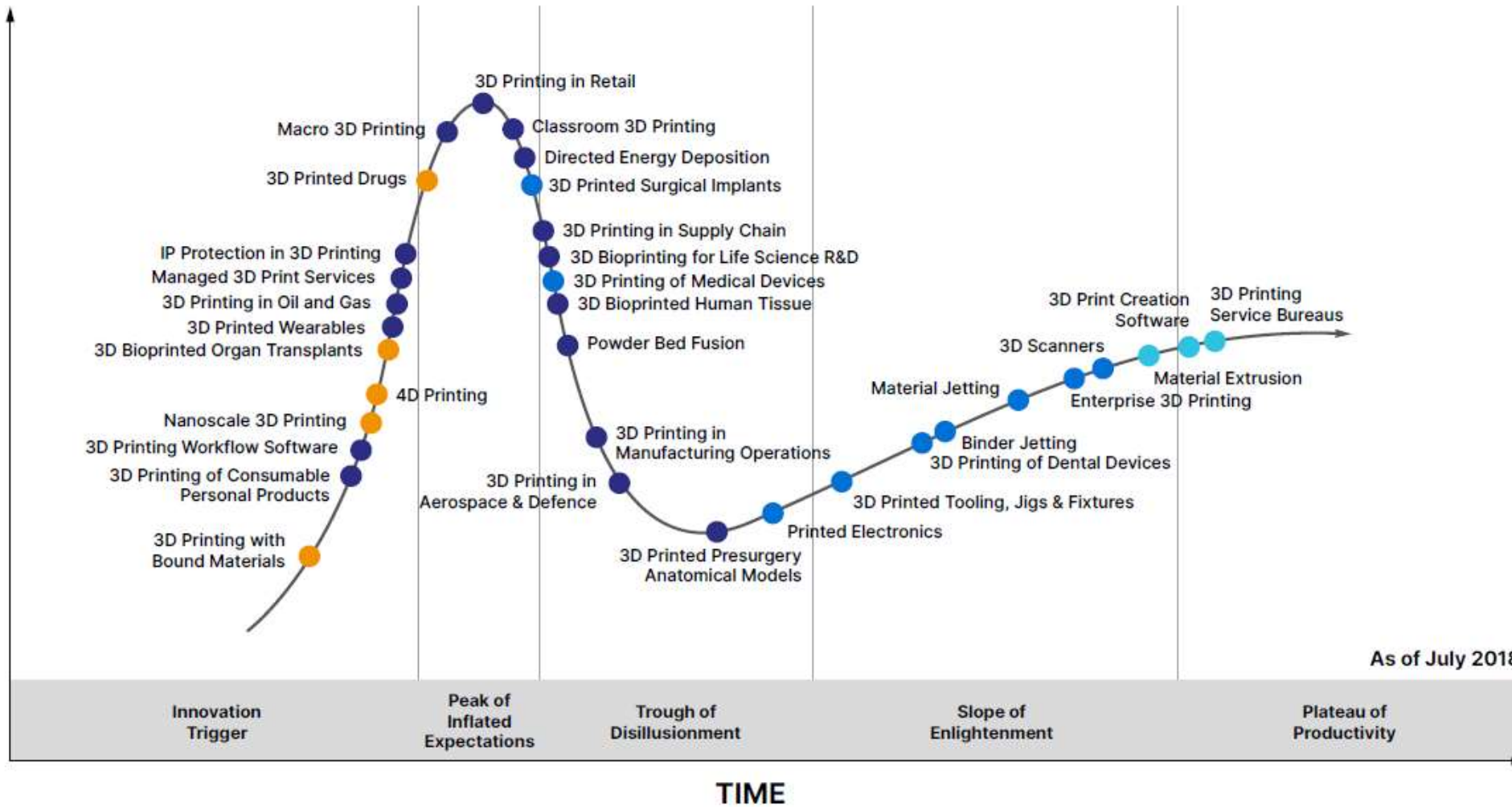
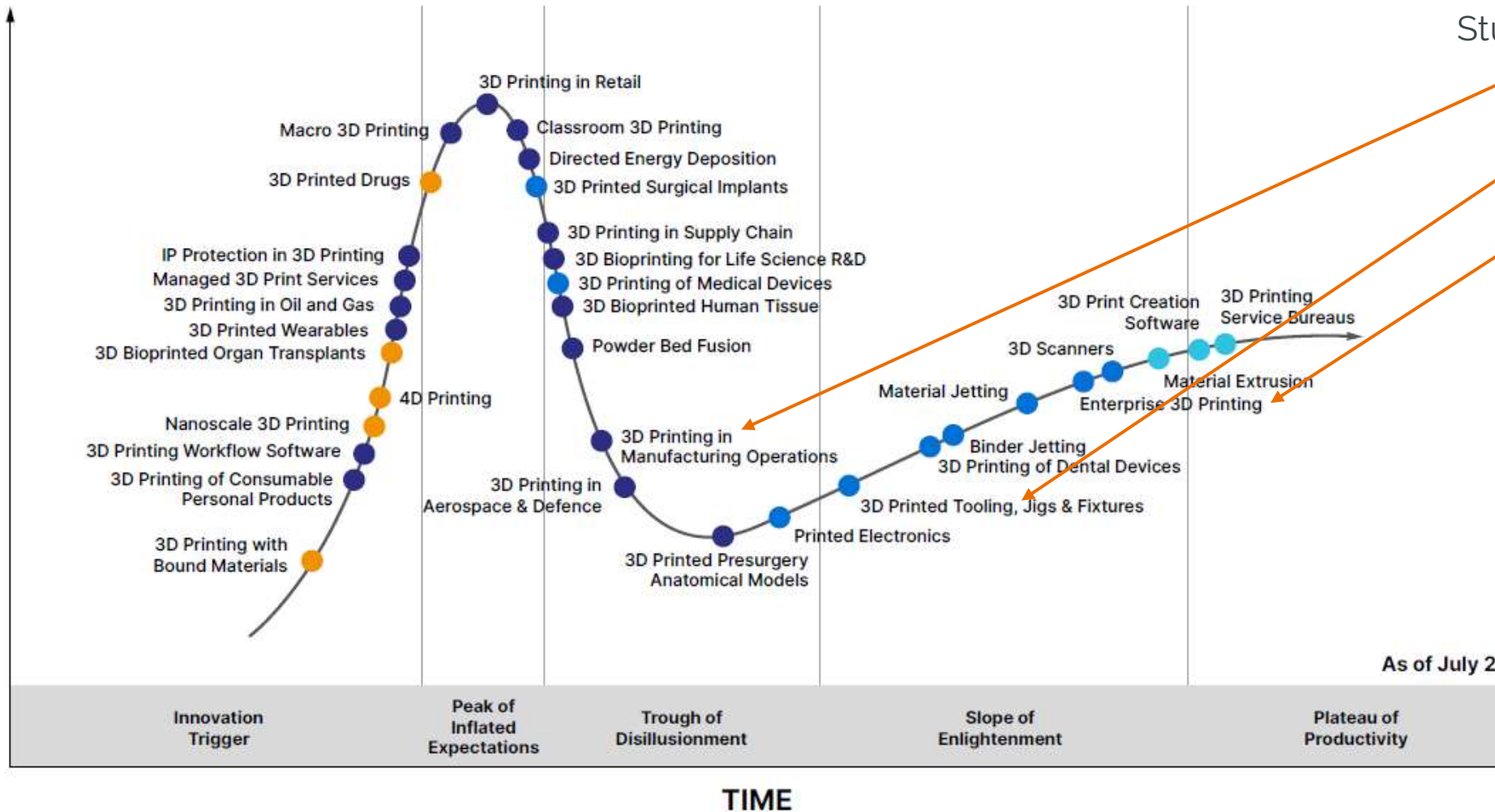# 600 BEGINS

Time to go traditional?

