Generative Design and Fabrication:

A One Touch Experience for Additive Manufacturing

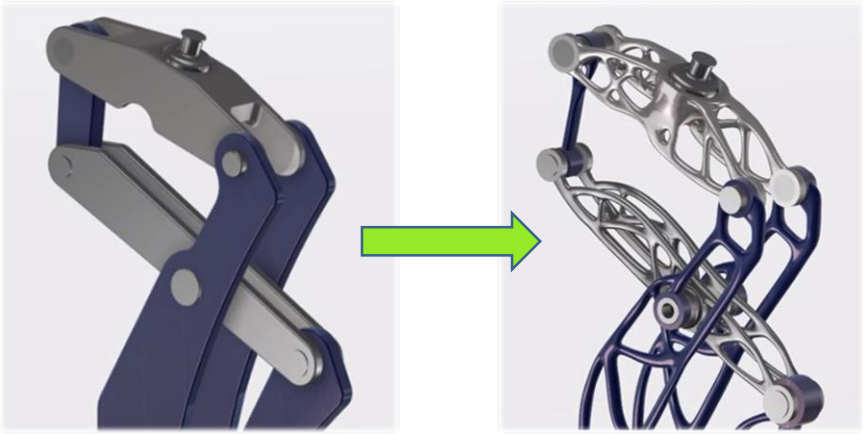
Andy Kalambi / Colin Swearingen
RIZE / Lightweight Engineering
Dassault Systemes

WHAT is Generative Design?

A New Way to Design

Traditional Design:

- Based on established practices
- Based on designer experience
- Leverages existing design iterations



Generative Design:

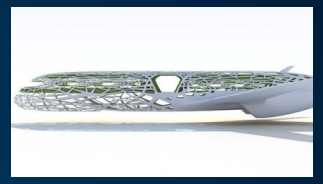
- Optimal design is computer-generated
- Requirements driven
- Results based on the function of the part

Rather than asking, "*Does this shape meet the requirements?*" we are asking, "*Which shape best meets the requirements?*"

- http://www.cimdata.com/en/resources/cimdata-blog/item/8402-generative-design-what-s-that

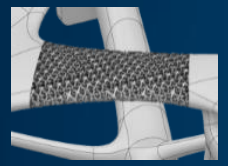
Engineering in the age of Experience | Towards Cognitive Augmented Design (CAD)

