



MANUFACTURING **THE FUTURE**

INTRODUCTION



Rob van Loon

*“Additive Manufacturing Opportunities in
Aerospace”*



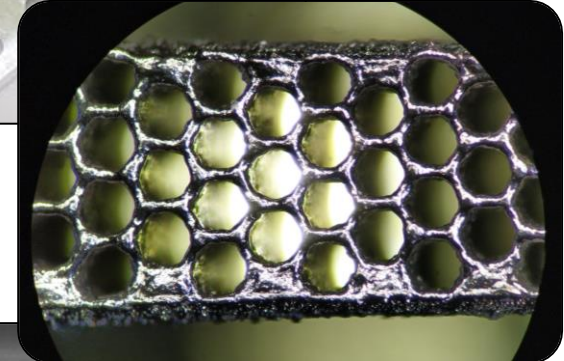
Fluid Distribution



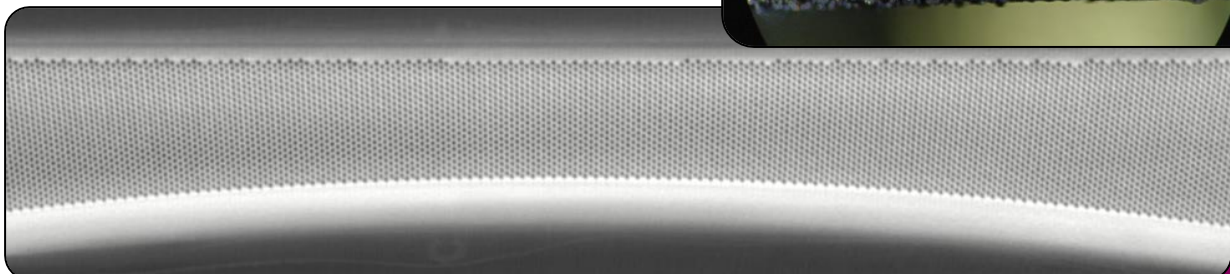
Optical Housing

More Examples

Topology Optimized Structures



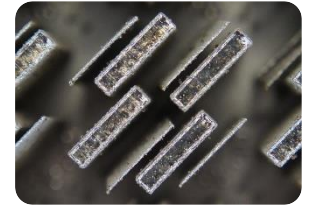
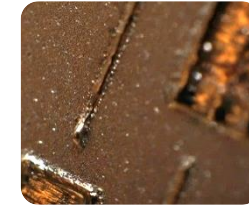
Injectors
Laminar Flow Devices



Our Additive Journey

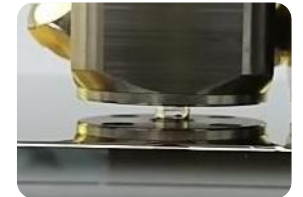
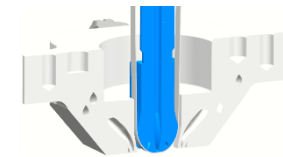
AddLab 2013-2016

- Parameter development
- Capability study's



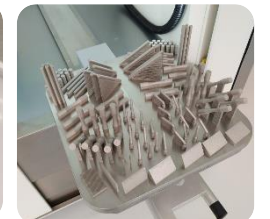
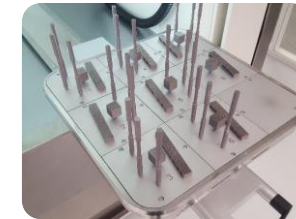
AddFAB 2016-2018

- Design Rules development
- First parts design and manufacturing for series production



K3D-AddFAB 2019-....

- Documentation and certification (Aerospace and Semicon)
- Process reliability development
- (Other NNS AM technology development)



KMWE Additive

- Design for Additive manufacturing
- Series production
- Other NNS AM technology development