GARTNER HYPE CYCLE 2019: 3D PRINTING PREDICTIONS

3D Printing in Retail

Macro 3D Printing

Classroom 3D Printing

Directed Energy Deposition

3D Printed Drugs

3D Printed Surgical Implants

3D Printing in Supply Chain

IP Protection in 3D Printing

3D Bioprinting for Life Science R&D

Managed 3D Print Services

3D Printing of Medical Devices

3D Printing in Oil and Gas

3D Bioprinted Human Tissue

3D Printed Wearables

3D Bioprinted Organ Transplants

Powder Bed Fusion

3D Print Creation Software

3D Printing Service Bureaus

3D Scanners

4D Printing

Material Jetting

Material Extrusion

Nanoscale 3D Printing

Enterprise 3D Printing

3D Printing Workflow Software

3D Printing in Manufacturing Operations

3D Printing of Consumable Personal Products

Binder Jetting

3D Printing of Dental Devices

3D Printing in Aerospace & Defence

3D Printed Tooling, Jigs & Fixtures

3D Printing with Bound Materials

Printed Electronics

3D Printed Presurgery Anatomical Models

As of July 2018

| Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity |

TIME

● Less than 2 years   ● 2 to 5 years   ● 5 to 10 years   ● more than 10 years   ● Obsolete before plateau

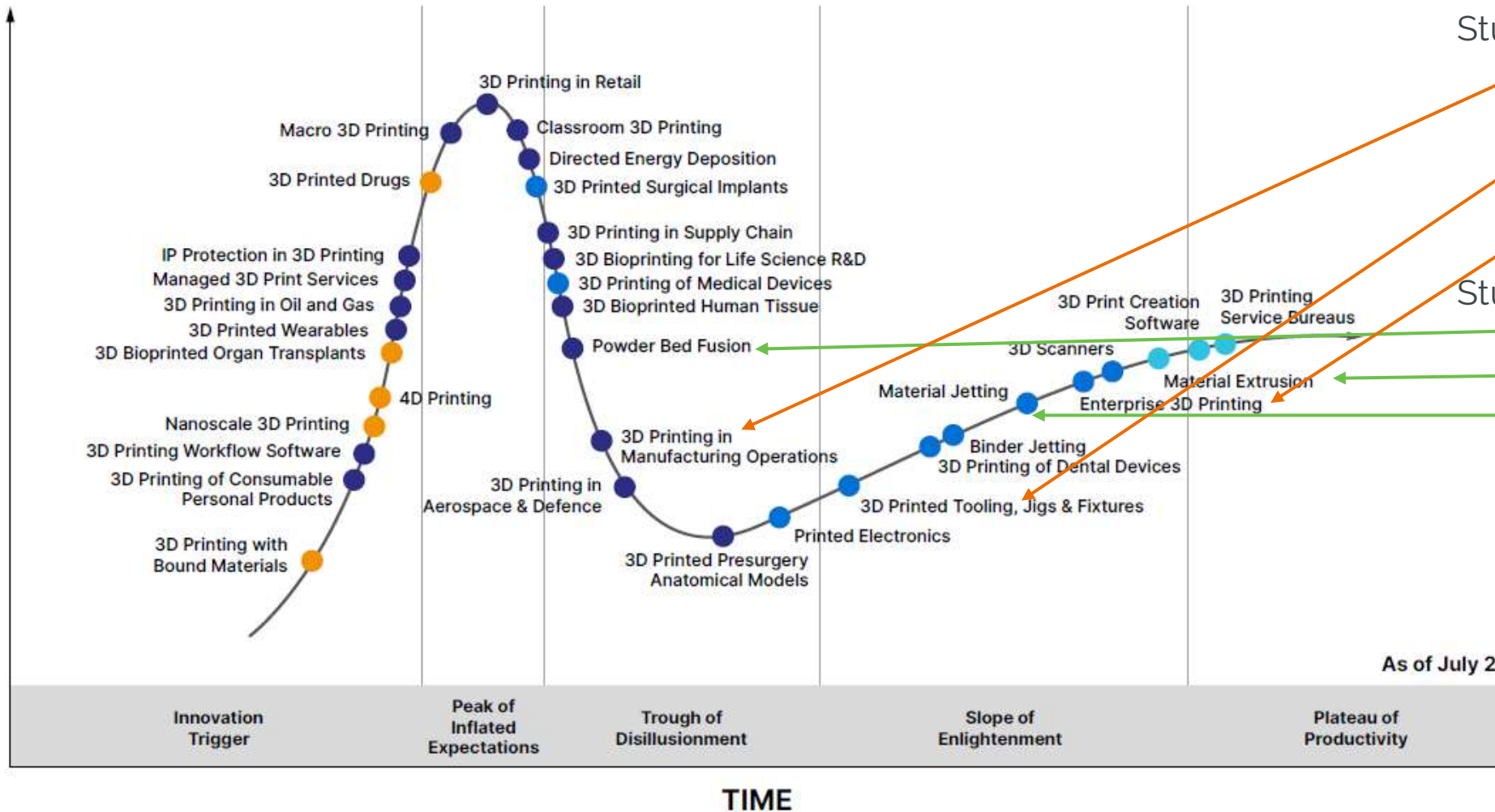# GARTNER HYPE CYCLE 2019: 3D PRINTING PREDICTIONS

Stuff we do:
- 3D printing in manufacturing!
- 3D printed tooling, jigs & fixtures!
- Enterprise 3D printing!

3D Printing in Retail

Macro 3D Printing

Classroom 3D Printing

Directed Energy Deposition

3D Printed Drugs

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| Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity |

As of July 20

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GARTNER HYPE CYCLE 2019: 3D PRINTING PREDICTIONS

Stuff we do:
- 3D printing in manufacturing!
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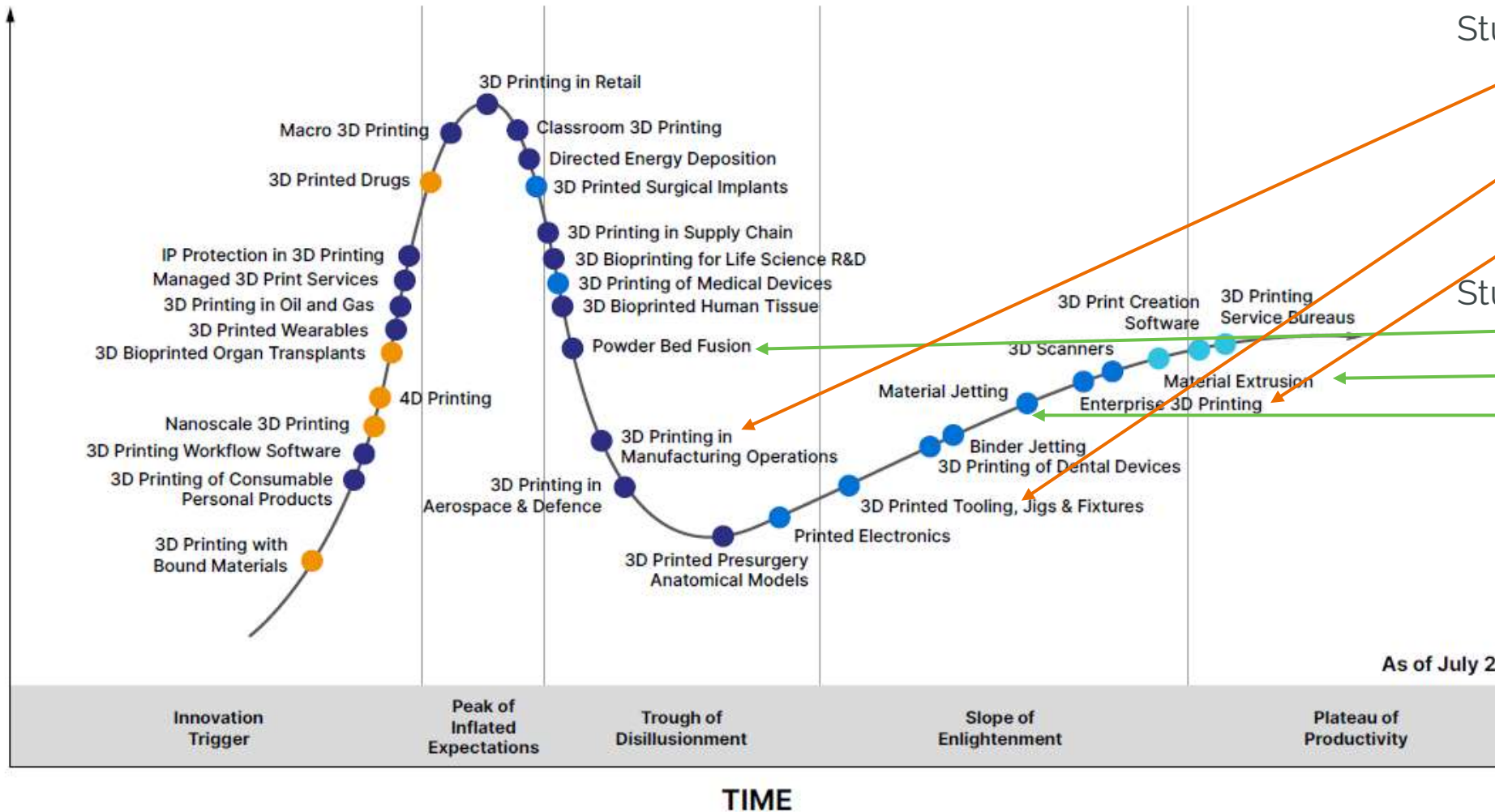- Enterprise 3D printing!

