3DEXPERIENCE®

PRINT TO PERFORM

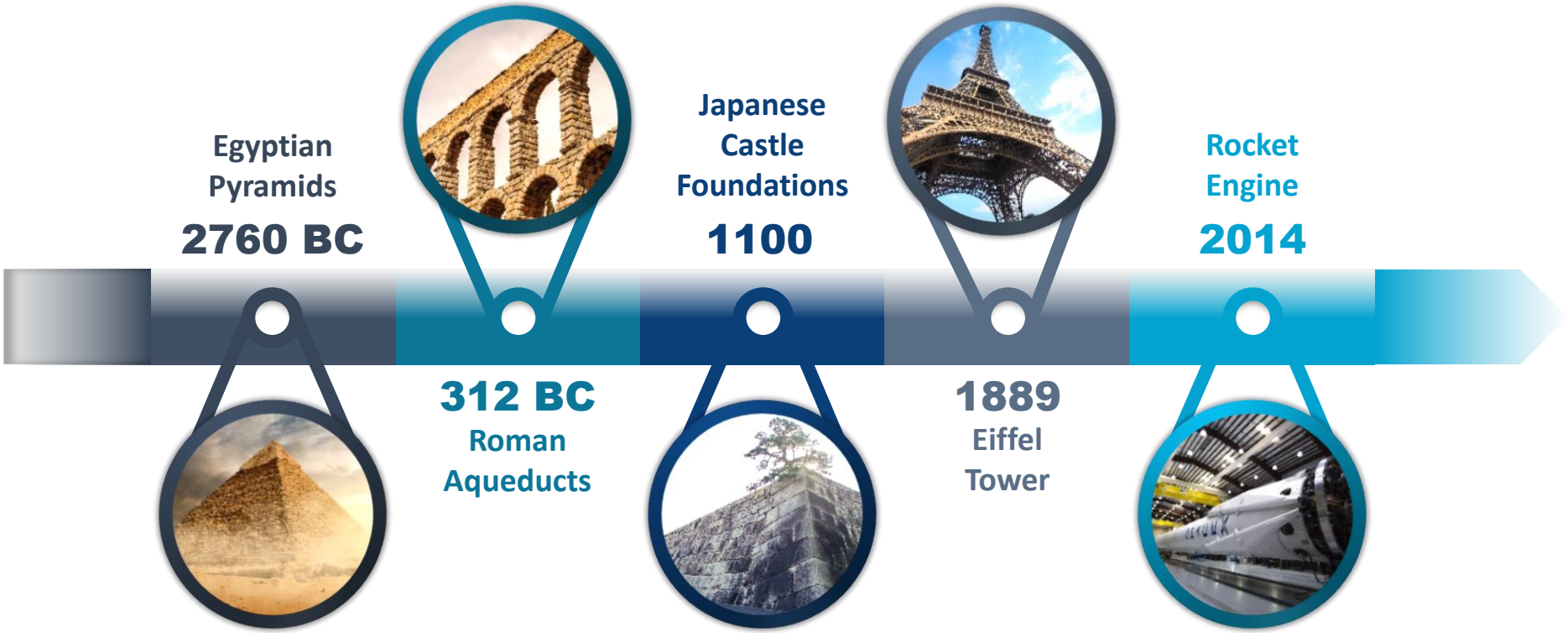
2.0

THE GUIDE TO DIGITAL ADDITIVE MANUFACTURING

The Journey of Additive Manufacturing

DASSAULT SYSTEMES

Additive Manufacturing Is Not New



AM Opportunities

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AM Challenges

In Design

- Can the part be made of metal, plastic, ceramic, …?
- Can we achieve directional stiffness?
- Can we make the part 50% lighter and 50% stiffer?

In Manufacturing

- How many parts per hour can we make, with a UTS of 900MPa?
- What is the off-line impact on production?
- Can we do THIS design with THAT material?

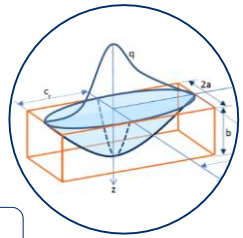
In Quality

- Is it possible to make spare parts on-site?
- Is it possible to guarantee durability?
- What are the consequences of a potential failure?