Neuro Systems Engineering - AI



Experiential Engineering

Knowledge-based Engineering



Exact Design

Exact Geometry

Automated & Intelligent Guided Design

1. **Generative Design (Experience driven)**

2. **Generative Design (Leveraging Enterprize patrimony)**

Rule-based Automation

Multi-discipline Template-based Automation

Learning-based Automation

V4 | **V5** | **V6**

3DEXPERIENCE PLATFORM
Big Data-Centric, Revealing Patrimony, Guided Creativity

1999 — **Past** — 2009 — 2014

DASSAULT SYSTEMES | The 3DEXPERIENCE® Company

The Path to Intelligent Parts

Digitally Augmented

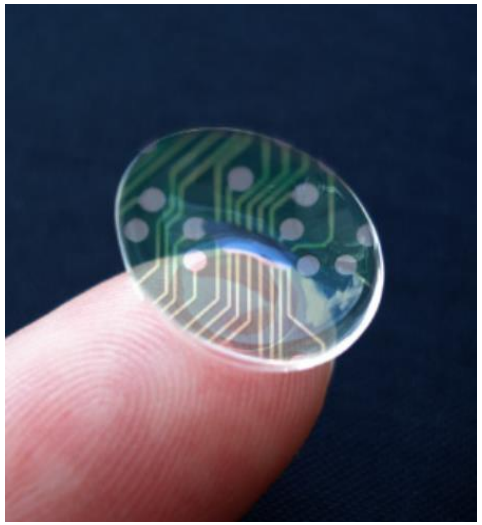
- ✓ Industry 4.0 Technologies

  Blockchain / AR/VR/ Digital thread/digital twin

Cognitive Augmented

- ✓ Generative design acceleration

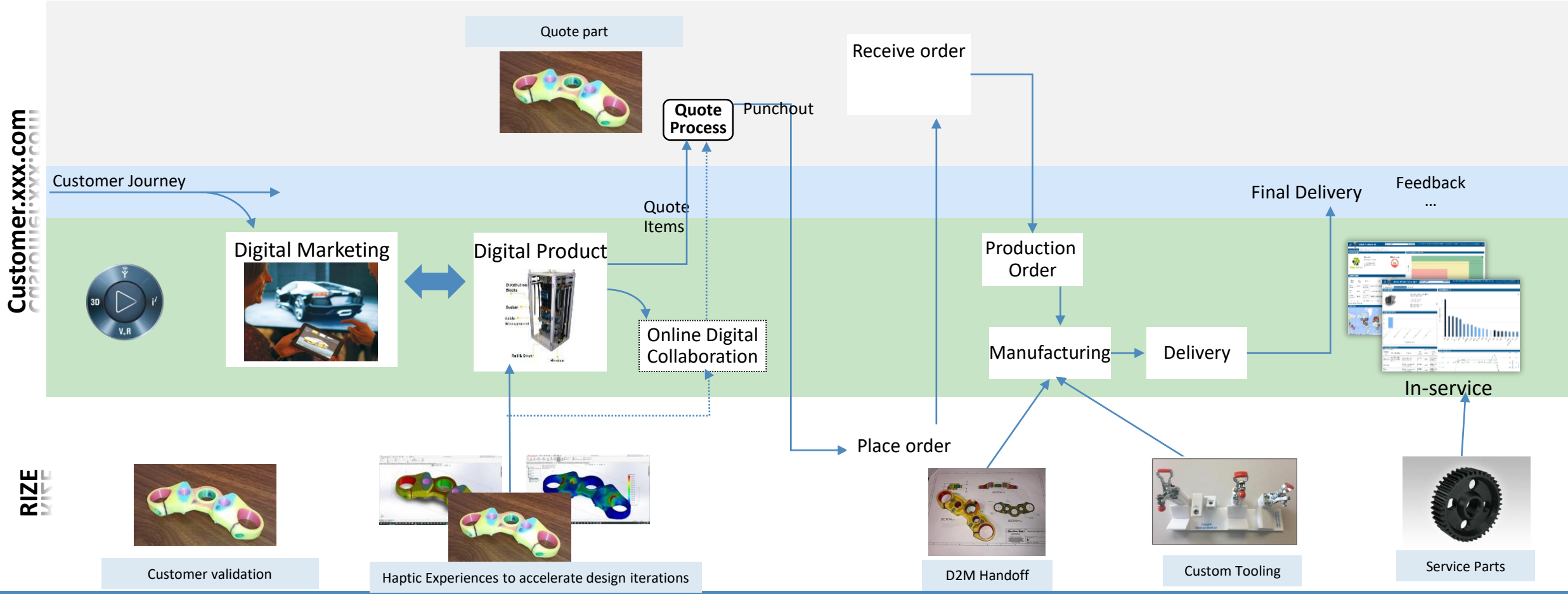
Intelligent parts

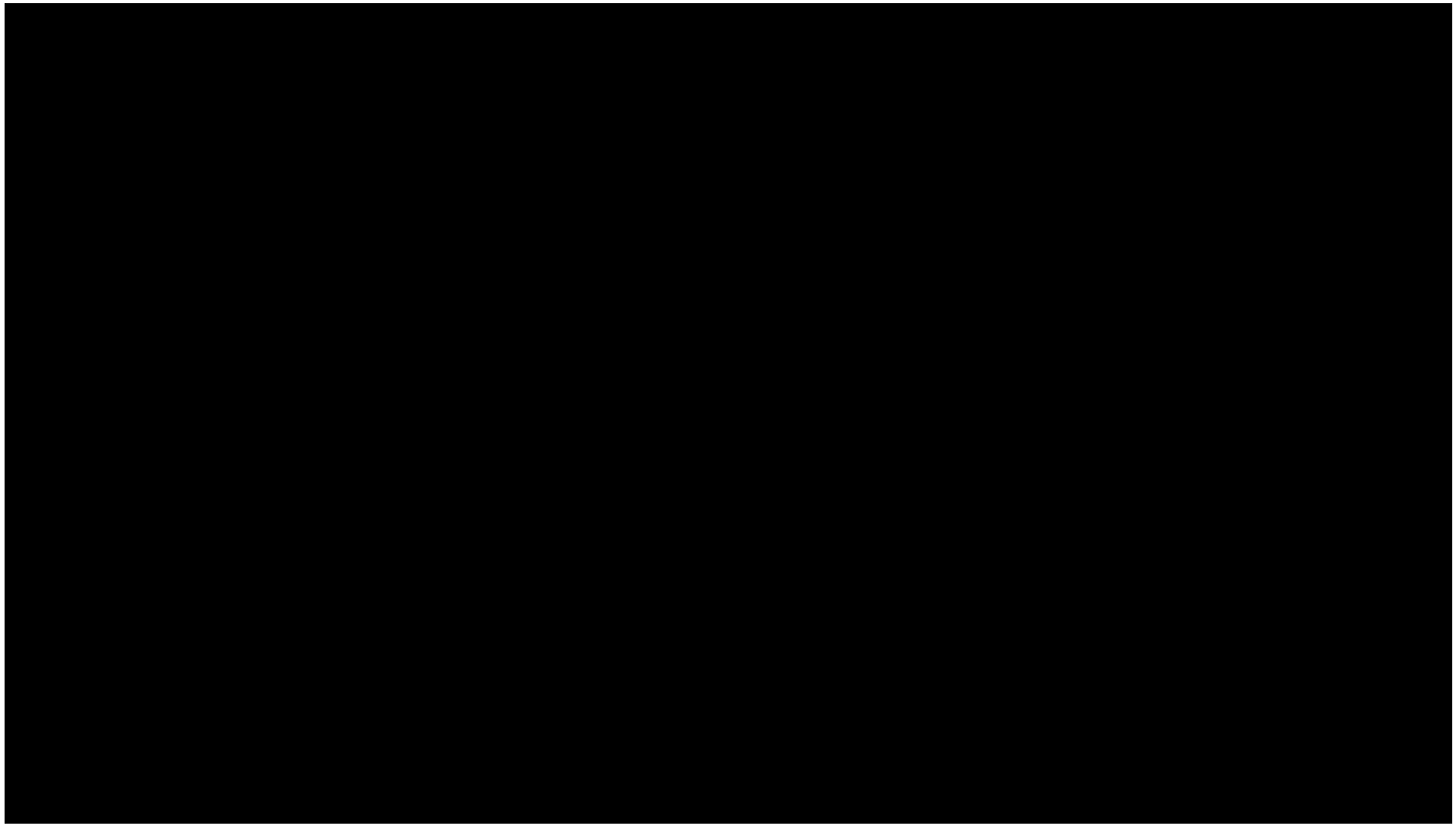


- ✓ Embedded sensors, actuators in 3D Printed parts

Intelligent Parts journey

1. Increase Sales with 3D Printed Parts and Digital Quotes
