Carbon

From 2D replication…

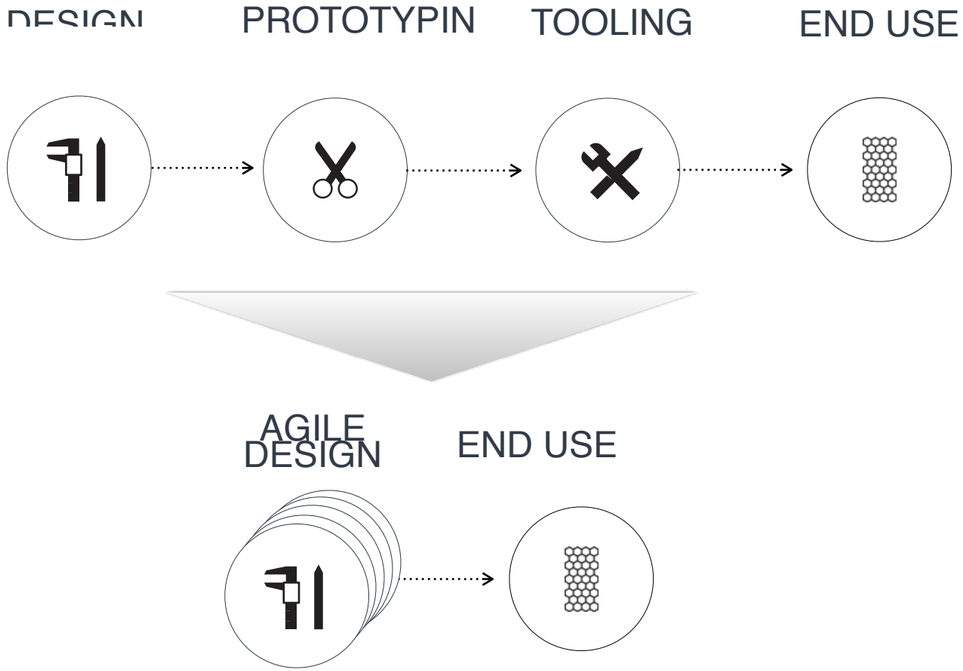
…to digital disruption

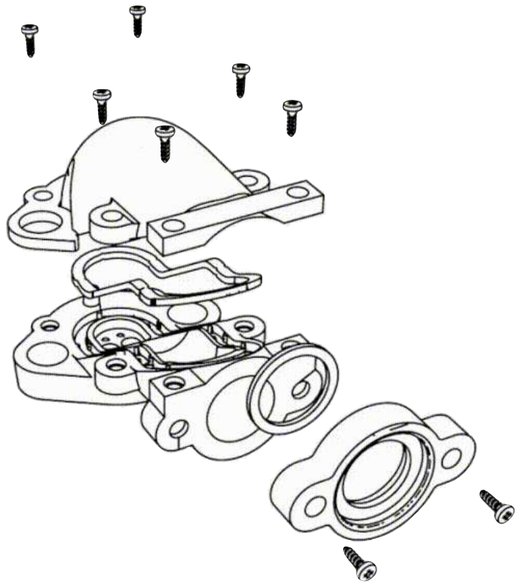
WORLD MATERIALS FORUM

The tyranny of injection molding…

- DESIGN CONSTRAINTS
- LONG LEAD TIMES
- HIGH TOOLING COSTS
- PROGRAM RISKS
- SUPPLY CHAIN COMPLEXITIES

DESIGNING ON THE MEANS OF PRODUCTION





The Need for an Integrated Approach: Manufacturing is Hard!