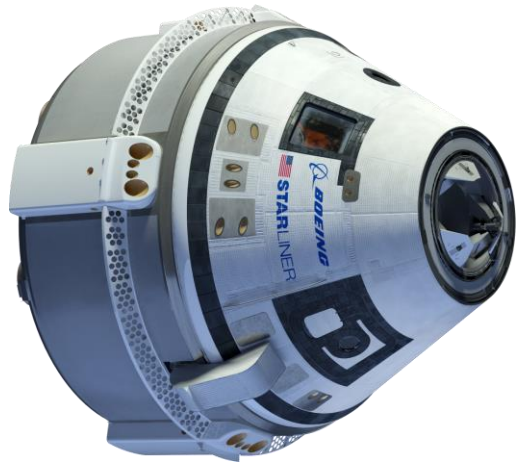




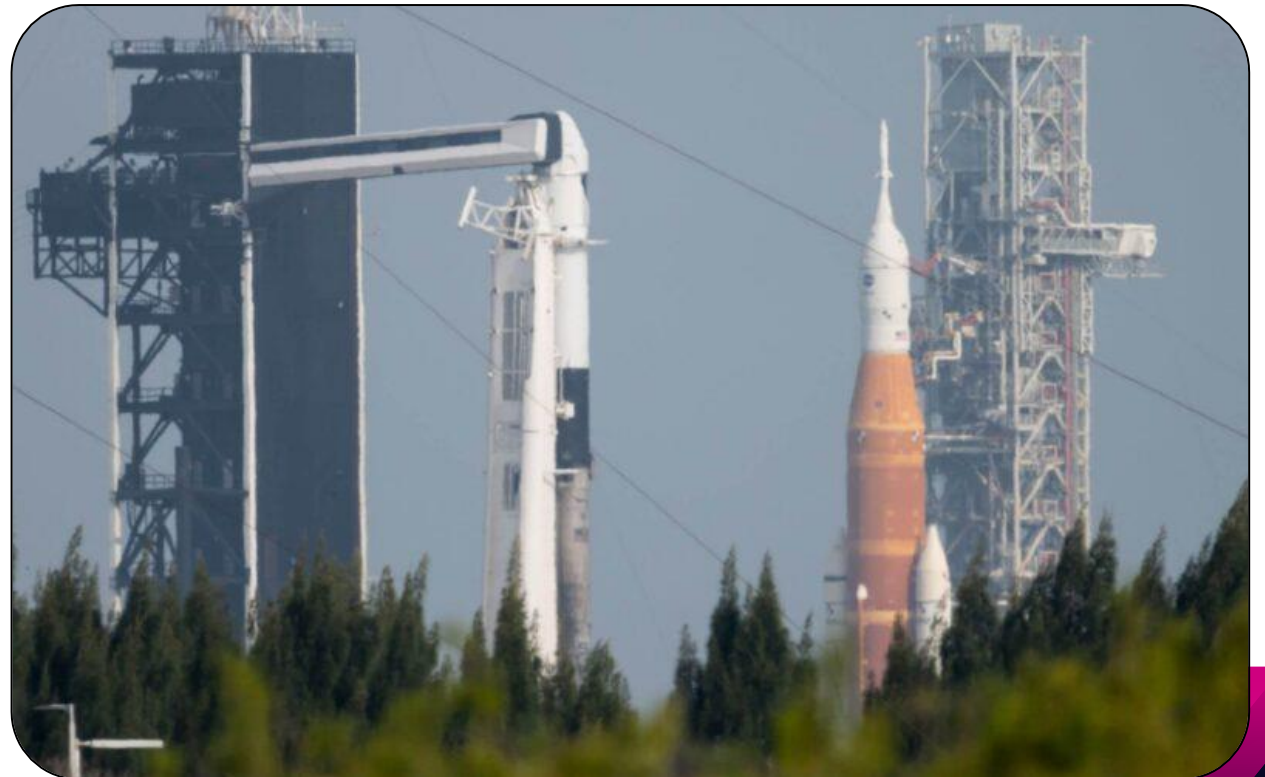
“OLD SPACE”



“NEW SPACE”