2. Complete Designs Faster by 20%
3. Cut tooling Costs with custom jigs/fixtures/tooling
4. Increase equipment uptime with service parts





RIZE – Building momentum

*"Rize is the **#1 startup driving innovation in 3D printing.**"*
-American Society of Mechanical Engineers

Company

- Growth stage; VC funded; HQ in Boston
- Experienced leadership from 3D Printing, CAD, ERP/PLM
- Unique patented technology
- 100+ systems in 15 countries
- Customers in Auto, A&D, Life Sciences, Education
- Strategic partnership with Dassault Systemes

Partnerships

Lighthouse Customers

Industry Recognition

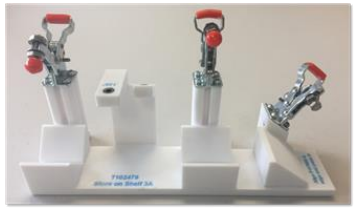
"IDC Innovator 2018"

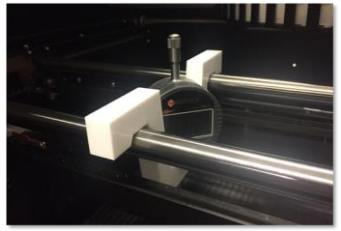
3DS/RIZE– creating Smart Spaces

Smart Spaces

"Connected, interactive and intelligent environments"… Gartner

- **Intelligent parts in design, manufacturing and service**
- **Digitally connected and Augmented experiences**
- **Sustainable and inclusive innovation**





