

# You have optimised the design, now it's time to build it.

## Different ways to apply AM in your business

Alessandro Consalvo – Renishaw SpA

# Renishaw

- World leading metrology company founded in 1973.
- Skills in measurement, motion control, spectroscopy and precision machining.
- 2011 MTT acquisition making Renishaw the only UK manufacturer of metal additive manufacturing systems.



# Agenda

Myths and realities about metal 3D printing

Applying AM in your business

Application examples



# Agenda

## Myths and realities about metal 3D printing

Applying AM in your business

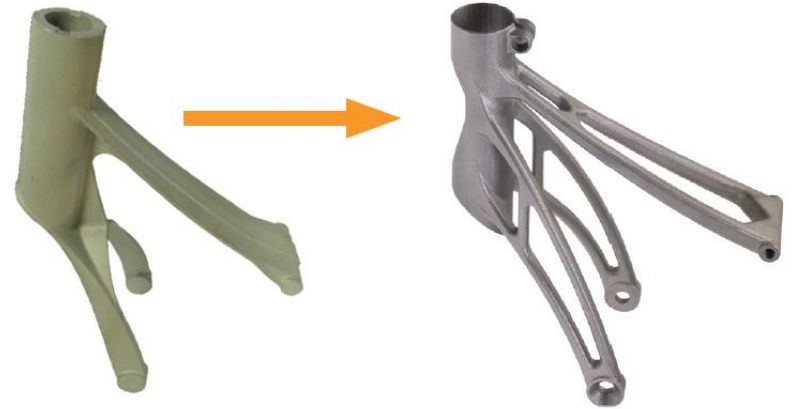
Application examples



# Why everyone is interested in metal 3D printing...

## Additive manufacturing (AM) benefits

- ✓ Innovative product designs
- ✓ Complex internal details
- ✓ Lightweight, optimised forms
- ✓ Efficient material usage with minimal waste
- ✓ Improved cooling & heat transfer
- ✓ Customisation for specific applications
- ✓ Short lead times
- ✓ Build from CAD with no special tooling



**Cast aluminium bike seat post bracket and optimised titanium bracket.**

**A weight reduction of 44% was achieved by optimising the design for AM.**

# What should I know about metal 3D printing?

## 3D printing is a part of the process

- ✓ You will need all your knowledge
- ✓ It will support what you already do
- ✓ It gives a high added value
- ✓ It reduces the process end-to-end time
- ✓ Professional profiles at different levels

✓ **Cast aluminium bike seat post bracket and optimised titanium bracket.**

- ✓ The result is a semifinished  
The seat post comes out of the machine  
✓ It requires a peculiar surface finishing

## 3D printing will cure all the evils

- ✓ Forget everything you learned before
- ✓ It will replace everything done so far
- ✓ It costs less always
- ✓ It's faster than all the other processes
- ✓ Even a child is able to use it
- ✓ Printing for metal is the same
- ✓ The products come out finished
- ✓ Mirror surface finishing is achievable

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# Getting the most from AM



## Why use AM for prototype & tooling development?

- Prototypes help to de-risk system designs at low cost
- No intention to use AM to make production parts
- AM avoids tooling costs whilst the design is still in flux
- AM enables cost-effective manufacture of complex tooling