Stuff we use:
- Powder bed fusion
- Material extrusion
- Material jetting

13

GARTNER HYPE CYCLE 2019: 3D PRINTING PREDICTIONS

Stuff we do:
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- 3D printed tooling, jigs & fixtures!
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Stuff we use:
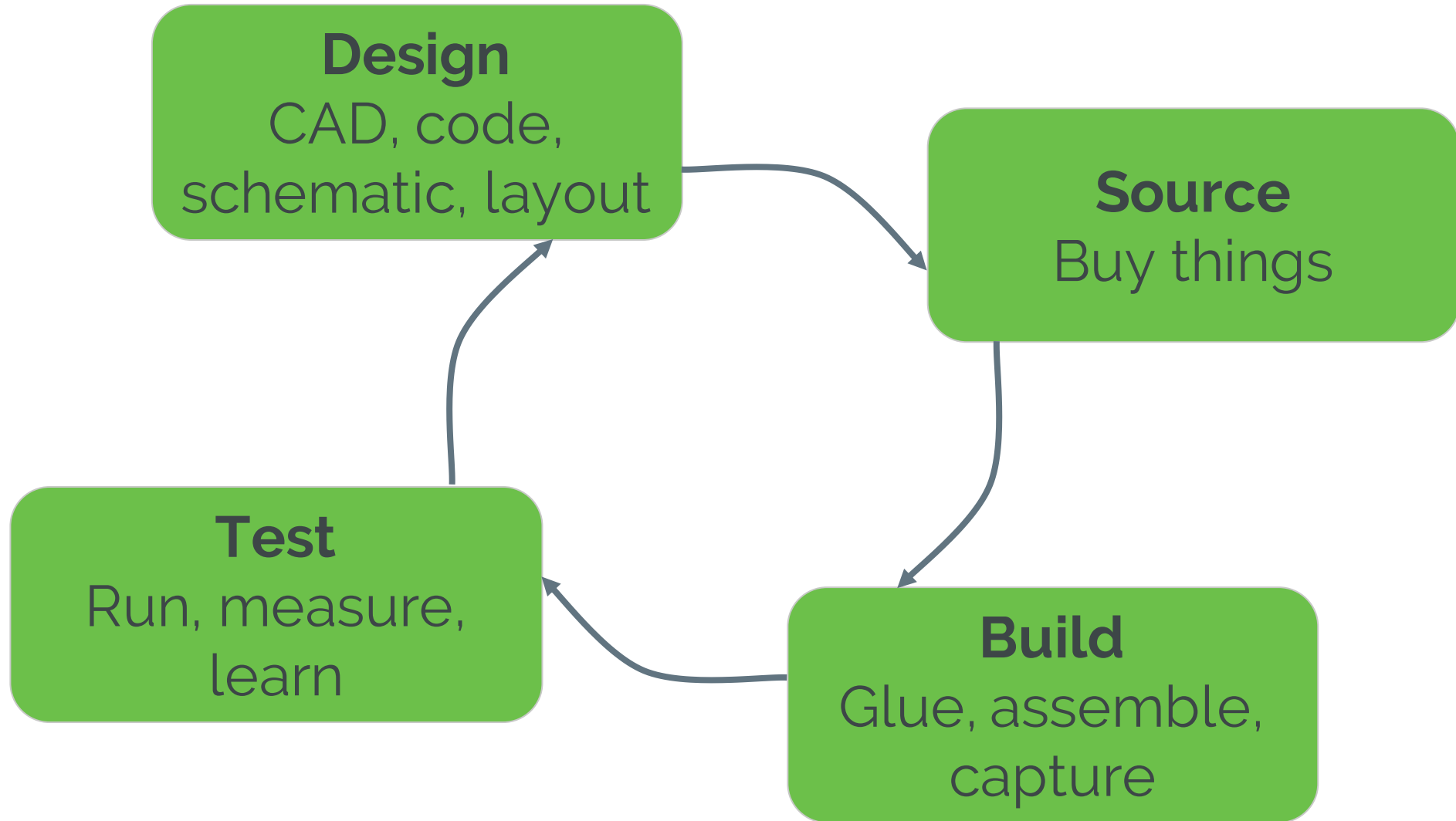- Powder bed fusion
- Material extrusion
- Material jetting

Chart labels (left to right, along the hype cycle curve):

- 3D Printing in Retail
- Macro 3D Printing
- Classroom 3D Printing
- Directed Energy Deposition
- 3D Printed Drugs
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- 3D Printed Presurgery Anatomical Models

As of July 20

Phases: Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity

TIME

Legend:
- Less than 2 years
- 2 to 5 years
- 5 to 10 years
- more than 10 years
- Obsolete before plateau