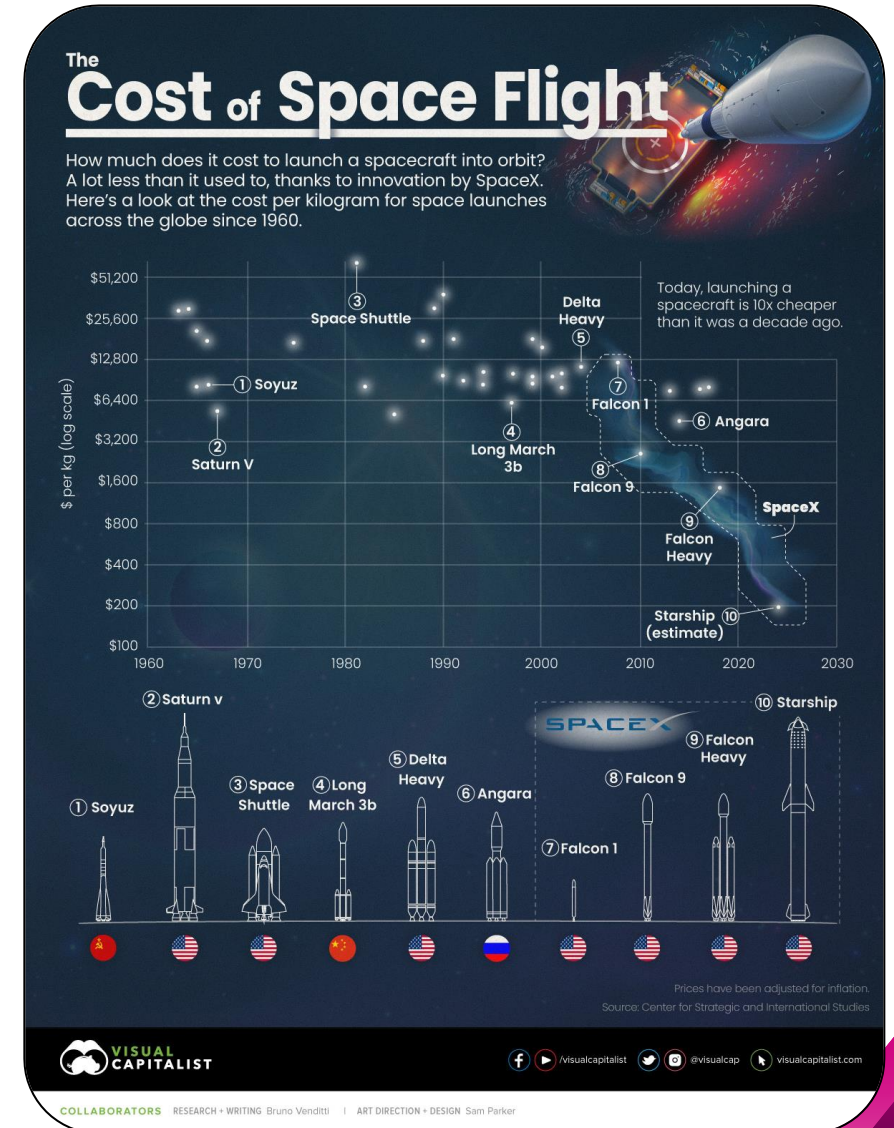
OLD SPACE VS NEW SPACE



OLD SPACE VS NEW SPACE

THE DEVELOPMENT DIFFERENCES

- “Old Space”
 - Traditional project architecture
 - Everything is calculated and validated before 1 piece of metal is acquired
 - Over time and over budget
- “New Space”
 - Fail fast, fail forward method
 - Quick successive iterations
 - Requires lower budget and achieves faster lead times
 - Lower costing products



What does it have to do with Additive Manufacturing?

ADDITIVE MANUFACTURING?

- ✓ Rise of “New Space” dates back approx. 10 years
- ✓ Rise of industrial AM dates back approx. 10 years

Coincidence?

I don't think so...