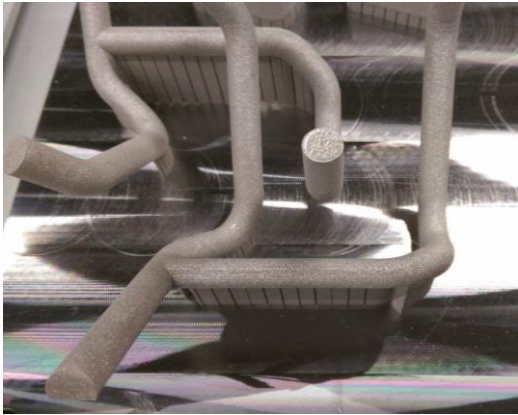
Benefit

**Low volume parts**  
made direct from CAD

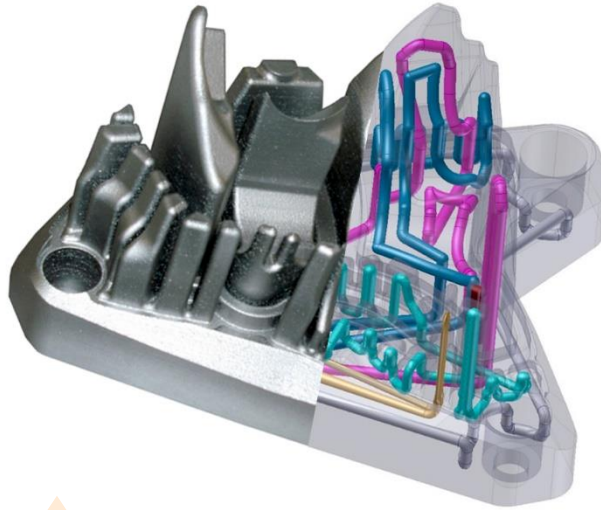
**Rapid prototypes & tooling**



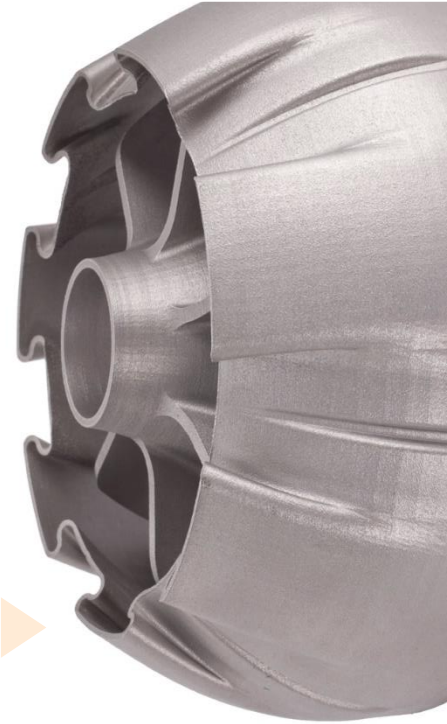
## Examples: Rapid prototypes & tooling



▲  
Complex bar  
locators for part  
handling



▲  
Conformal  
mould tooling for  
rapid cooling



▲  
Prototype  
exhaust  
nozzle

# Getting the most from AM



## Why use AM for direct part replacement?

- Gain experience with AM in low risk applications
- Develop a supply chain for AM parts

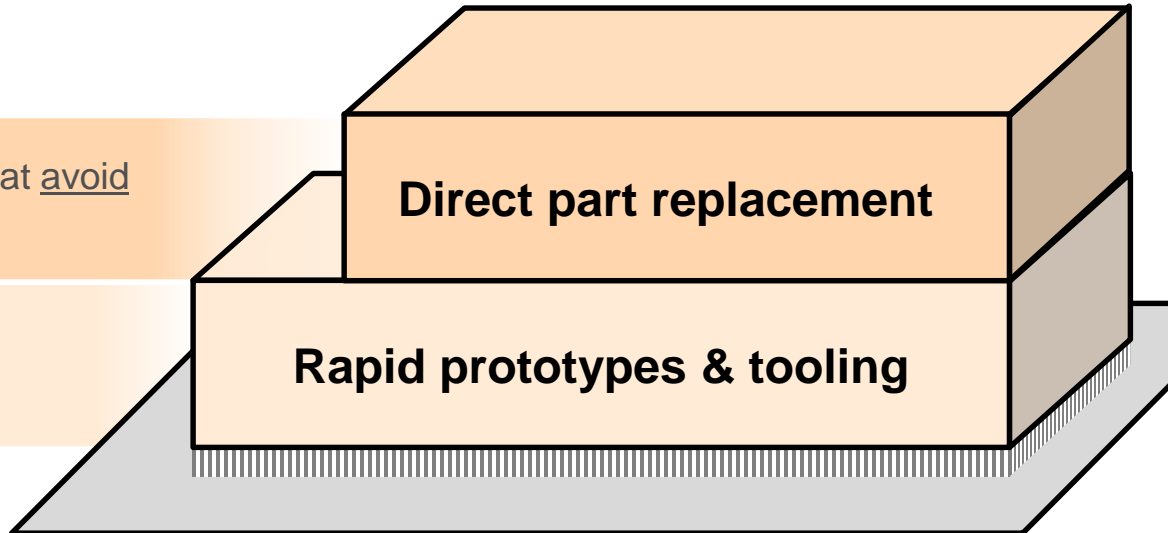
Re-production parts, that avoid complex manufacturing