Team status - June 2020

1 team
Matt + 6 engineers
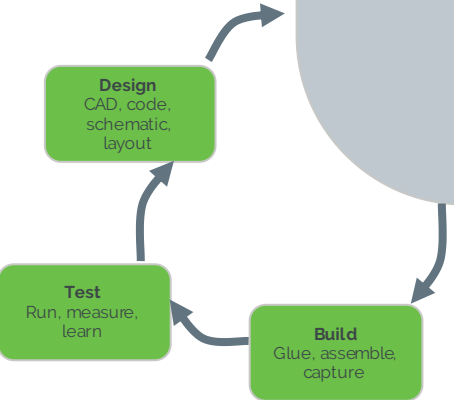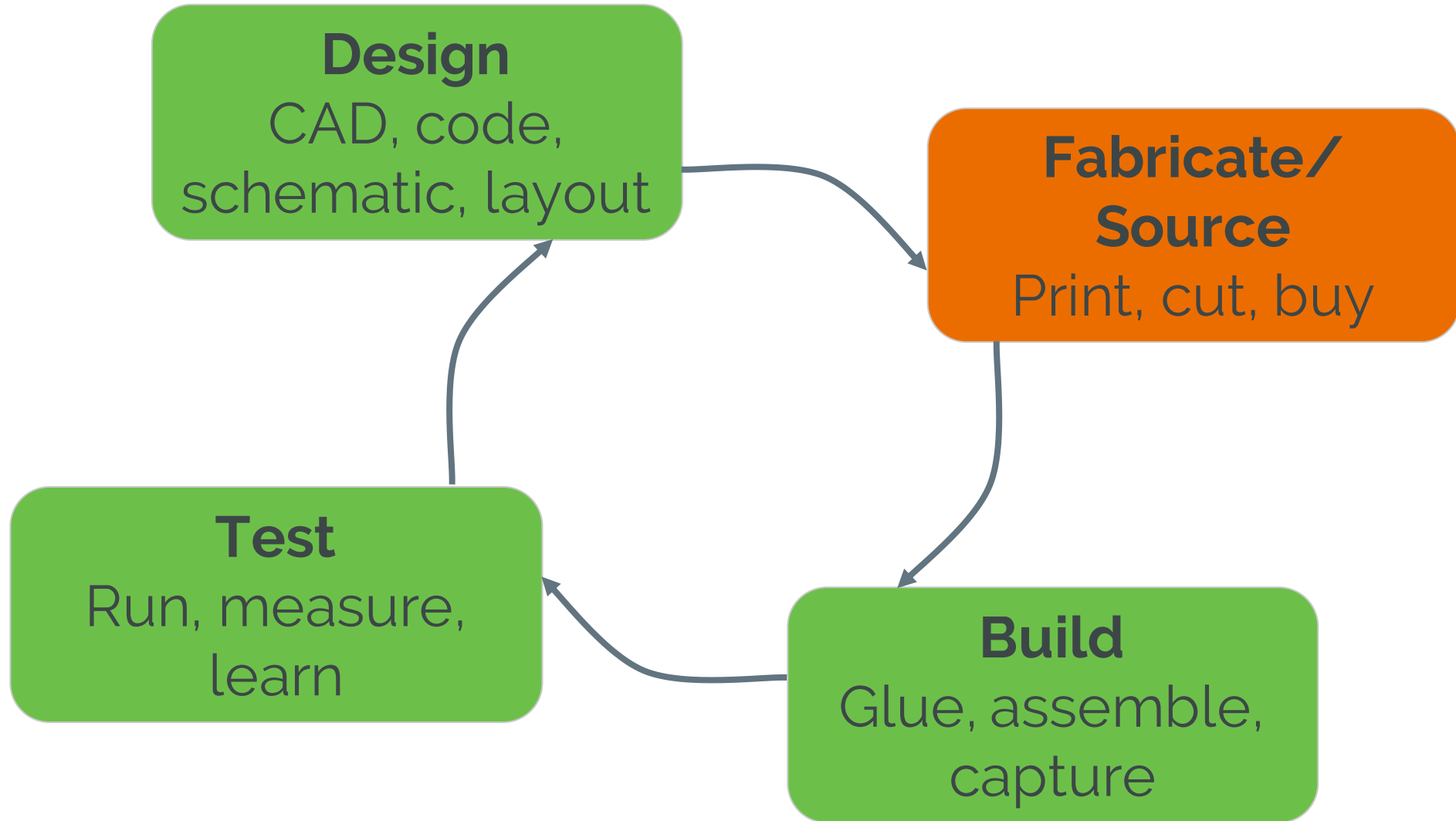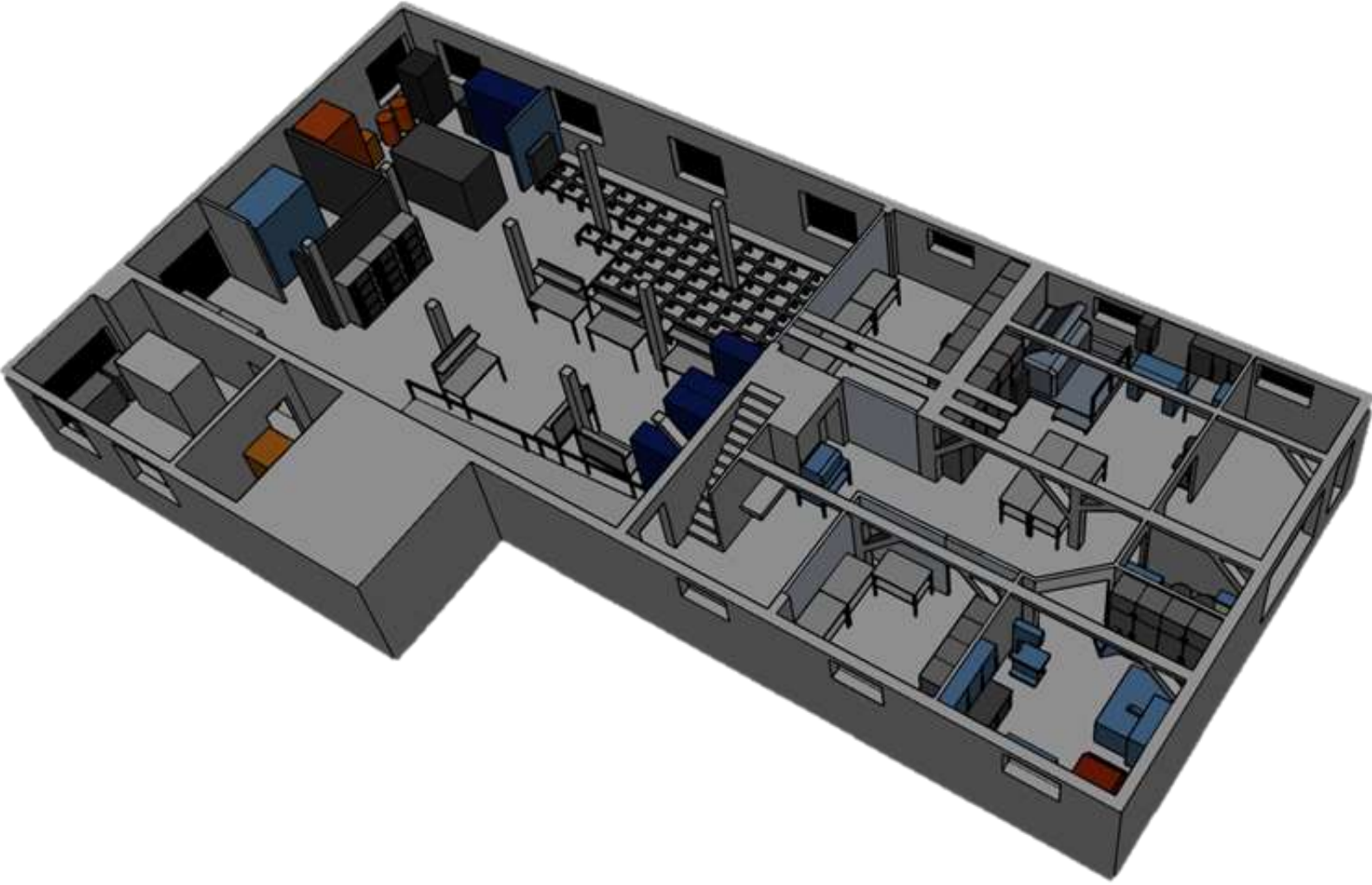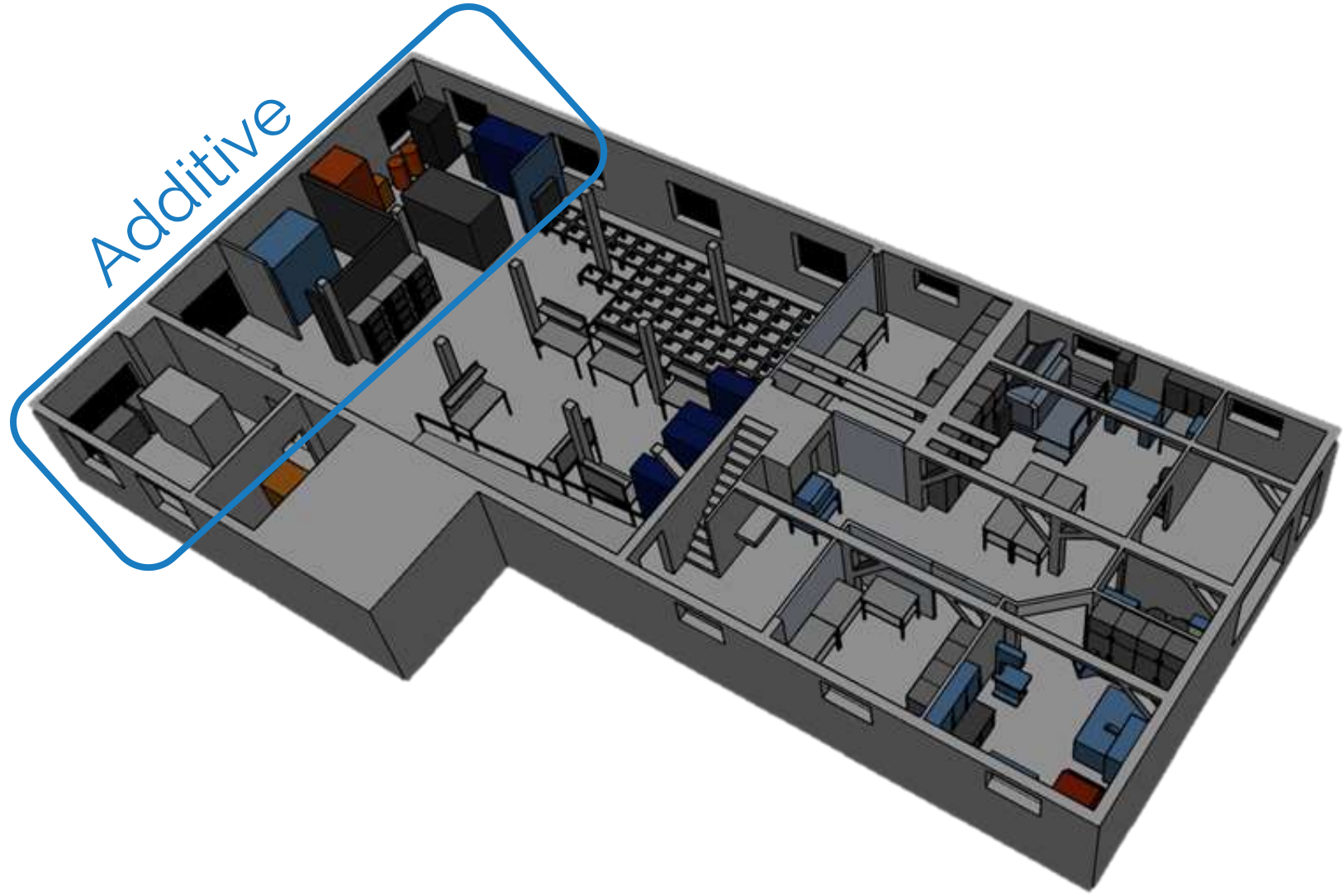
Design
CAD, code, schematic, layout