Digital Thread

RIZE – Platform for creating intelligent parts

Full Color and multiple materials

Simplicity - minimal post processing, ease of use

Safety – zero emissions; people-safe, environment safe

Intelligent parts– marking; authenticity; augmentation

Color / Carbon – new applications; new users; new industries

Industrial 3D Printing – made easy

5+ stakeholders + 3-6 weeks per iteration

Need expert users Investment in additional facilities

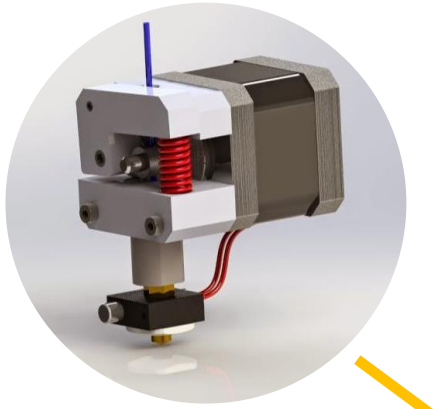
1 person; quick turnaround

1/3rd the cost; much less time

APD Voxel level control printing leveraging industry first hybrid process

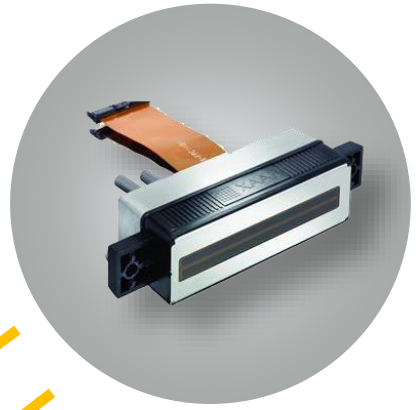
MATERIAL EXTRUSION

RIZIUM ONE

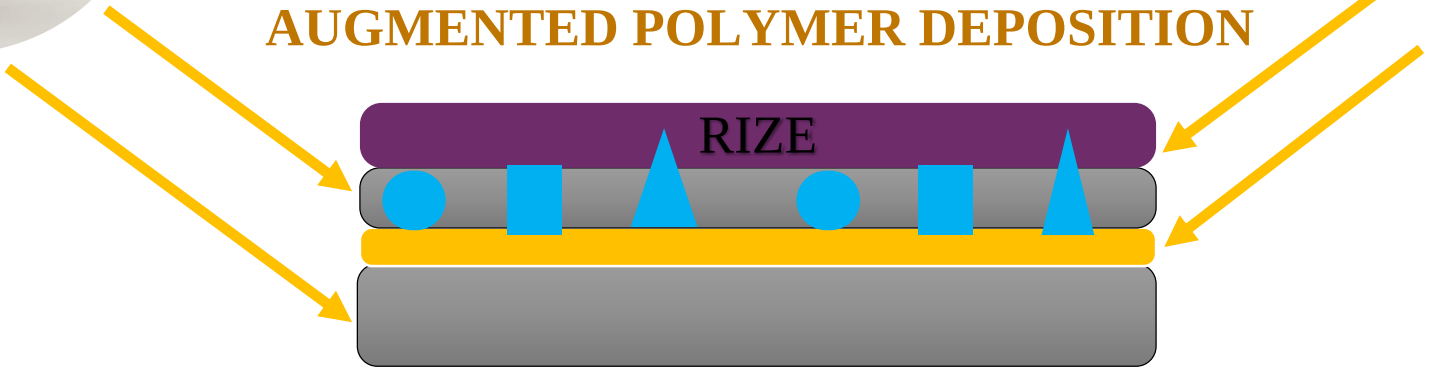


MATERIAL JETTING

SPECIAL INKS



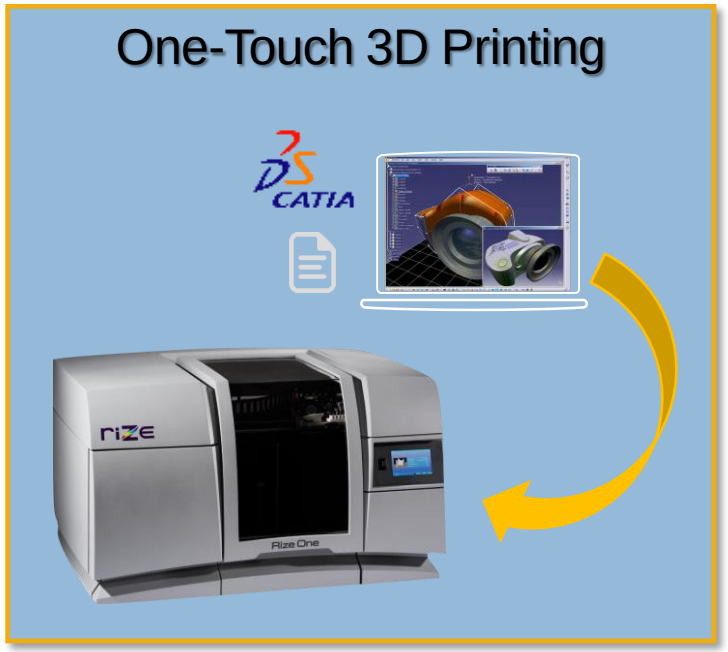
AUGMENTED POLYMER DEPOSITION

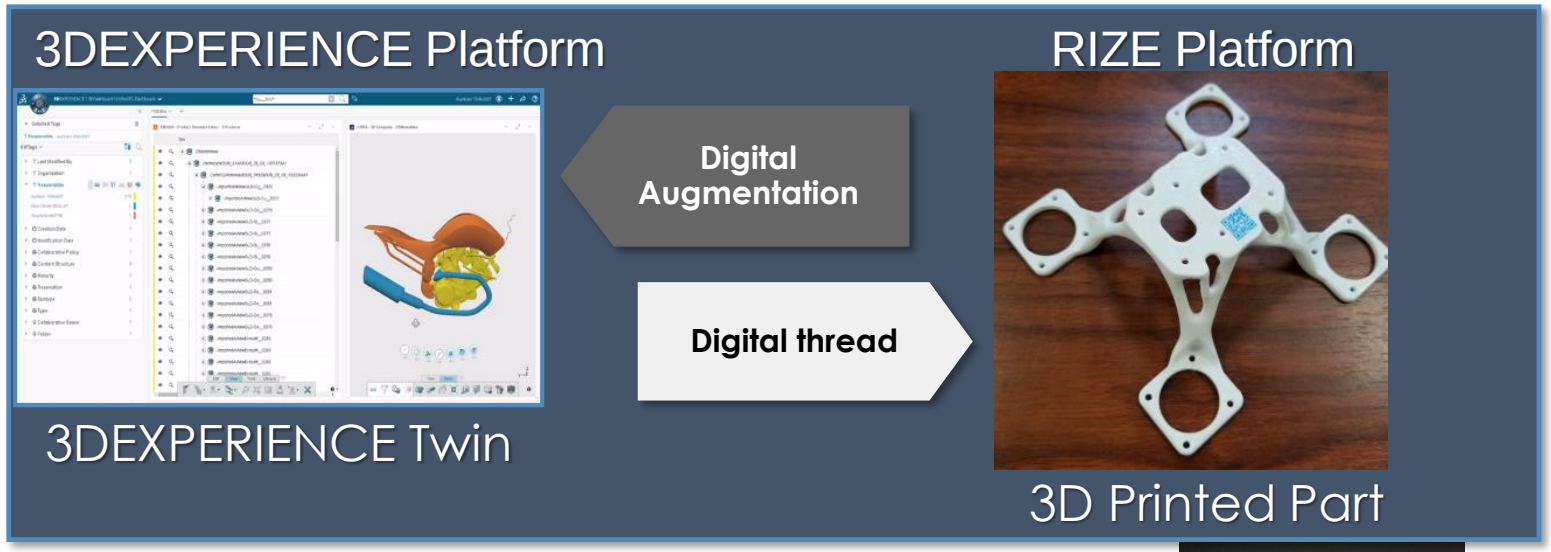


US Patent 9227366 Process for fabrication of three-dimensional objects
US Patent Application 20160096324 Process and Apparatus for fabrication of three-dimensional objects
US Application No.: 62/381,300 Method of fabricating a three-dimensional object with removable support structure

INDUSTRY 4.0 Applications

Digitally connected 3D Printing





Digital augmentation

Leverage AR/VR ; Block chain

Digitalize value stream processes