Low volume parts made direct from CAD

**Direct part replacement**

**Rapid prototypes & tooling**

Benefit

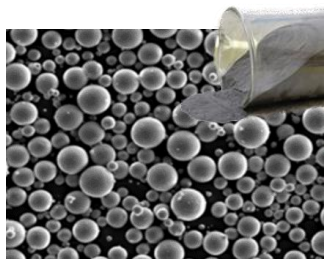


# Example: Direct part replacement

Subtractive



Additive



Significant waste reduction with AM process.

# Getting the most from AM



## Why combine parts using AM?

- Simpler assembly & fewer joints / bonds

**Complex parts** that simplify assembly & enhance reliability

**Re-production parts**, that avoid complex manufacturing

**Low volume parts** made direct from CAD

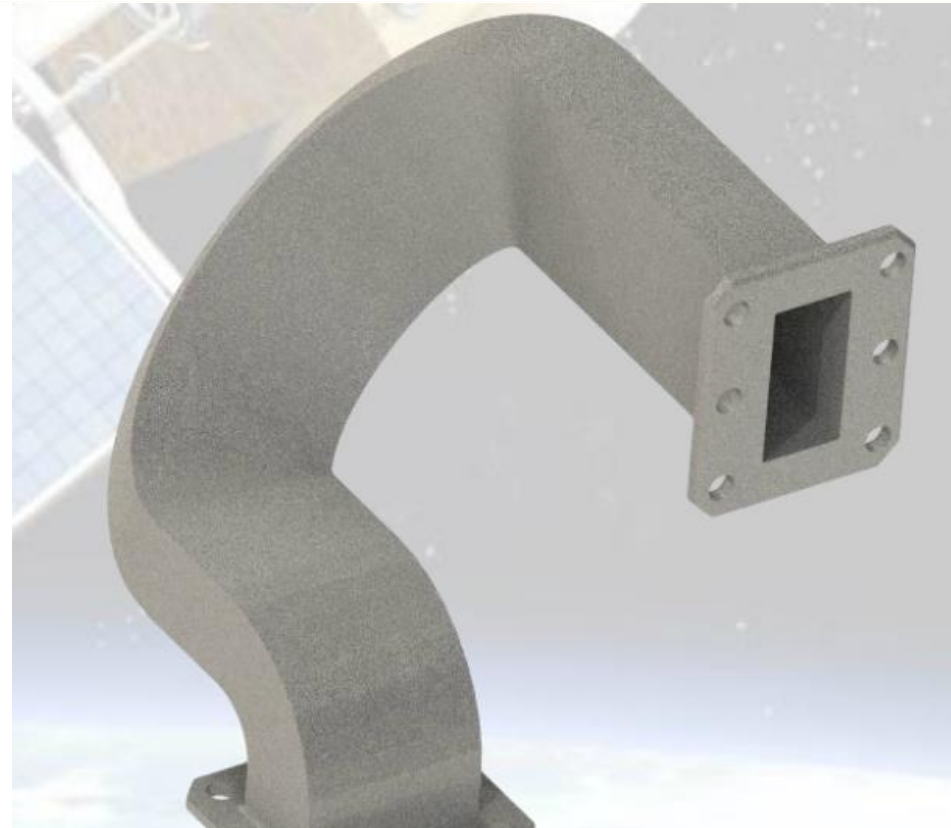
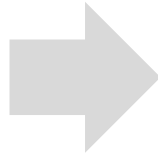
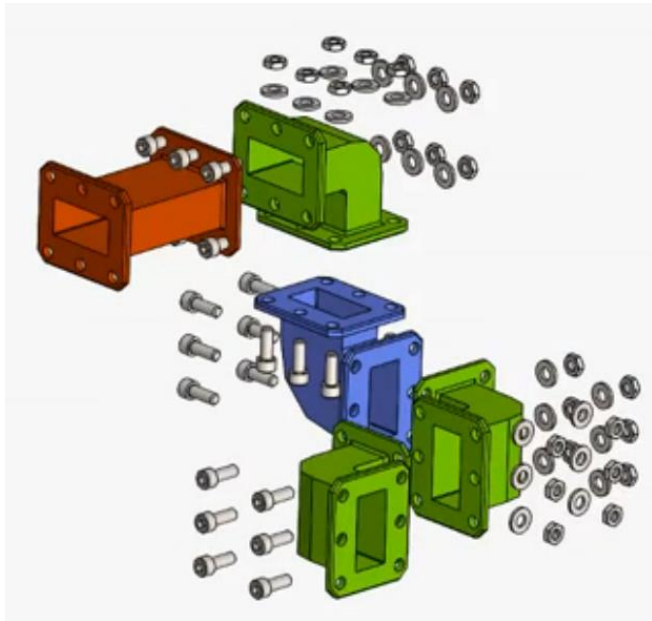
**Part consolidation**