Source
Buy things

Test
Run, measure, learn

Build
Glue, assemble, capture

Source
Wait for things

Design
CAD, code, schematic, layout

Test
Run, measure, learn

Build
Glue, assemble, capture

Design
CAD, code, schematic, layout

Fabricate/ Source
Print, cut, buy

Build
Glue, assemble, capture

Test
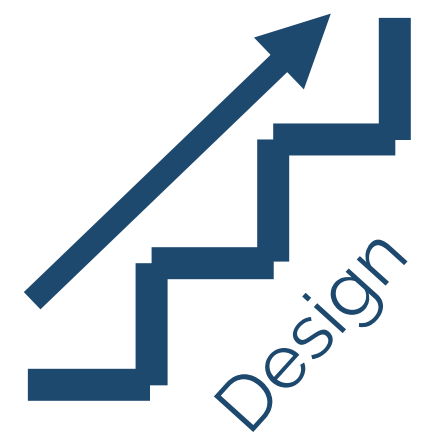Run, measure, learn
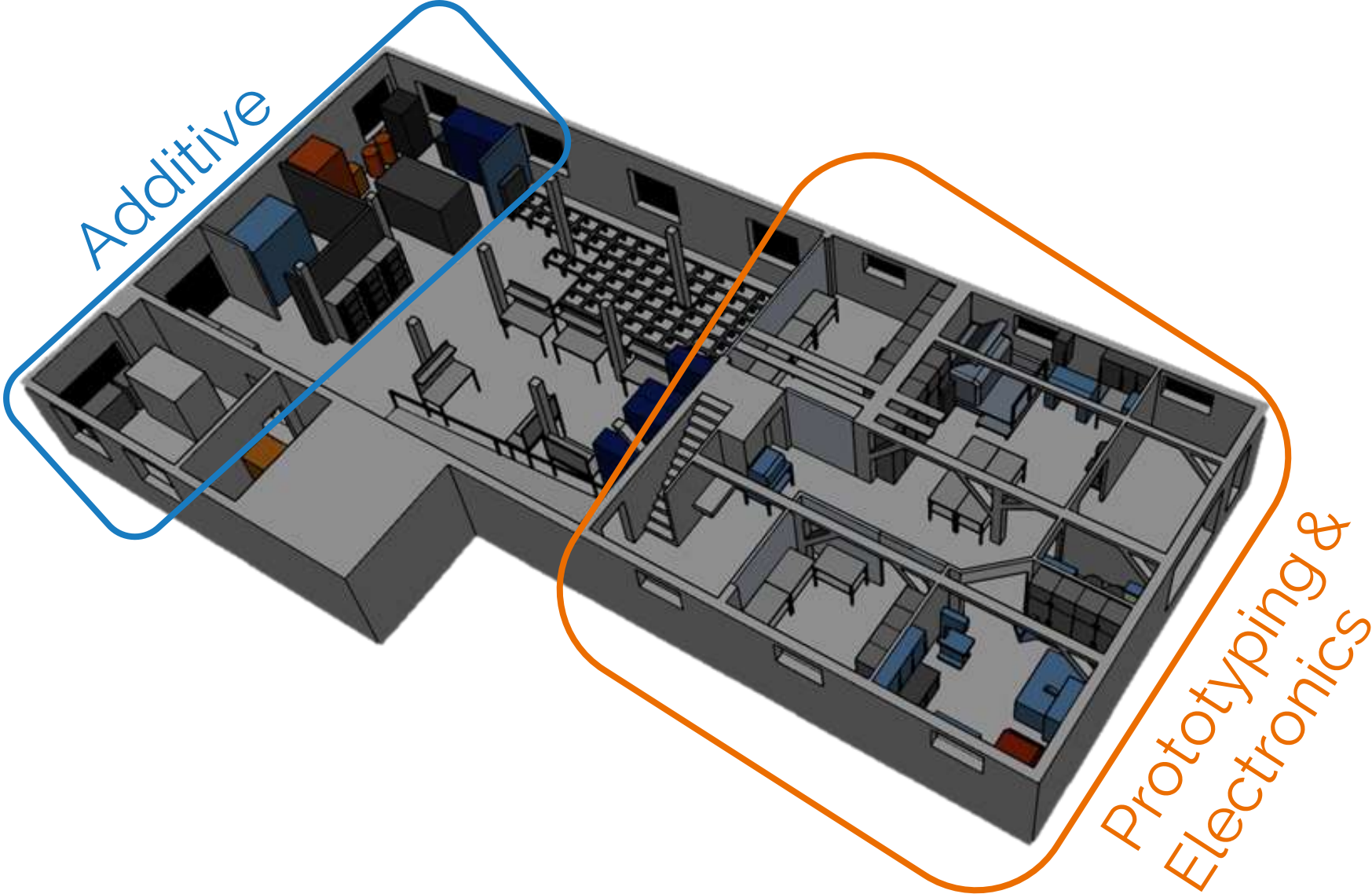
Additive