3DEXPERIENCE

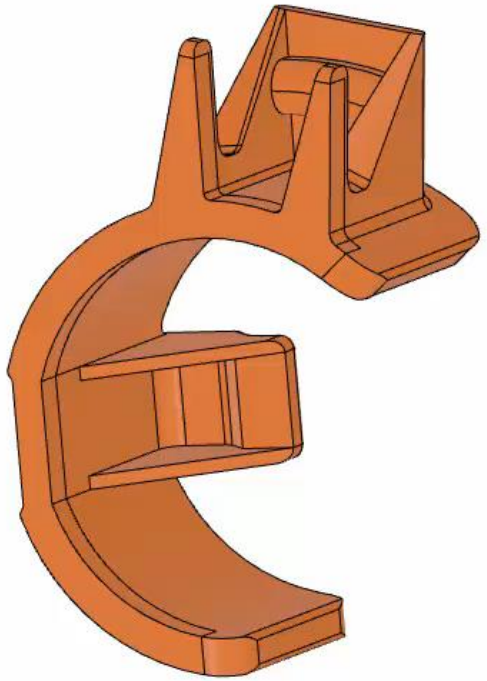
3DEXPERIENCE | CATIA Functional Generative Design

Search

Brayley BAZZELLE
GDE Projects

Sim_demopart v4

- Sim_demopart v4
  - Model
    - demopart v4 A.1
      - demopart v4 A.1
        - xy plane
        - yz plane
        - zx plane
        - Axis Systems
        - PartBody
          - Fillet15
          - Solid Partition.1
        - Geometrical Set.1
      - FEM of Design Space Analysis.1 A.1
      - Materials
  - Scenario
    - Design Space Analysis.1
    - Topology Optimization Case.1
  - Result
    - Result Of Design Space Analysis.1
    - Result Of Topology Optimization Case.1



Exploration Assistant

Design Space Analysis.1

- Design Space Setup
  - Design Space
  - Functional Regions
- Meshing Setup
- Analysis Setup
- Setup Validation
- Targets
- Constraints
- Shape Controls
- Concept Shape
- Design Validation

Standard | Design Study | Design Space | Analysis Setup | Free Shape Design | Parametric Design | Milling Reconstruction | Shape Review | Detailed Refinement | View | AR-VR | Tools | Touch

Cut | Copy | Paste | Undo | Update | Exploration Assistant | Model | Diagnostic Viewer | Material Palette | Natural Shape | Remove Face | Defeaturing | Positioned Sketch | Fill | Sew Surface | Partition Design Space | Axis System | Body | Geometrical Set...