**Direct part replacement**

**Rapid prototypes & tooling**

Higher benefit

## Example: Part consolidation



Microwave guide: from 77 to 1 piece  
Reduced weight and improved performances

# Getting the most from AM



Highest benefit

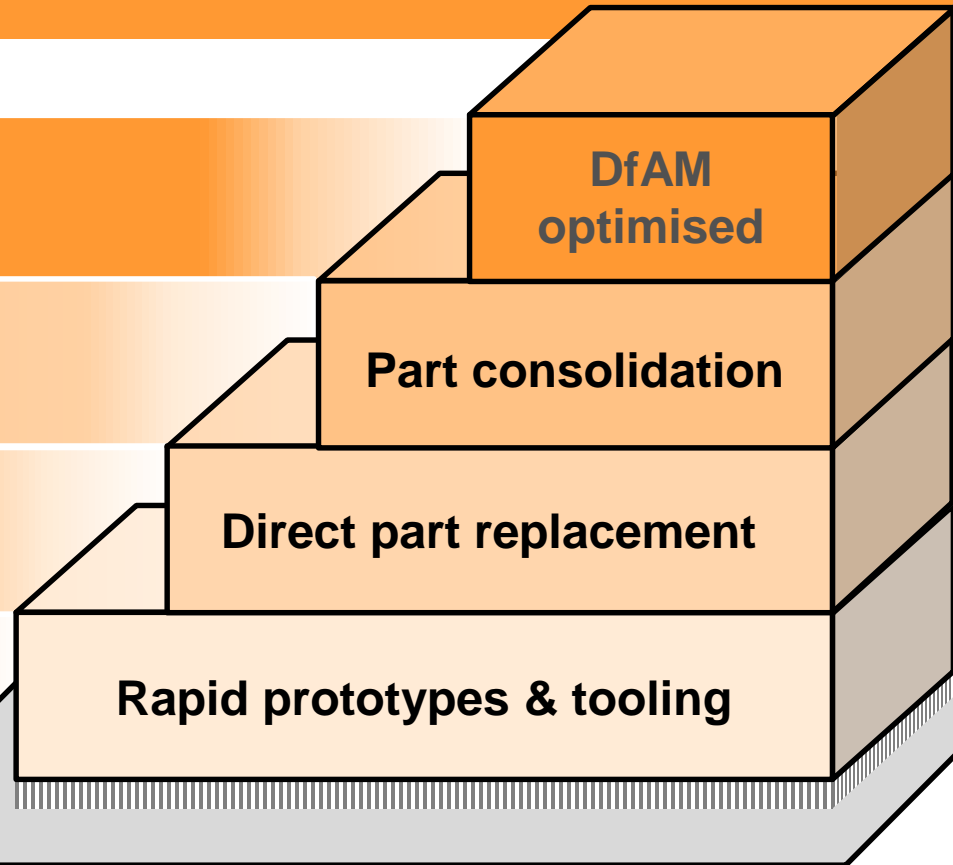
**New product designs that**

1. Deliver lifetime benefits in use
2. Provide mass customisation

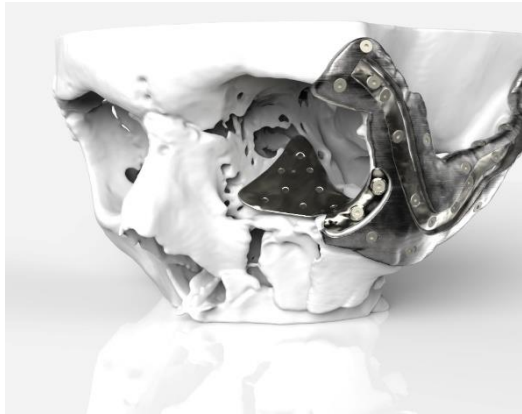
**Complex parts that simplify assembly & enhance reliability**