1

Continuous Printing (CLIP): New 3D Printing Process

- Layerless
- Injection molded qualities
- Surface finish
- US Patent 9,498,920
- US Patent 9,360,757
- US Patent 9,211,678
- US Patent 9,205,601

2

Dual-Cure Materials: New 3D Materials

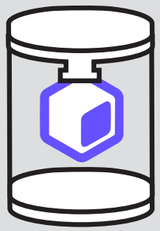
- Wide range of proprietary materials
- Unmatched mechanical properties
- US Patent 9,676,963
- US Patent 9,598,606
- US Patent 9,453,142

3

Modern Software: Securely Connected Architecture

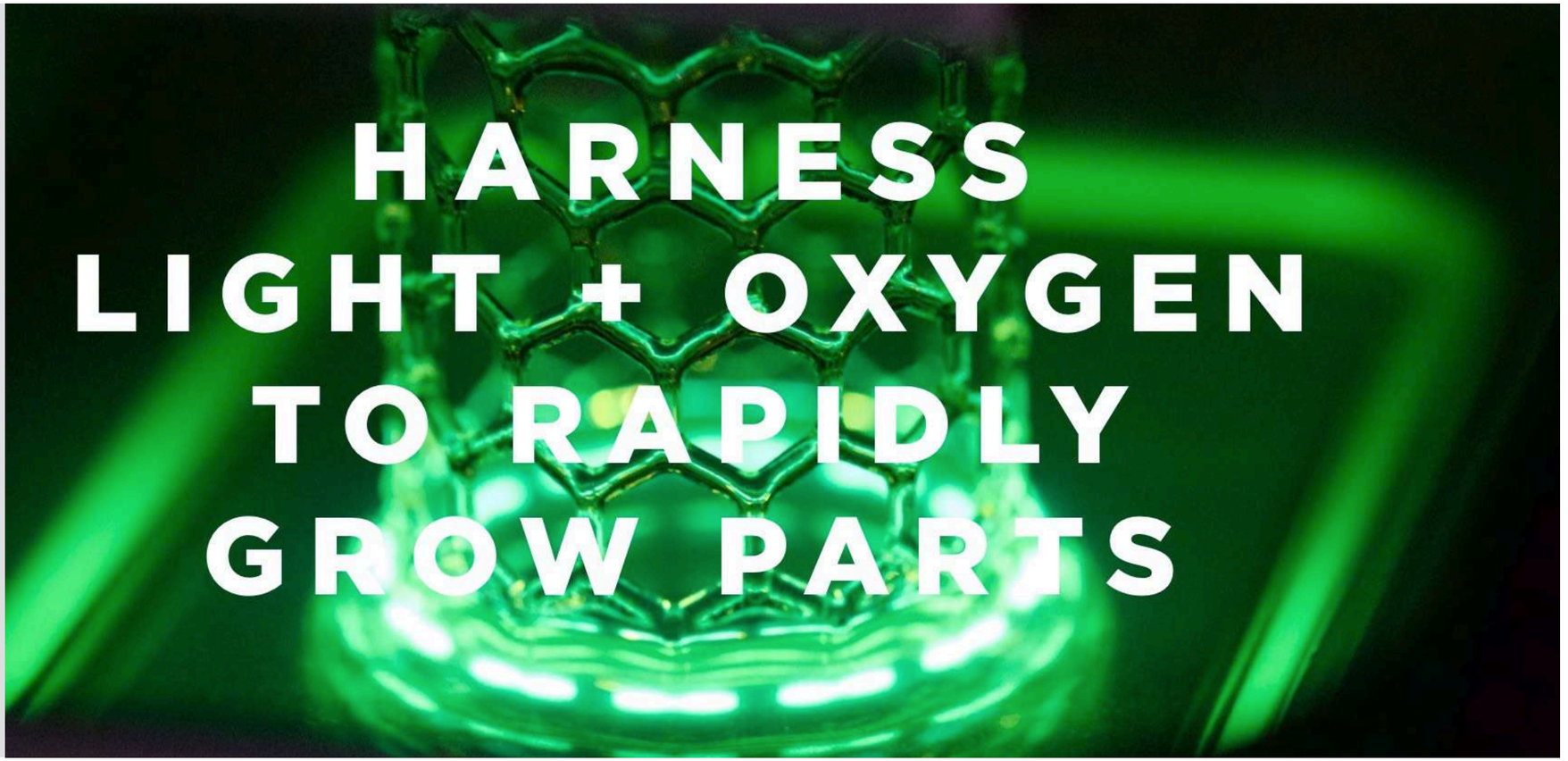
- Cloud-based
- Regular upgrades until production
- Traceability of digital process
- New design tools (lattices, textures)