Select an object or a command

Rize – Intelligent parts

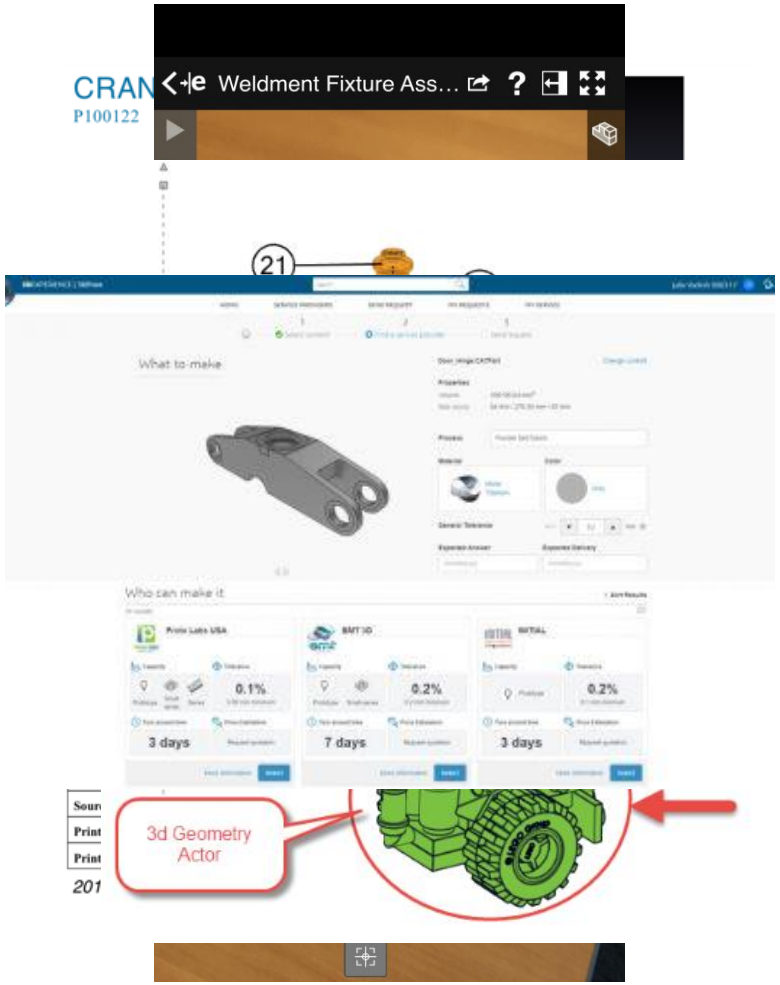
Embedded in Innovation Process

Digitally Augmented Parts
Connect to PDM/PLM/ERP

New Experiences
AR/VR/MR

Assembly Instructions
Service Instructions

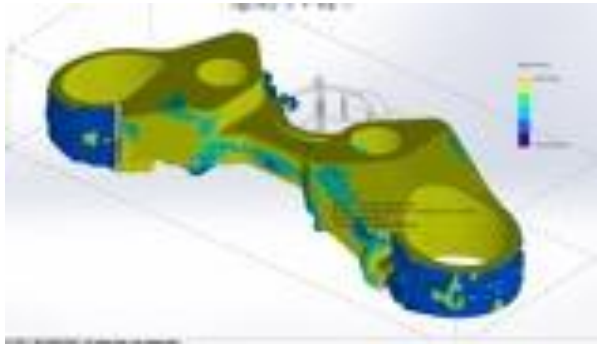
Marketplaces



Smart Spaces with RIZE

Product Innovation

- Accelerate time to part with faster iterations
- Increase Product Performance
- Generative shapes – new & lightweight designs



SI2 Technologies

CHALLENGES

SI2 wanted one machine that could combine 3D printing and ink jet printing capabilities.