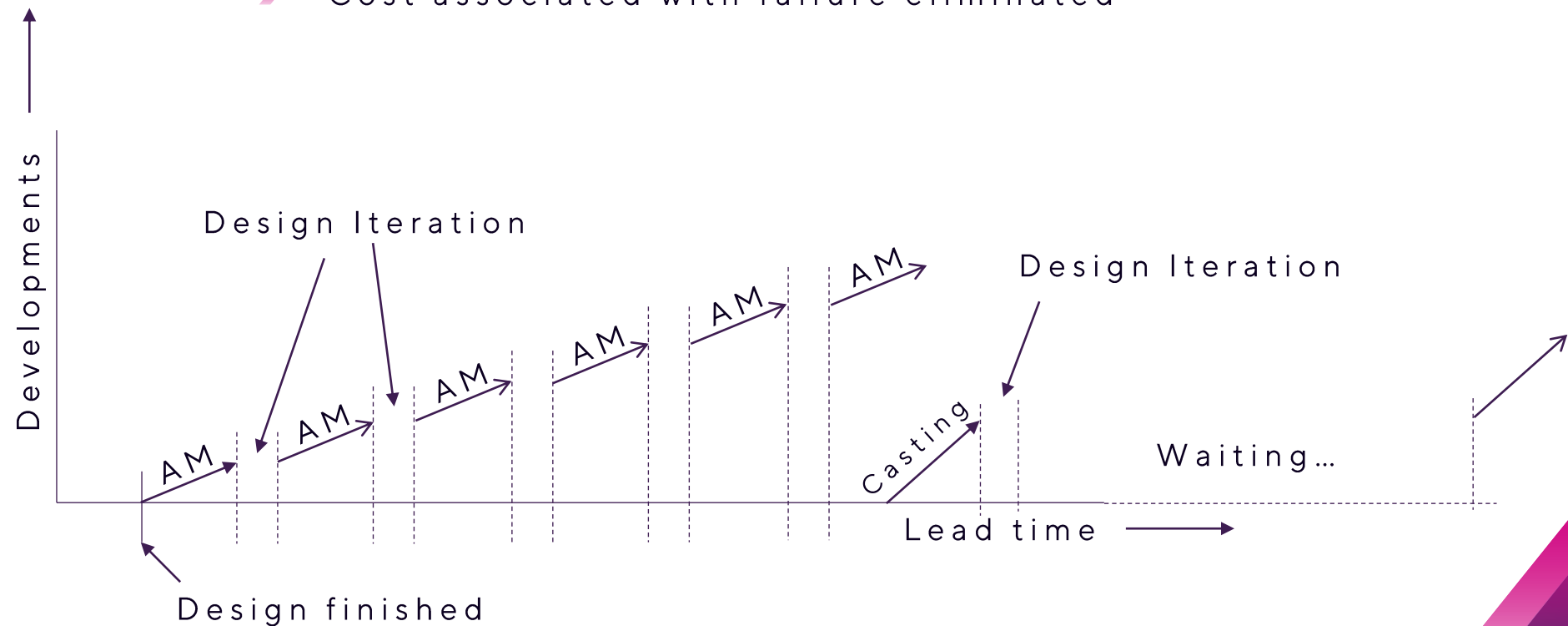
ADDITIVE MANUFACTURING

RISE OF NEW SPACE

- **Launch vehicle companies**
 - 2013 – Approx. 10 to 15
 - 2023 – More than 250
 - Over 90% of new companies use Additive Manufacturing to create their rockets
- **Why?**
 - Lower investments needed to start
 - Lower investments needed to create viable products

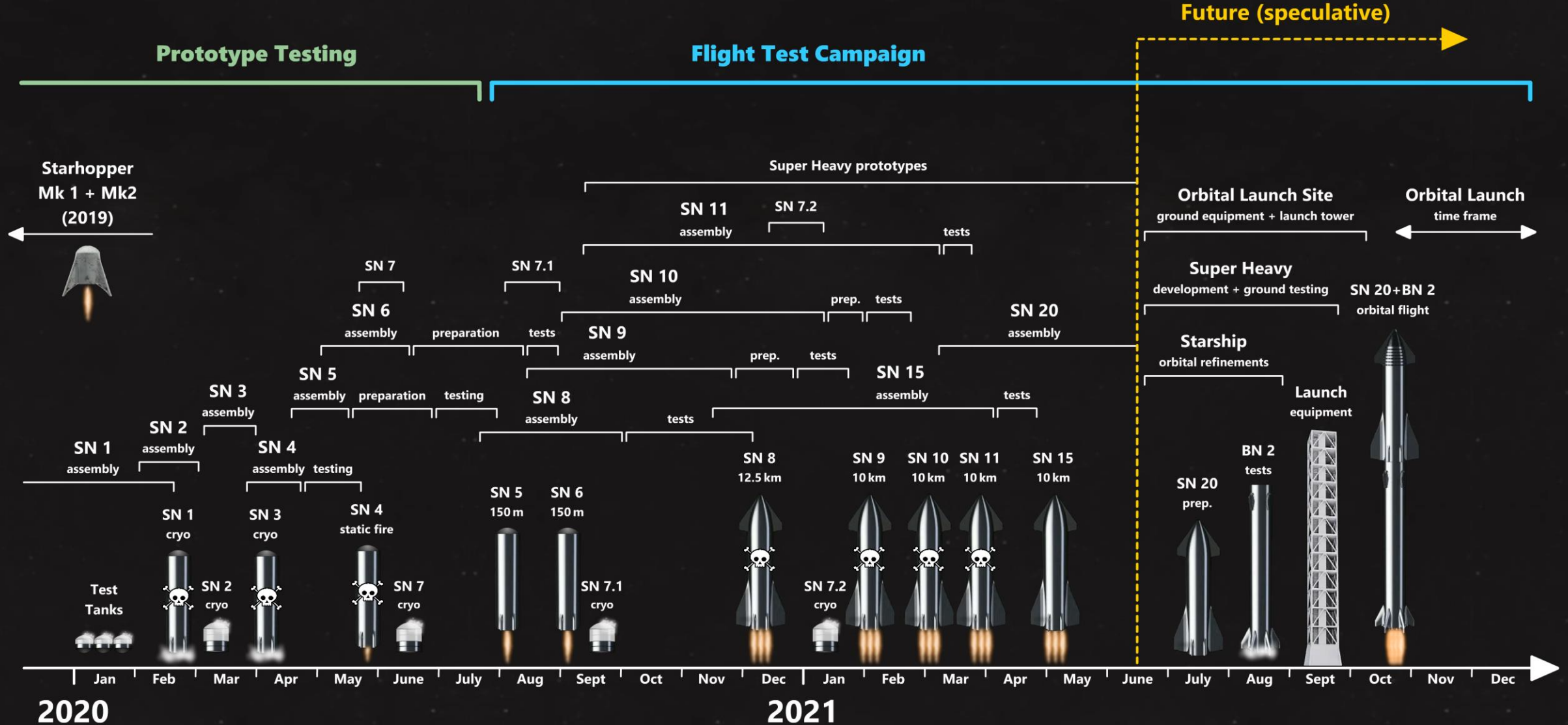
ADDITIVE MANUFACTURING?