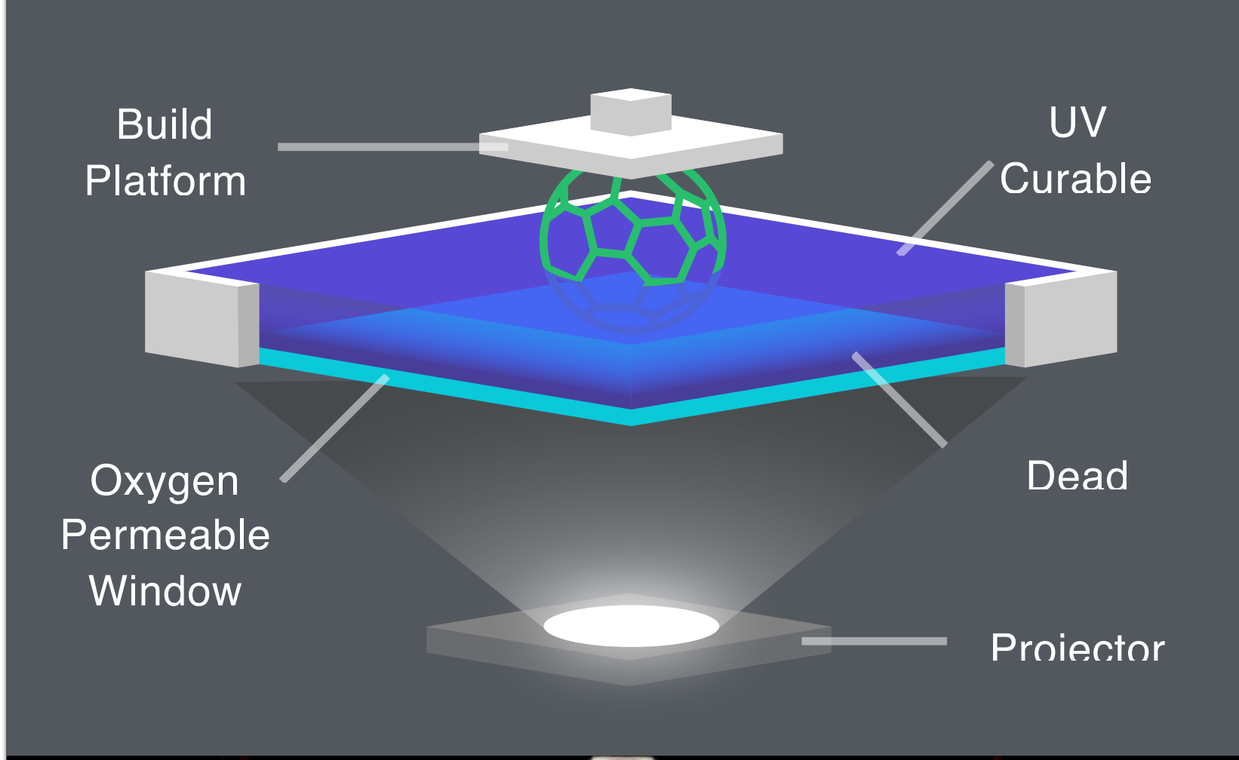
Breakthrough 1 Continuous Liquid Interface Production (CLIP)



CLIP
New 3D Printing Method:

- No layers
- Production-quality properties
- Final quality surface finish





TED

Ideas worth spreading

WORLD MATERIALS FORUM

Breakthrough 2 Dual Cure Programmable Resins

Dual Cure
New 3D Materials Method:

- Game-changing range of material choices
- Proprietary, unmatched mechanical performance characteristics
- US Patent 9,676,963