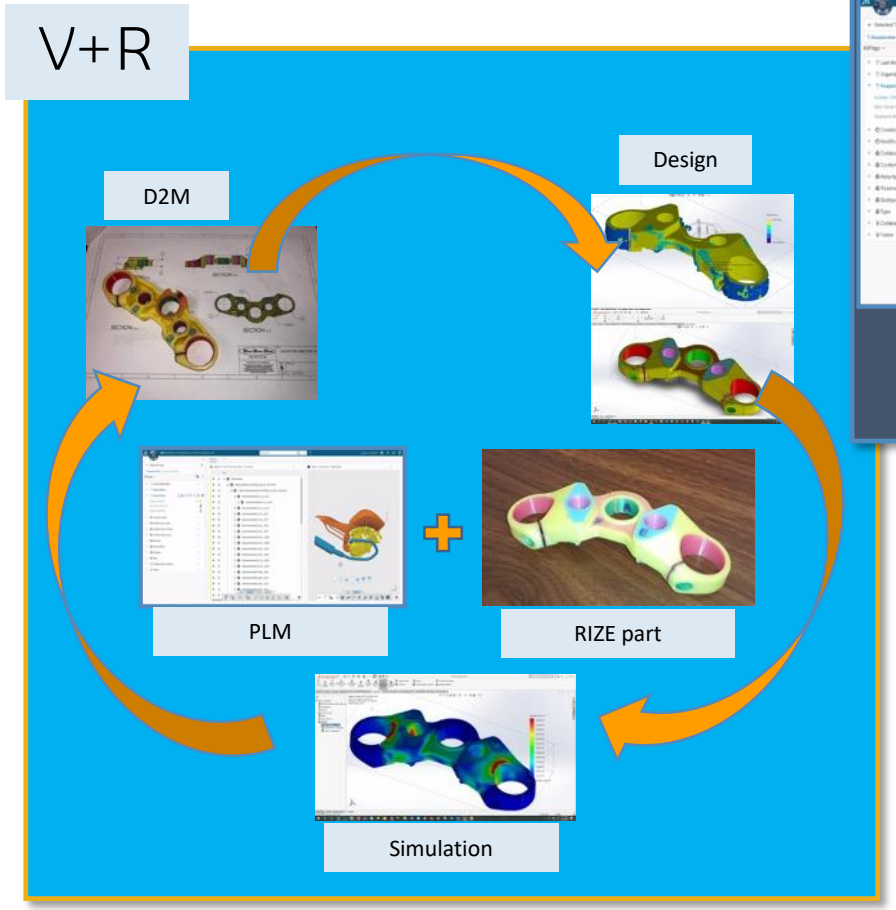
SUMMARY

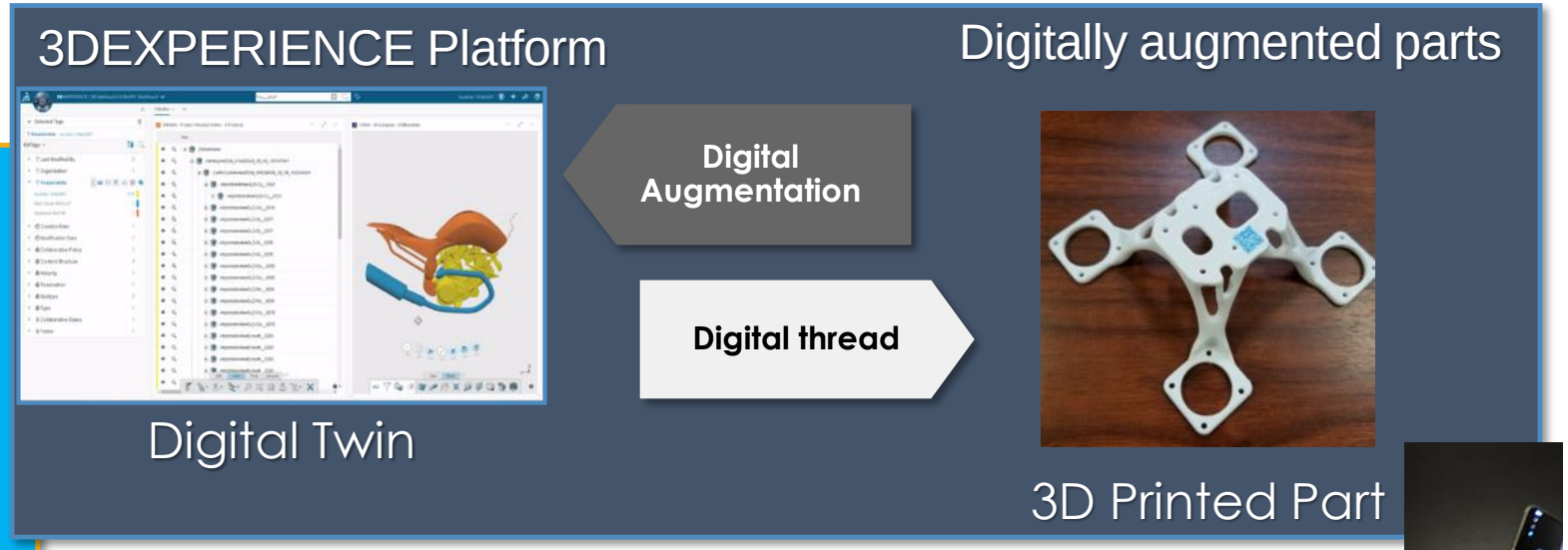
SI2 produces functional parts for the Department of Defense with their RIZE ONE 3D printer up to 6X faster and at a cost savings of $2K per part.

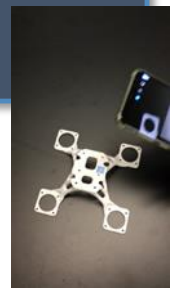
RESULTS

- $2K savings per part
- 6X faster time to part
- Easy post-processing on complex parts
- Highly accurate parts of an assembly for a precise fit
- Ink marking provides improved communication