Additive

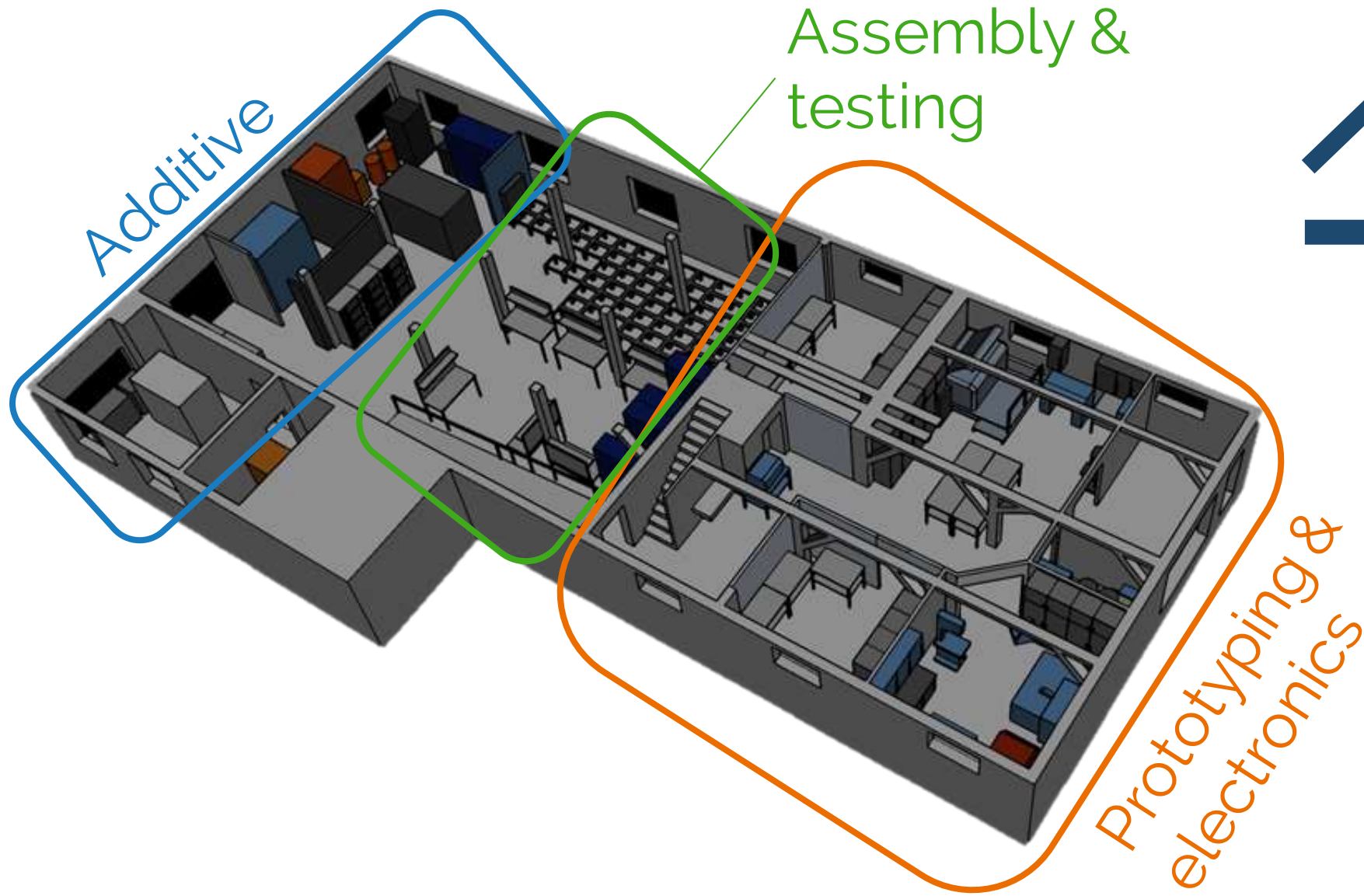Prototyping & Electronics

Additive

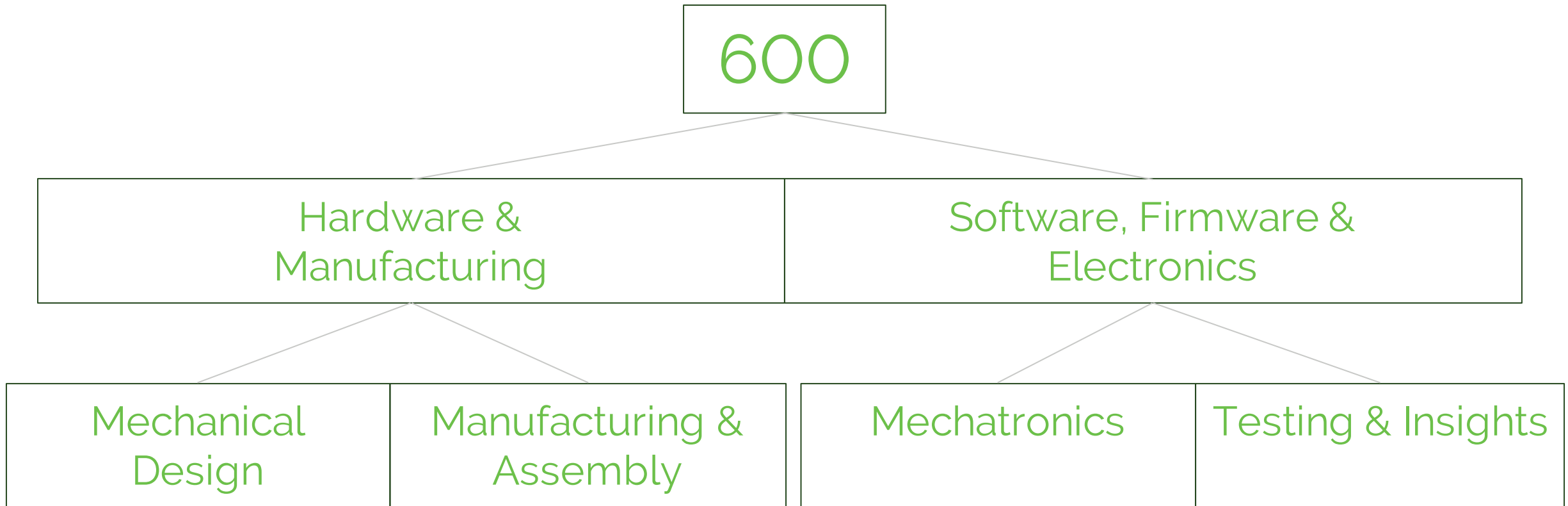Assembly & testing

Prototyping & electronics

Additive

Assembly & testing

Prototyping & electronics

Design

TEAM STATUS – 16 JUNE 2021

```
                           ┌──────────────┐
                           │     600      │
                           └──────────────┘
                   ┌──────────────┴──────────────┐
        ┌──────────────────────┬──────────────────────────────┐
        │   Hardware &         │  Software, Firmware &         │
        │   Manufacturing      │  Electronics                  │
        └──────────────────────┴──────────────────────────────┘
```

Mechanical Design	Manufacturing & Assembly		Mechatronics	Testing & Insights

Game on!

TEAM STATUS – 16 JUNE 2021

```
                    ┌──────────┐
                    │   600    │
                    └────┬─────┘
         ┌───────────────┴───────────────┐
┌─────────────────────┬─────────────────────────┐
│    Hardware &        │   Software, Firmware &   │
│   Manufacturing      │       Electronics        │
└─────────────────────┴─────────────────────────┘
```

Mechanical Design	Manufacturing & Assembly	Mechatronics	Testing & Insights

TEAM STATUS – 17 JUNE 2021

600 Head of Engineering

600 Head of Product

Hardware & Manufacturing (Sweden)

Software, Firmware & Electronics (Sweden)

Hardware & Manufacturing (UK)

Software, Firmware & Electronics (UK)

Mechanical Design

Manufacturing & Assembly

Mechatronics

Testing & Insights

Mechanical Design

Manufacturing & Assembly

Mechatronics

Testing & Insights

TEAM STATUS – 17 JUNE 2021

600 Head of Engineering

600 Head of Product

Hardware & Manufacturing (Sweden)
- Mechanical Design
- Manufacturing & Assembly

Software, Firmware & Electronics (Sweden)
- Mechatronics
- Testing & Insights

Hardware & Manufacturing (UK)
- Mechanical Design
- Manufacturing & Assembly

Software, Firmware & Electronics (UK)
- Mechatronics
- Testing & Insights

+ Product management!

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Mechanical Design

Manufacturing & Assembly

Mechatronics

Testing & Insights

Mechanical Design

Manufacturing & Assembly

Mechatronics

Testing & Insights

+ Product management!

+ Project management!!

TEAM STATUS – 17 JUNE 2021

```
                        ┌──────────────┬──────────────┐
                        │ 600 Head of  │ 600 Head of  │
                        │ Engineering  │  Product     │
                        └──────────────┴──────────────┘
```

| Hardware & Manufacturing (Sweden) | Software, Firmware & Electronics (Sweden) | Hardware & Manufacturing (UK) | Software, Firmware & Electronics (UK) |

| Mechanical Design | Manufacturing & Assembly | Mechatronics | Testing & Insights | Mechanical Design | Manufacturing & Assembly | Mechatronics | Testing & Insights |

+ Product management!

+ Project management!!

+ Deadline!!!

CAN YOU BE BIG AND AGILE?

Then	Now

CAN YOU BE BIG AND AGILE?

Then	Now
~20 people	~80+80 people

CAN YOU BE BIG AND AGILE?

Then	Now
~20 people	~80+80 people
1 room	3 development centres

CAN YOU BE BIG AND AGILE?

Then	Now
~20 people	~80+80 people
1 room	3 development centres
1 timezone	3 timezones

CAN YOU BE BIG AND AGILE?

Then	Now
~20 people	~80+80 people
1 room	3 development centres
1 timezone	3 timezones
Handmade by engineers	Contract manufacture

How does the way you collaborate look today?

How did it look in 2020?

THE MINDSET

The best test is physical
Printing is free
Speed and rigour can coexist
The whole product belongs to everyone

THE TOOLS

Slack
Onshape
Jira
Miro
VIDEO!

THE TOOLS

Slack
Onshape
Jira
Miro
VIDEO!

Collaboration first!!!