New Resins = Biggest Lever to Increase Carbon's TAM

2016 - 2017 Resins: General use and Early Adopter Production

2018 - 2019 Resins: Validated Production Focus

EPX - connectors

FPU - enclosures

CE - fluidics

RPU - nozzle

EPU - foam replacement

SIL - padding

Surgical guides

DPR - models

EPU - midsoles

Auto

Dental

Medical

Aero

Digital Sustainability

Dematerialization

Material

Renewable Feedstocks

Recyclable Breakthroughs

Digital Inventory
“Smart manufacturing”
Collection /
Recyclability

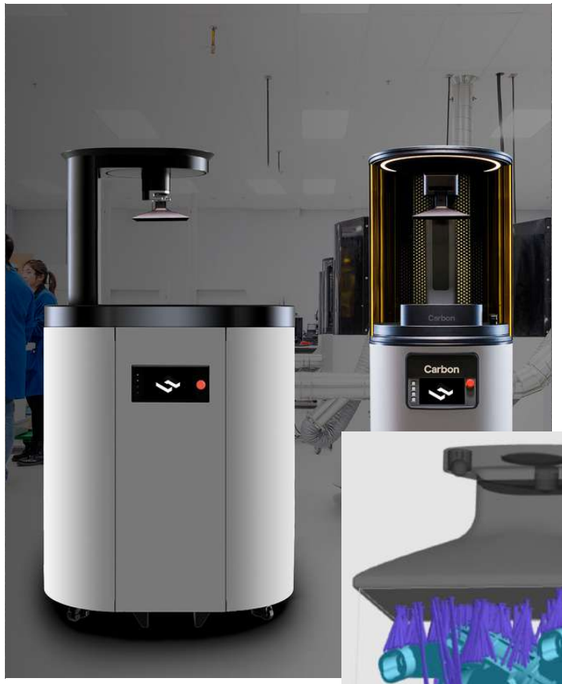
Recyclable / Compostable

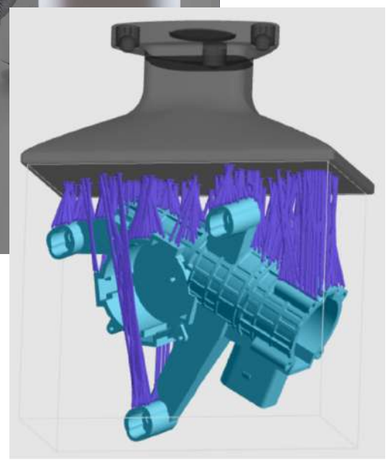
WORLD MATERIALS FORUM

3

Software Enabled

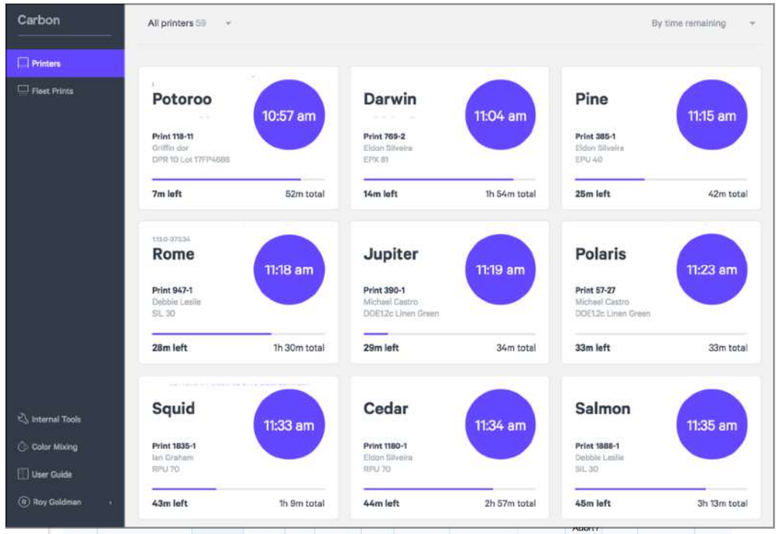
PRINTING & WASHING





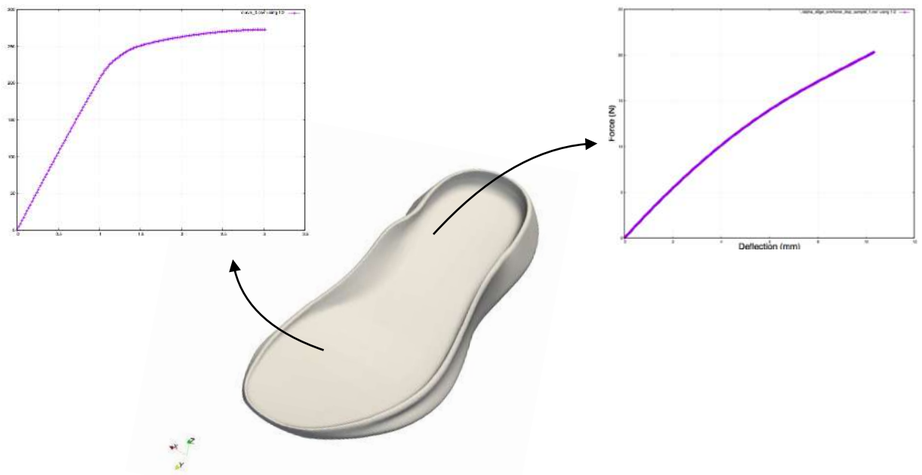
FEA, DESIGN TOOLS & PART SERIALIZATION; EMERGING AI AND M