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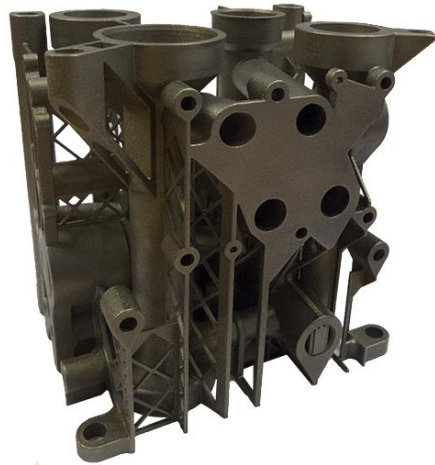
**Low volume parts made direct from CAD**



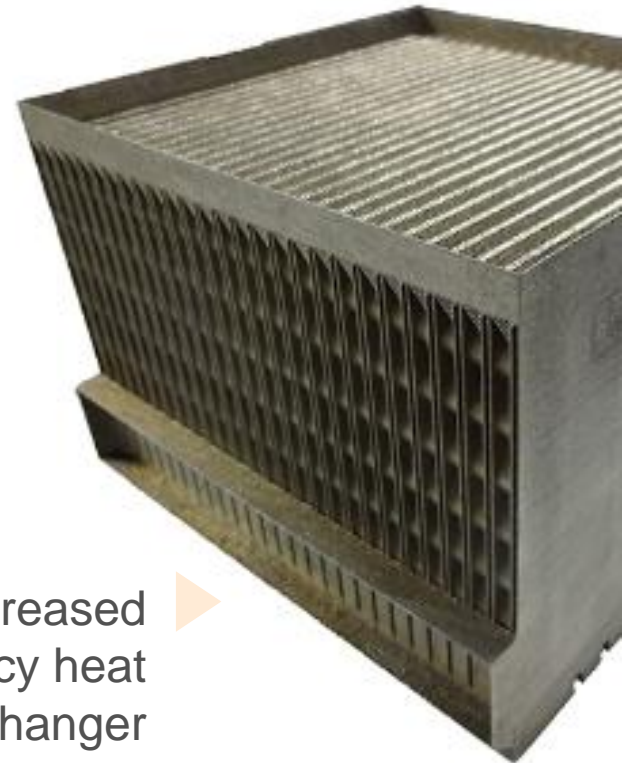
## Examples: DfAM optimised



▲ Customised  
cranio-facial  
implant



▲ Light-weight,  
efficient hydraulic  
manifold



▲ Increased  
efficiency heat  
exchanger

# Agenda

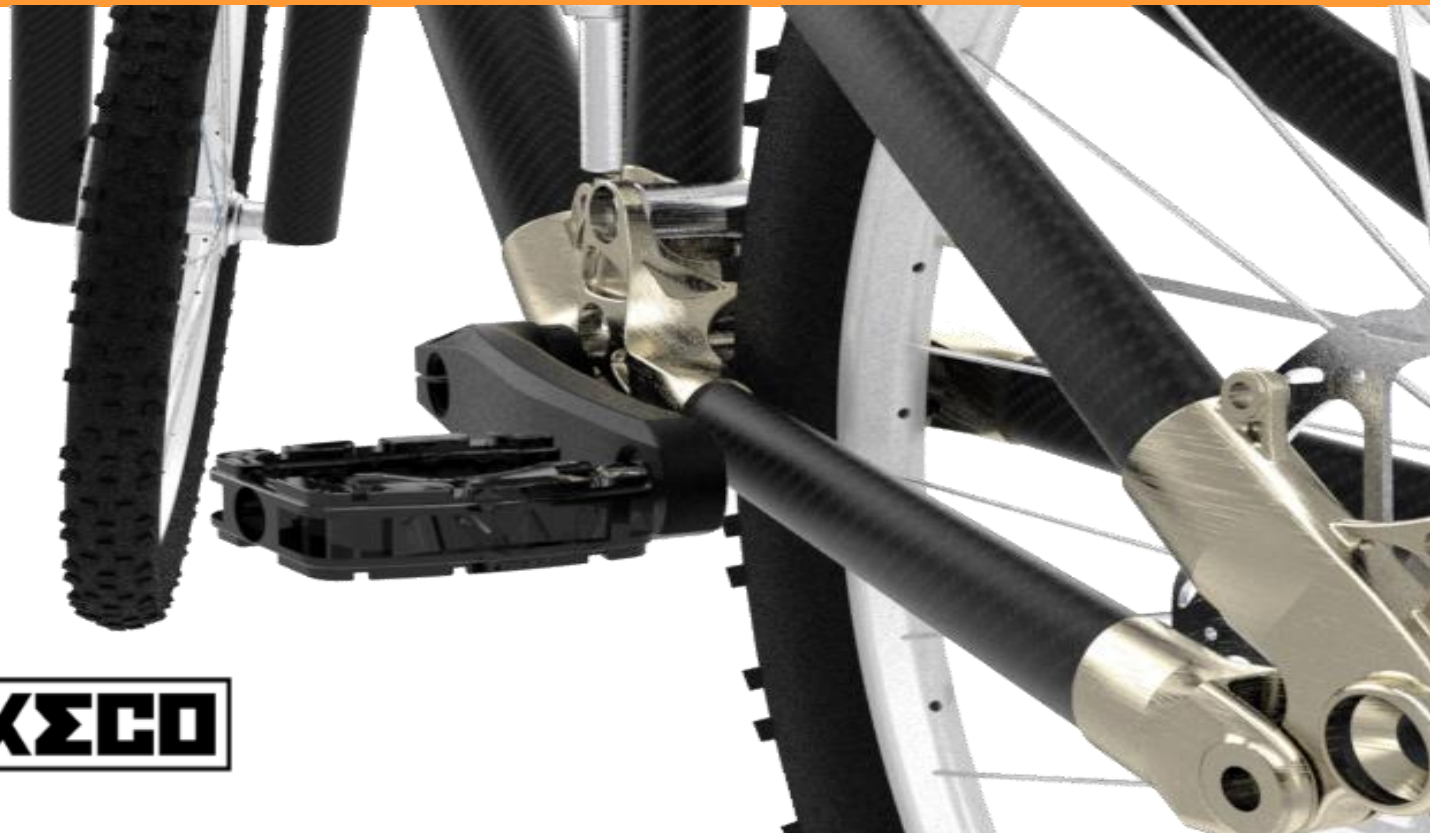