- Enables agile WoW in Manufacturing
- Lead times reduced from >1 year, to weeks
- Cost associated with failure eliminated



SpaceX Starship Timeline

June 2021



SUPERDRACO ENGINE

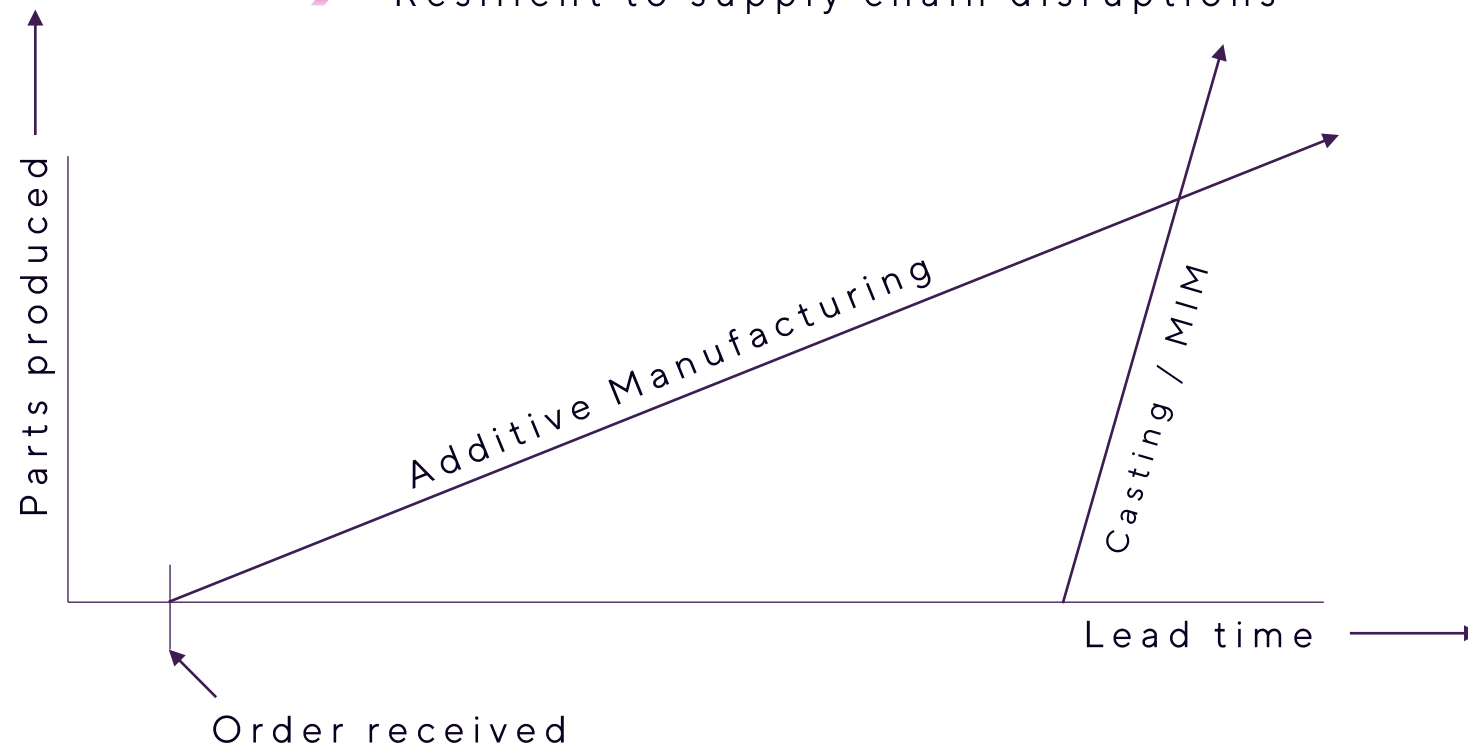
CREW DRAGON LAUNCH ABORT SYSTEM

- **Before Additive Manufacturing (2012)**
 - Traditional development cycle of multiple years
 - Casting as manufacturing method
- **After Additive Manufacturing (2013+)**
 - Concept to first hot-fire 3 months
 - Iterative improvements
 - Increased performance, reduced cost



SERIAL PRODUCTION?

- Flexible production
- Cash isn't stuck in material
- Resilient to supply chain disruptions



Today's Challenges



TODAY'S CHALLENGES

- **Sustainability**
 - Do more with less resources
 - Go towards circular economy
- **Global tensions**
 - Multiple wars
 - Supply chain shortages
- **Unstable economy**
 - Inflation
 - Divided population

TODAY'S CHALLENGES

AEROSPACE INDUSTRY

- **Sustainability**
 - Clean Aviation
 - Biofuels, Hydrogen, Electric, ...
- **Global tensions**
 - Short supply of materials
 - Difficult to get large quantities of special materials
- **Big challenges**
 - Urgent
 - Unable to be solved by one individual/company
 - Require a different way of working



HOW DOES AM HELP?

- **Enable new design possibilities**
 - Create technological solutions
- **Quick iterations**
 - Fast development cycle to get new solutions to market
- **Lower material usage**
 - Feedstock only used where required for final part
- **Lower weight**
 - Lower fuel usage
 - Lower Cost

Dutch Strengths

- Knowledge Industry
- European and Global Logistical Hub
- Masters in Cooperation

VERTICAL INTEGRATION

THE DUTCH ECO-SYSTEM

- **Vertical Integration**
 - Combine expertise to create efficient vertically integrated eco-system
- **Share knowledge**
 - Overcome hurdles quicker
- **Dutch manufacturing**