THE TECHNIQUES

Automate
Release often
Pair up
Build tooling if you have to

CI/CD

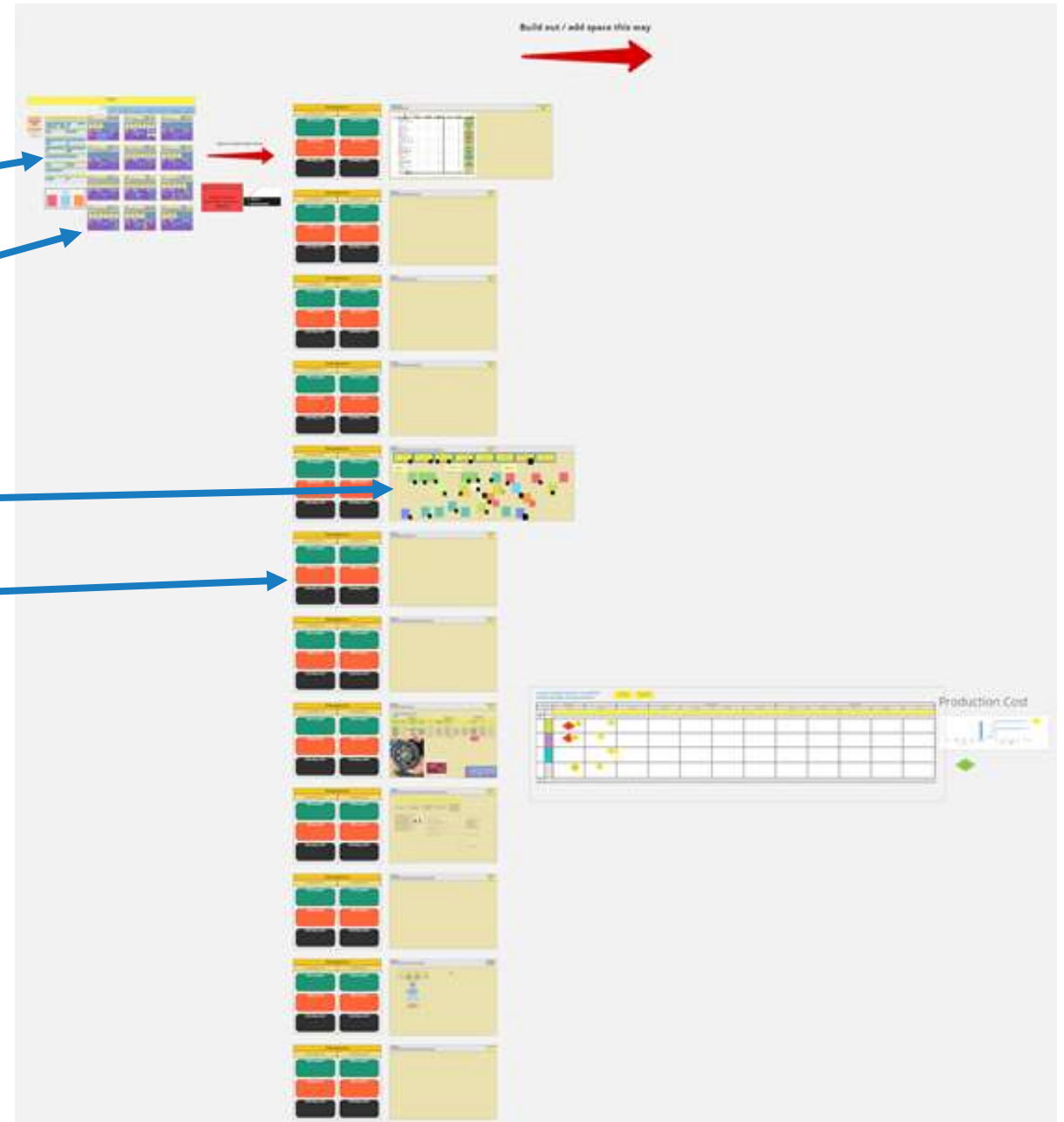- Automated topology optimisation

- Automated generation of manufacturing packs!