Myths and realities about metal 3D printing

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**ROBOTBIKESCO**

# Database to CAD Model

- **225.720** Geometries Possible
- **11** Individual Titanium Lugs
- **8** Carbon Fibre Tubes
- **1** Button
- **20** Seonds

**ROBOTBIKECO**

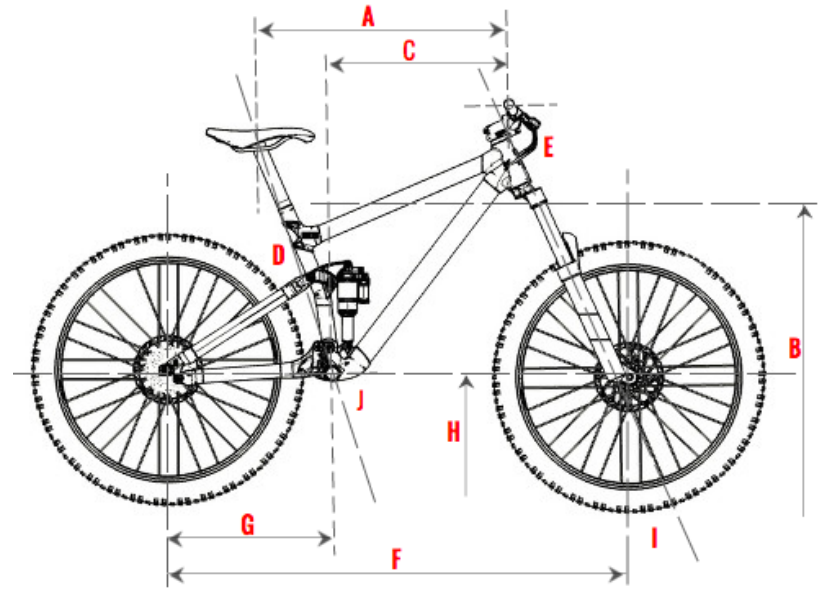
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Customer Input