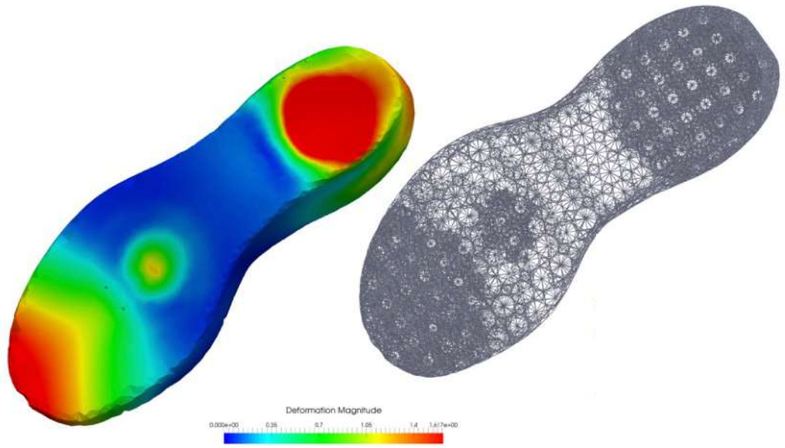
FLEET & FACTORY MANAGEMENT +

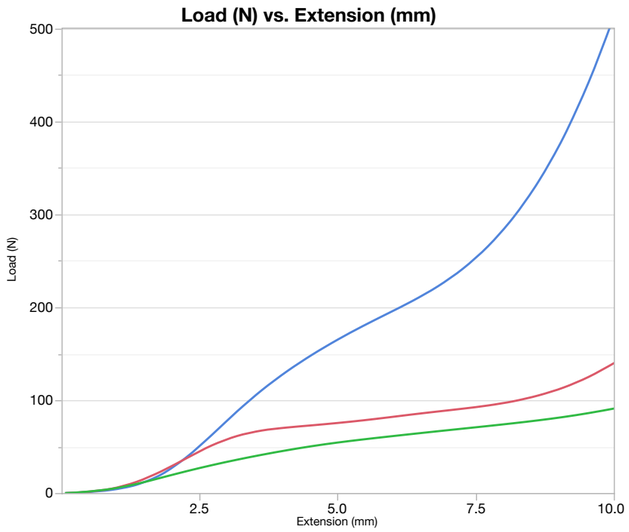


WORLD MATERIALS FORUM

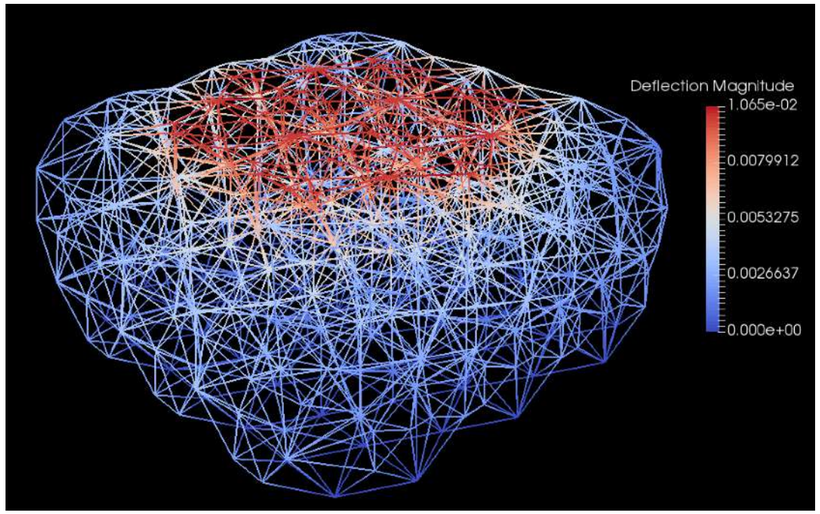
Computer Aided Lattice Design







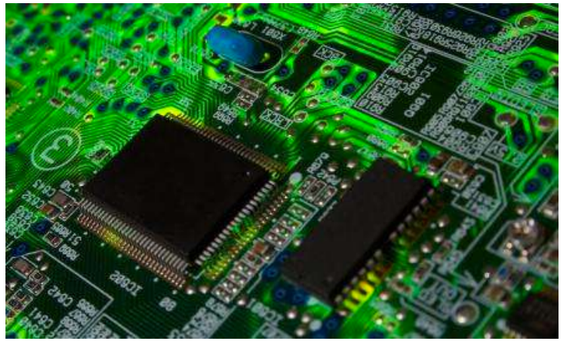
FEA @ Carbon



STOP PROTOTYPING. START PRODUCING.

WORLD MATERIALS FORUM

Applications across multiple manufacturing sectors



CONSUMER

INDUSTRIAL / AUTOMOTIVE / AEROSPACE

MICROELECTRONICS

LIFE SCIENCES

WORLD MATERIALS FORUM

Carbon + the Consumer Products Industry

Functional Surface Textures
[Aesthetics]

Constant Force Lattice
[Headband]

Soft Materials
[Wearables]

Impact Absorbing Lattice
[Foam Replacement]

Impossible Geometries

Multiple Functional Zones

Latticed + Textured Geometries

Flexible Clips
[Snap Fit]

Brackets
[with Hinges]

Comfort
+
Performance
+
Safety
+
Aesthetics

adidas Futurecraft 4D

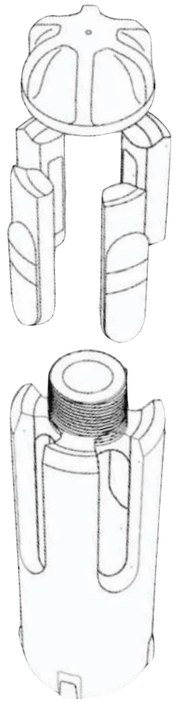
- Breakthrough design and performance
- 10x number of design iterations
- Scale up:
  - 100,000+ pairs in 2018
  - millions in 2019+
- Path to mass customization

“With Digital Light Synthesis, we venture beyond limitations of the past, unlocking a new era in design and manufacturing. One driven by athlete data and agile manufacturing processes.”

— Eric Liedtke, adidas Group Executive Board Member Responsible For Global Brands

VITAMIX RINSING NOZZLE

Legacy 6-part design



New single-part design

Tens of thousands deployed in stores across the U.S.

Description:

- Vitamix was looking to produce a durable microfluidic nozzle to rinse their commercial blenders in stores across U.S.