Smart Spaces with RIZE





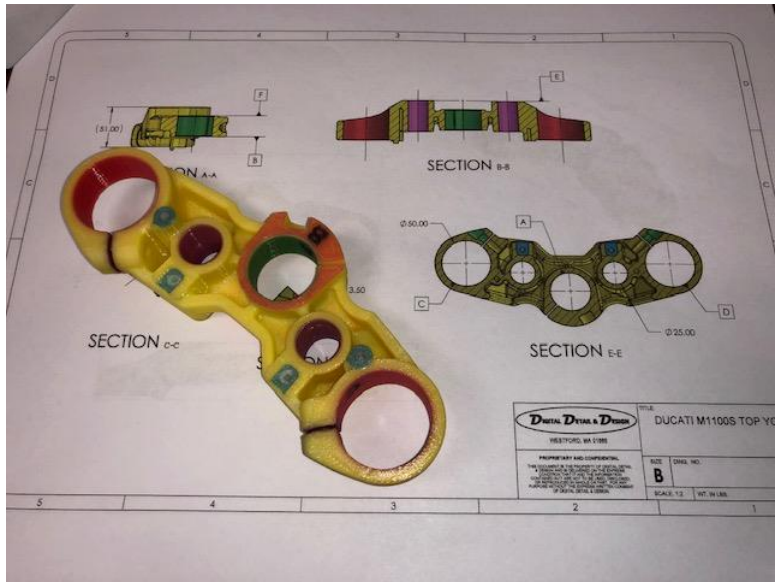


- **Smart Spaces for Product Innovation**
- **Smart Spaces for Manufacturing Innovation**
- **Smart Spaces for Service Innovation**

Smart Spaces with RIZE

Manufacturing Innovation

- Faster and flexible manufacturing Process
  - Design to manufacturing handoff
  - Zero setup time
  - Assembly consolidation
  - Low cost setup
- Lower cost of custom tooling, jigs and fixtures



New Hudson Facades

CHALLENGES

New Hudson Facades wanted to speed production, cut costs and increase product quality without incurring the high cost of hiring or training 3D printing specialists or building specially-equipped additive manufacturing facilities.

SUMMARY

NHF's CNC users operate RIZE ONE 24/7 in an office to save $200K annually, increase production speed 15% and inspection frequency 5X within the same timeframe.

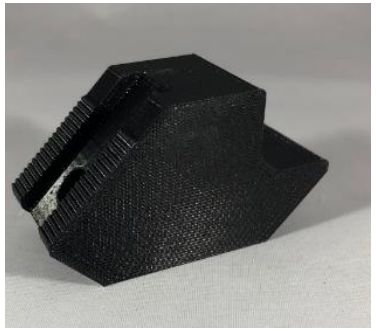
RESULTS

- 15% increase in production speed
- 5X reduction in inspection time
- $200K savings per year on fixture costs
- Improved production accuracy
- 50% reduction on assembly inspection times

Smart Spaces with RIZE

Service Innovation

- Spare Parts Management with 'Take One Make One'
- Simplified Supply Chain
- Streamlined Sales Process
- Elimination of Obsolete Parts



Azoth

CHALLENGES

PSMI wanted to find a better solution for sourcing machine spare parts. Orders are traditionally very costly due to small-batch quantities, and needed quickly. Parts can be difficult to source because they are old and OEMs have gone out of business or parts became obsolete and prints do not exist.

SUMMARY

PSMI created a wholly-owned subsidiary, Azoth, to provide its customers with on-site AM solutions. Azoth partnered with RIZE to build digital tool cribs. Manufacturing parts together on demand eliminates bottlenecks and saves money.

RESULTS

- Reduced some part costs by as much as 98%
- Cut lead times by as much as 8 weeks
- Ink marking capability ensures full traceability
- Safe, easy production of industrial parts provides compliance with plant safety policies

Innovation with Smart Spaces

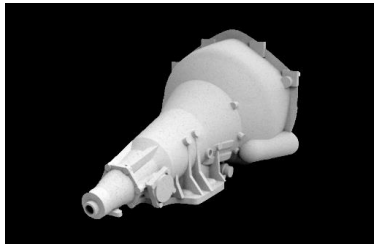
Increase Sales

Why Additive:
1. New Customer Experience for sales
2. Replicate and augment in service parts
3. Worldwide sales team demoes with printed parts shortening sales cycle

Why Rize:
1. Safe and Easy operation by non technical employees – sales and marketing
2. Accurate replication & Fastest time to part
3. Branding with Marking Inks

Complete Designs Faster

Why Additive:
1. Faster iterations of prototypes
2. Haptic Experiences
3. Functional prototypes to test product



Why Rize:
1. Minimal post processing enables faster time to part – more iterations for the design engineer
2. Marking of parts enables full traceability
3. Marking of parts enables multiple iterations to be printed and tested simultaneously

Reduce Manufacturing Costs

Why Additive:
1. Increase life of critical tooling
2. Custom jigs and fixtures
3. Increase uptime of equipment through replacement of critical parts

Why Rize:
1. Print tool holding arbors with marking to enable better storage and increased life
2. Print custom jigs and fixtures with marking and QR codes to ensure proper usage
3. Print critical spare parts/obsolete on demand

Questions

Diversity of Applications/Parts