THE PROCESS

THE PROCESS

Title

Motivation

Definition of done
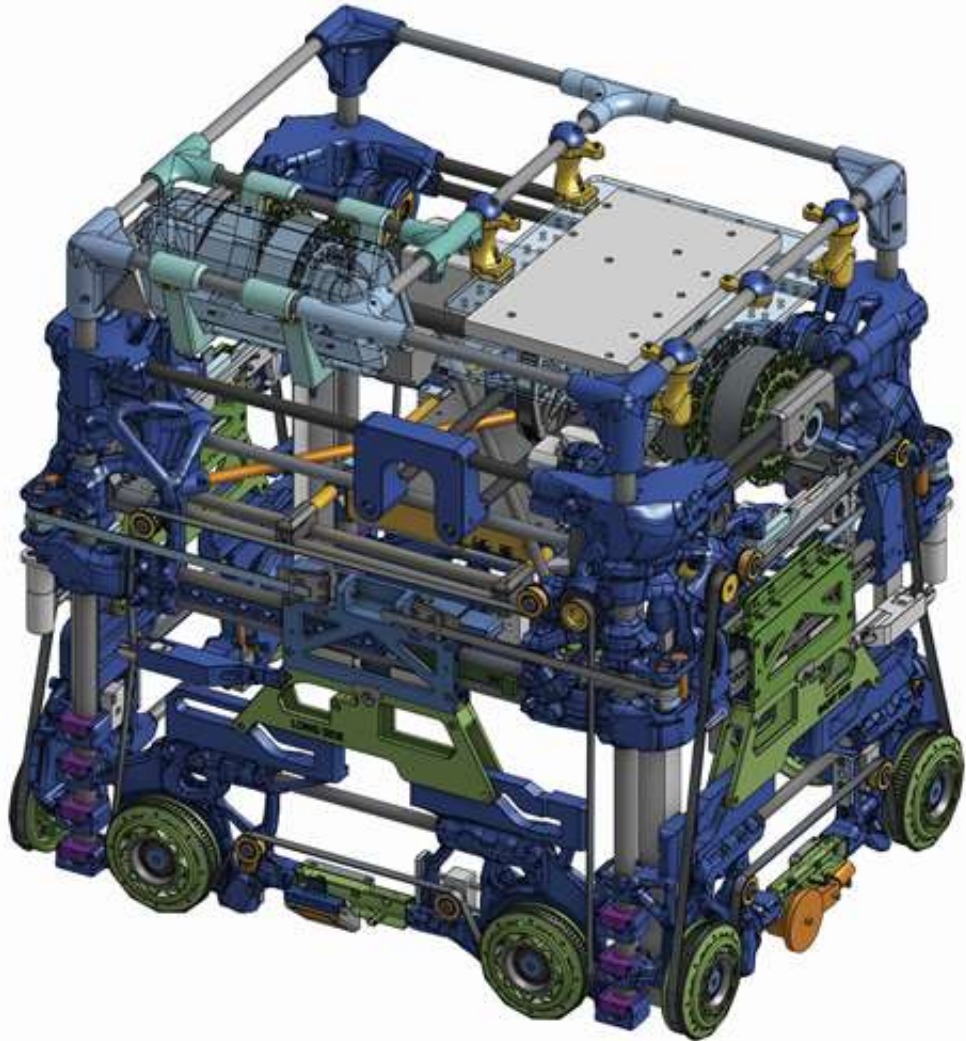
Type of work

People doing the work

People in the loop
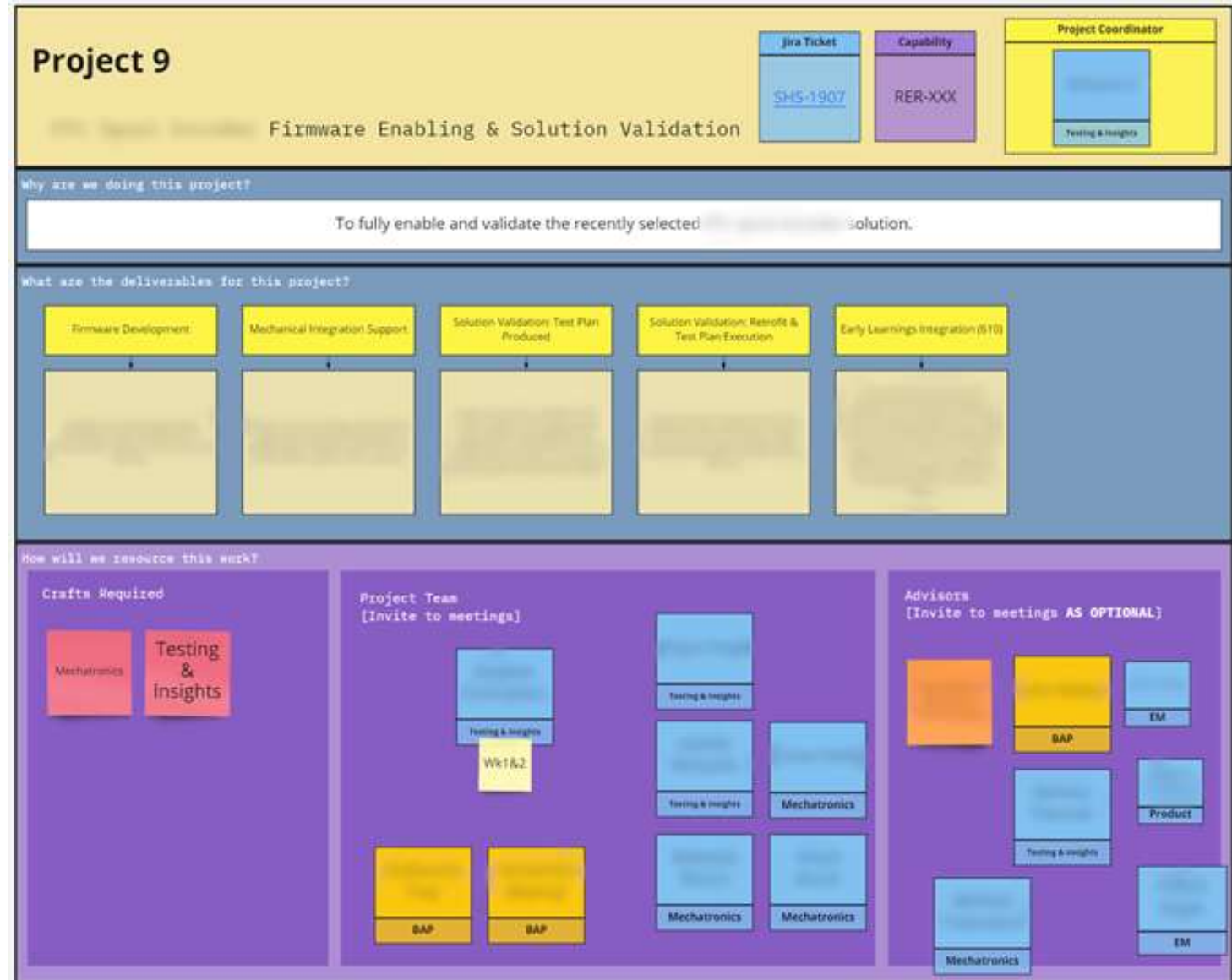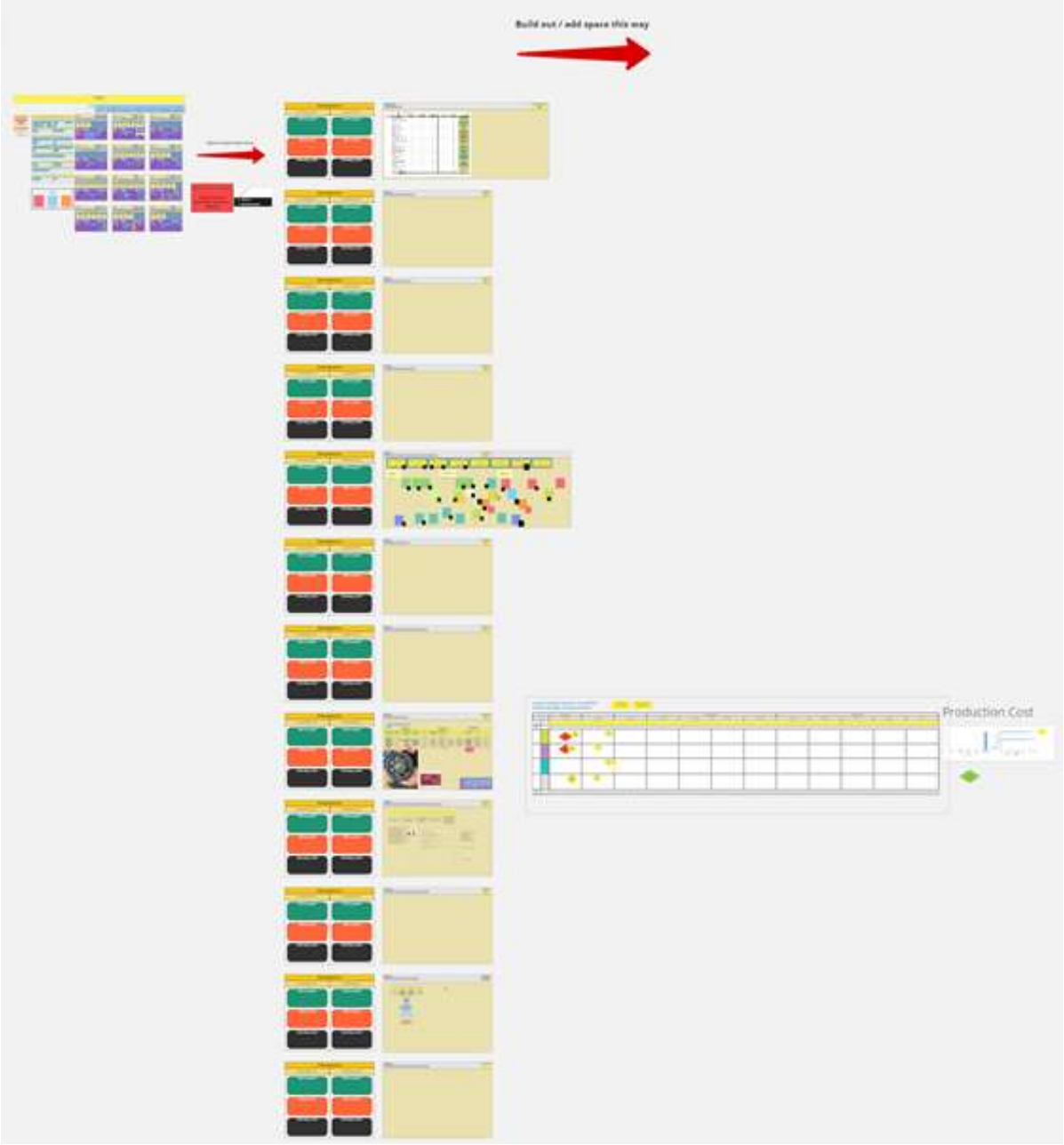
THE PROCESS

THE PROCESS
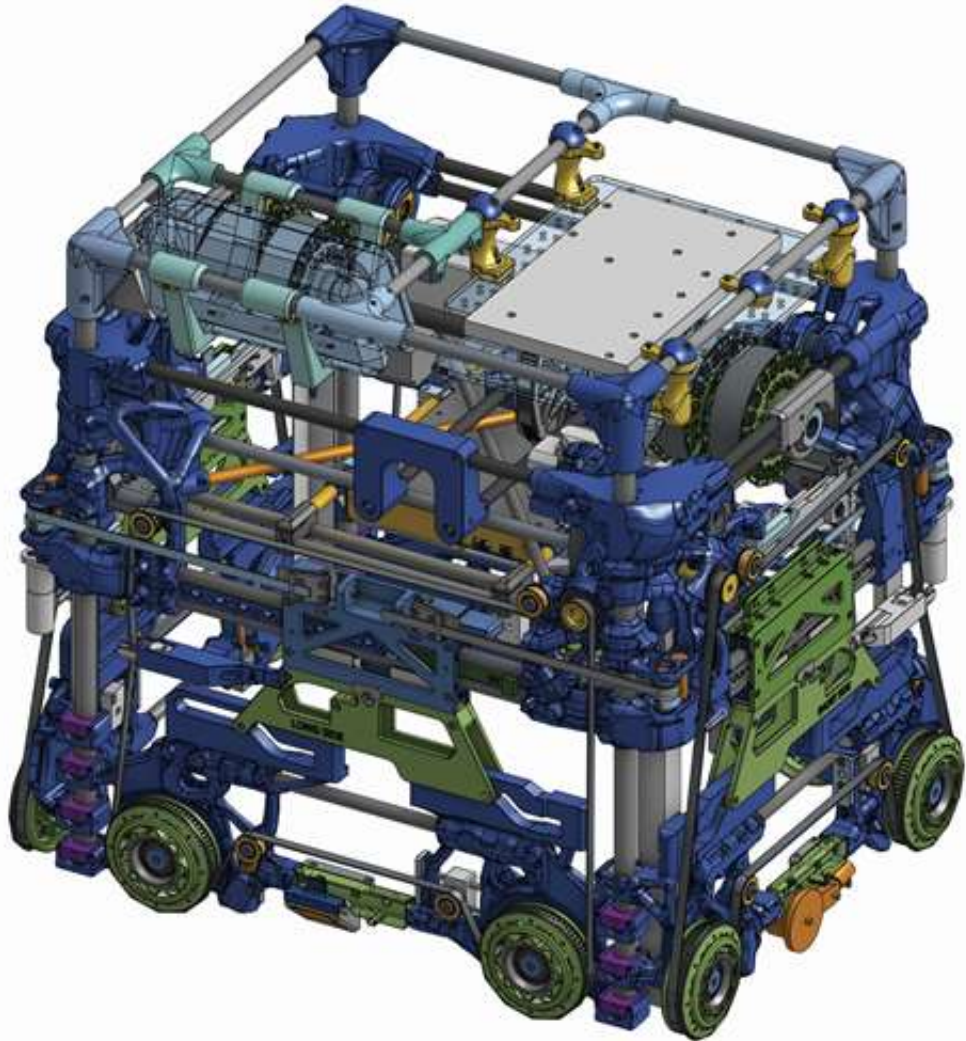
Team tokens

Project definitions

Planning space

Retro

REALITY CHECK

- Today's supply chain is incredibly challenging to work with

- You can't really 3D print electronics yet (my number 1 wish!)

- Copy paste of this process probably won't work for you, you need to design your own!

LEGAL BITS

Onshape is a registered trademark of Onshape Inc.

Slack is a registered trademark of Slack Technologies, Inc.

Jira is a registered trademark of Atlassian Pty Ltd.

Miro is a registered trademark of RealtimeBoard, Inc.

Ntopology is registered trademark of Ntopology Inc.