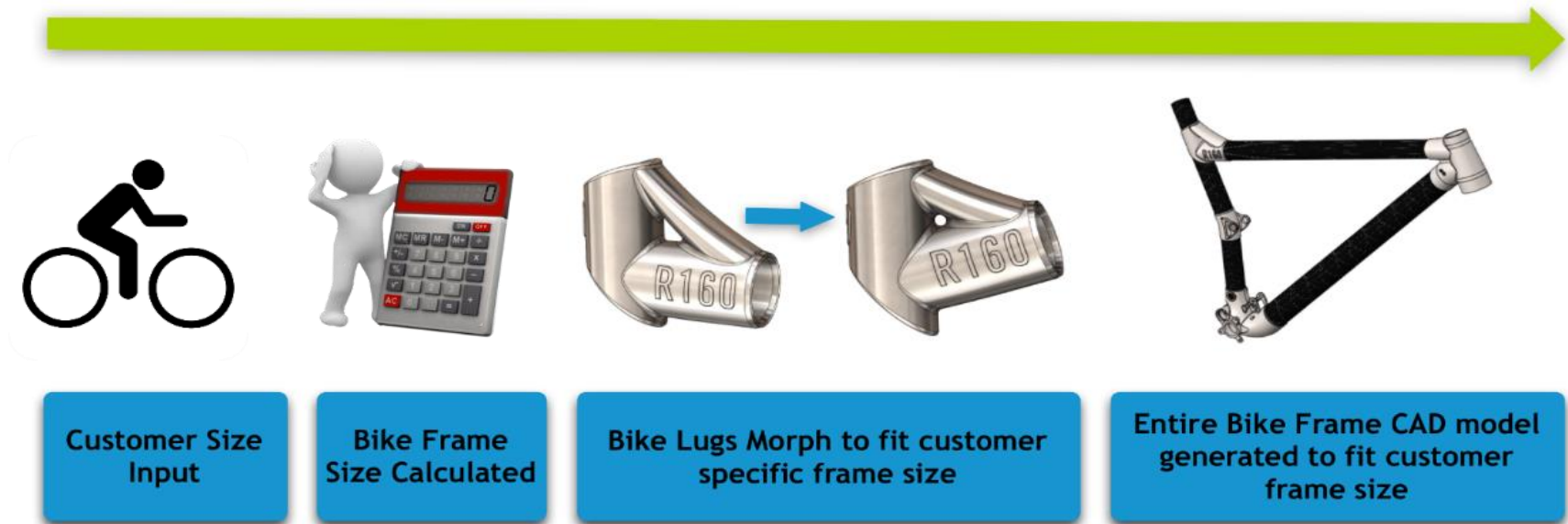
Name	<input type="text" value="Mike Adams"/>
Email	<input type="text" value="mhadams@rota.biz"/>
Height (mm)	<input type="text" value="1810"/>
inside Leg (mm)	<input type="text" value="808"/>
Arm Span (mm)	<input type="text" value="1810"/>

Engine Output

Reach (mm)	440
Seat Tube Length(mm)	472
Effective Top Tube (mm)	543
Standover Height(mm)	744
Head Tube Length(mm)	125
Wheelbase(mm)	1194
Chainstay Length(mm)	430
Bottom Bracket Drop (mm)	30
Head Tube Angle(mm)	56.5
Seat Tube Angle(mm)	72
Stack Height (mm)	508



# A new business model



## CAD model to the frame

- Acceptance of the CAD model by the customer
- Creation of the lugs set with an AM machine
- Bespoke length unidirectional carbon fiber tubes
- Assembly of the frame





## Workshop VI 22 September 15:00

### Optimising, redesigning and preparing to build: steps to additively manufacture mechanical parts

- real cases of optimization and redesign of parts for AM
- live demonstration of QuantAM, a new software tool to prepare files for a Renishaw additive manufacturing process
- orientating, supporting and slicing a 3D model before is manufacture

Thanks for your attention.

For more information visit [www.renishaw.it](http://www.renishaw.it)  
or call us at **0119661052**