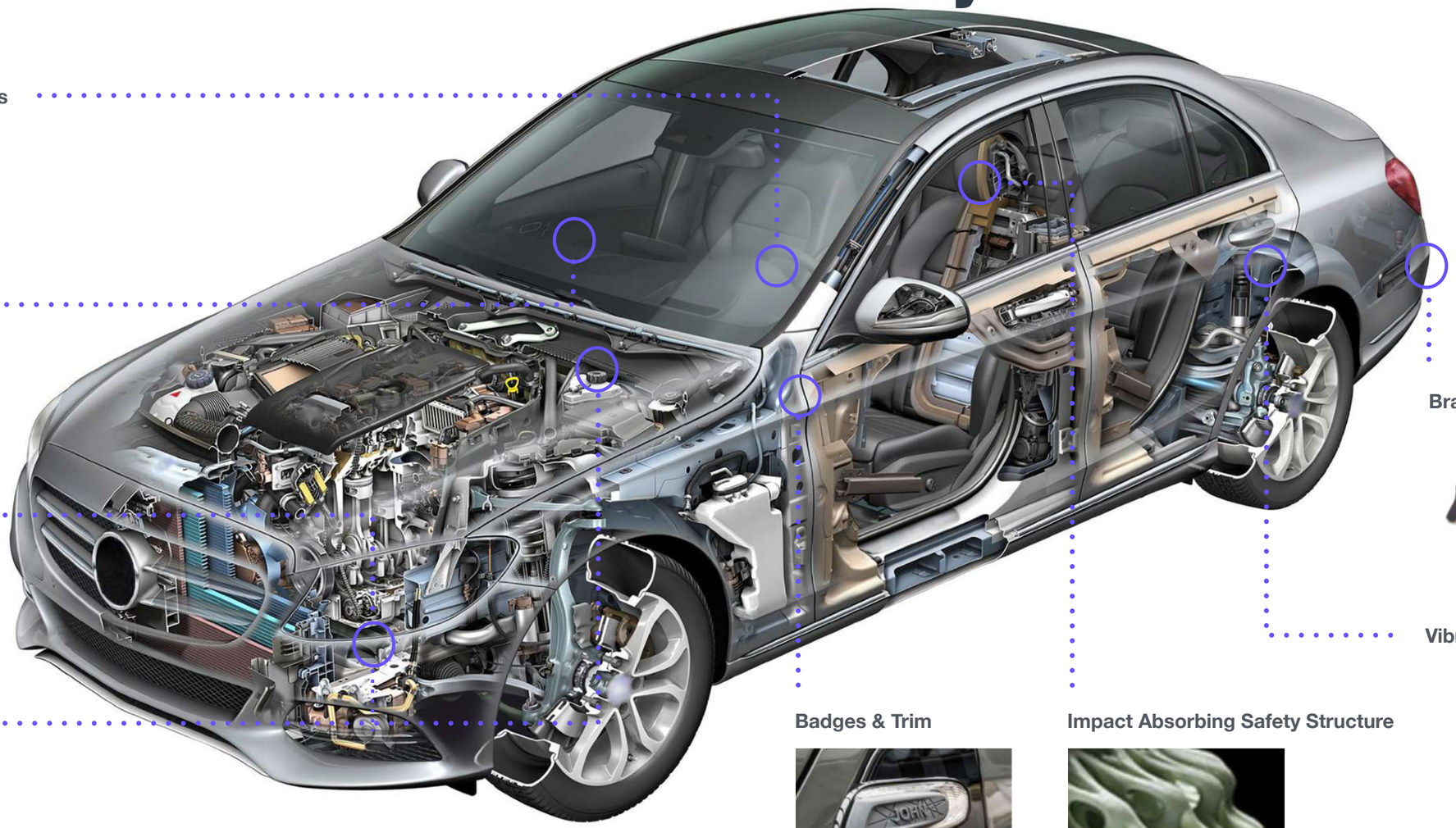
The challenge:

- Traditional injection molding design used 6 parts
- Potential durability challenges due to multi-part assembly
- Ability to perform in environments with bleach and other sanitizers

The solution (in partnership with TTH and Carbon):

- 10x durable: Passes 1.5 million rinse cycles in field testing, offering excellent resistance to bleach and other sanitizers
- 30% less material: Design freedom to make single 3D-printed part using Carbon's RPU material
- 33% more economical: FEA optimized design is lighter, requires no tooling, and secondary operations

Carbon + the Automotive Industry



Functional Surface Textures

Speaker Grills

Electronics Housing

Air & Fluid Routing

Badges & Trim

Impact Absorbing Safety Structure

Brackets & Mounts

Vibration Dampening

Many companies in the transportation industry, including companies like John Deere and Caterpillar, offer lifetime spare parts for all their products. The physical storage of spare parts requires:

- Large facilities
- Climate control
- Maintenance
- Quality control on shelf life
- Periodic re-stock
- Up-keep on tooling
- Transport