 - Key player in transition to sustainable aviation



ASML Semicon Eco-System



Source: <https://www.asml.com/en/company/sustainability/innovation-ecosystem>

VERTICAL INTEGRATION

THE DUTCH ECO-SYSTEM

- **Who do we need?**
 - Government
 - Research institutes
 - Universities
 - OEM's
 - Engineering facilities
 - Manufacturing partners
 - Certifying bodies
 - Material suppliers
 - Testing facilities
 - ...



Let's Leverage Dutch strengths

- /// Create an efficiently integrated eco-system
- /// Use our knowledge & state-of-the-art manufacturing facilities
- /// Additive Manufacturing will offer a backbone

WORKING TOGETHER



The NAG 3DP Special Interest Group works together to support the Dutch Aerospace industry in the adaptation of the 3D Printing technology and creating a competitive edge by providing knowledge and guidance and in all relevant aspects

KMW

Brightlands Materials Center

ADSE
CONSULTING AND ENGINEERING

Berenschot

Additive Industries

materialise
innovators you can count on

SIEMENS nlr

ADDITIVE
Rapid prototyping
Rapid AM prototyping
DIGITAL
On-demand Production
Cost
Sustainable
Material polymers
ADDITIVE
MANUFACTURING
Rapid AM prototyping
METAL
Plastic Cost

Just-in-time
Manufacture
3D Printing
Supply STL
CAD
Plastic
Metal
Digital supply chains

Metal
3D Printing
Just-in-time
Material
STL
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ADDITIVE
supply chains
Rapid prototyping
AM
polymers
3D Printing
Rapid prototyping

Supply AM
CAD
Production
Materials
Sustainable
Manufacture
On-demand
MANUFACTURING
Materials
DIGITAL
Cost AM
3D Printing
Plastic
Digital
STL

The logo for KMWE features the letters 'K', 'M', 'W', and 'E' in a bold, sans-serif font. The 'K' and 'M' are pink, while the 'W' and 'E' are light blue. A thick, diagonal line with a gradient from pink to blue passes through the 'M' and 'W'.

KMWE

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