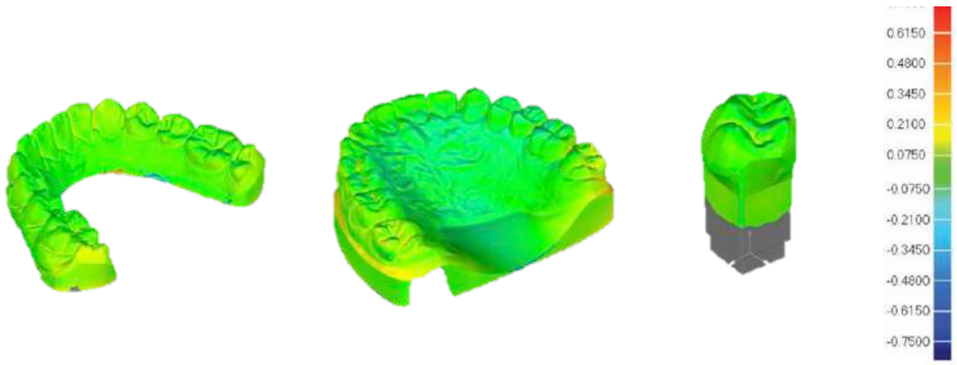
> “On any given day, 2% of the world’s GDP can be found in UPS delivery trucks or package cars.”
>
> Thomas L. Friedman
>
> in *The World Is Flat*

Warehouse in the Cloud

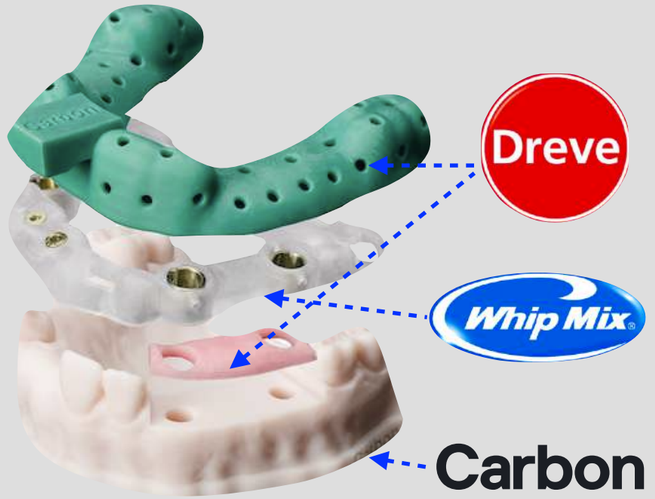
On-demand local manufacturing

ccelerating into Dental Production

- End-to-end dental solution
  - High-speed M Series printers
  - Materials that deliver accuracy
  - Software capabilities and OTA upgrades



New Certified Resins for Carbon



Carbon

Carbon Complete Solution Model, Gingiva Mask, Surgical Guide & Impression Tray

DENTCA™
CAD/CAM DENTURE

First FDA-cleared (Class II) 3D Printed Denture Base & Teeth

Industry-first:
Subscription Model for Hardware, App Store for Resins

SpeedCell & Service

M2: $50K/year, 3yr subscription

Smart Part Washer: $10K/year

All-inclusive predictive service

Purpose-built mass manufacturing solutions

“App Store” for Resins

7 Production Resins

3rd-party resin platform

Bespoke manufacturing resins

Software

Performance and capabilities always improving: regular updates

Industry-first digital design tools

Provenance and tracking

Connected intelligence drives

Digital Fabrication promises new markets

Future of

THE PROMISE OF 3D MANUFACTURING

- On demand inventory
- Impossible Geometries
- Mass customization
- Design freedom
- Flexible factory
- Local for local production
- Digital traceability
- Production as a service

BARRIERS

- No true Digital Fabrication
  - Substandard

Digital Fabrication unlocks new value creation

Future of

CARBON

The unmake-able, isn’t.
End use parts.
Economical.
Manufacturing scale.

3D MANUFACTURING

- On demand inventory
- Impossible Geometries
- Mass customization
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WORLD MATERIALS FORUM