AM Simulation Strategy

Physics

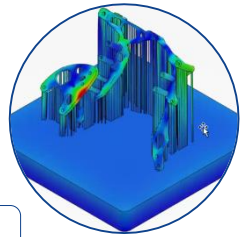
Material Modeling
Process Specifics



1

Simulate

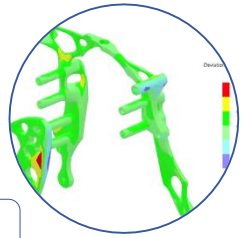
Stresses
Distortions
Tolerances



2

Calibrate

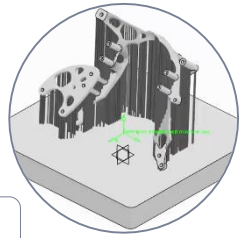
Close the Gap between design and build



3

Process

Product Quality
Customer Experience
ROI



4

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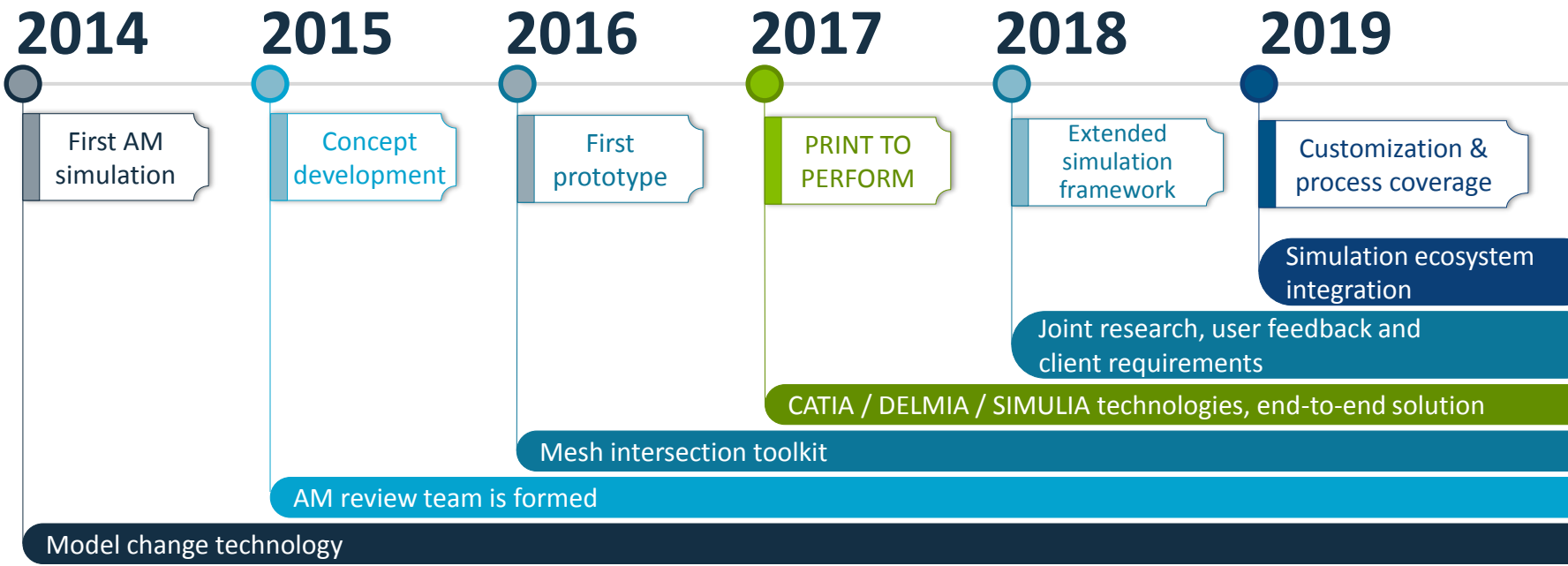
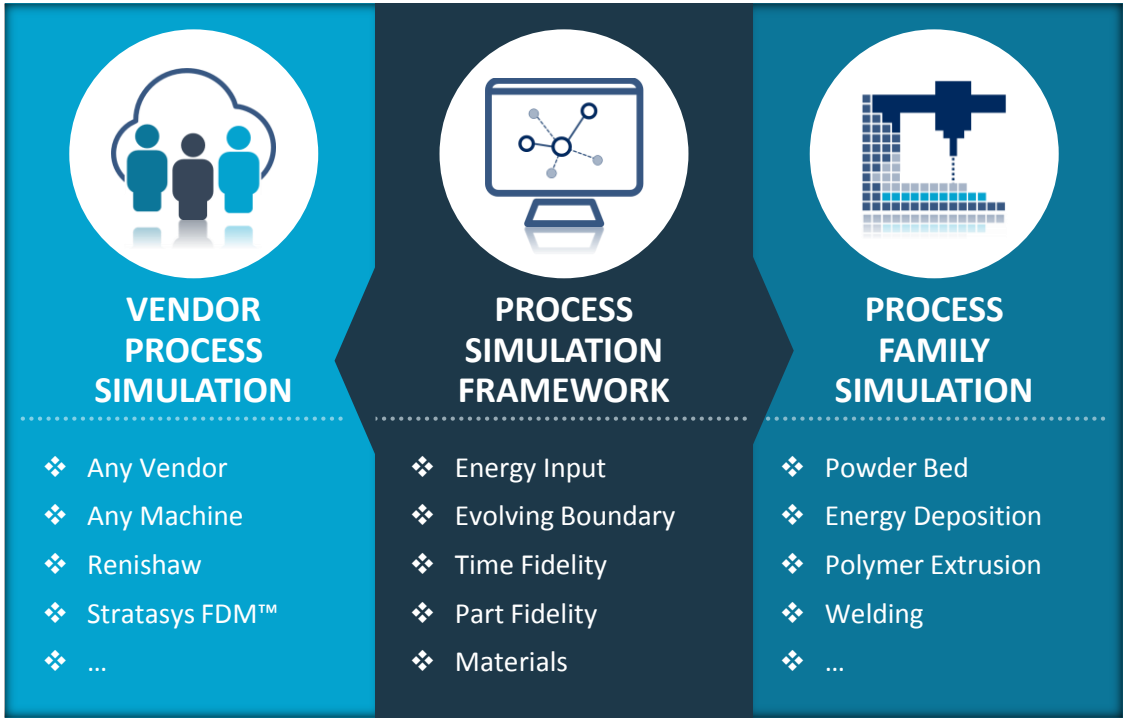
The Print To Perform Legacy



The Simulation



What is the **3D**EXPERIENCE Platform?

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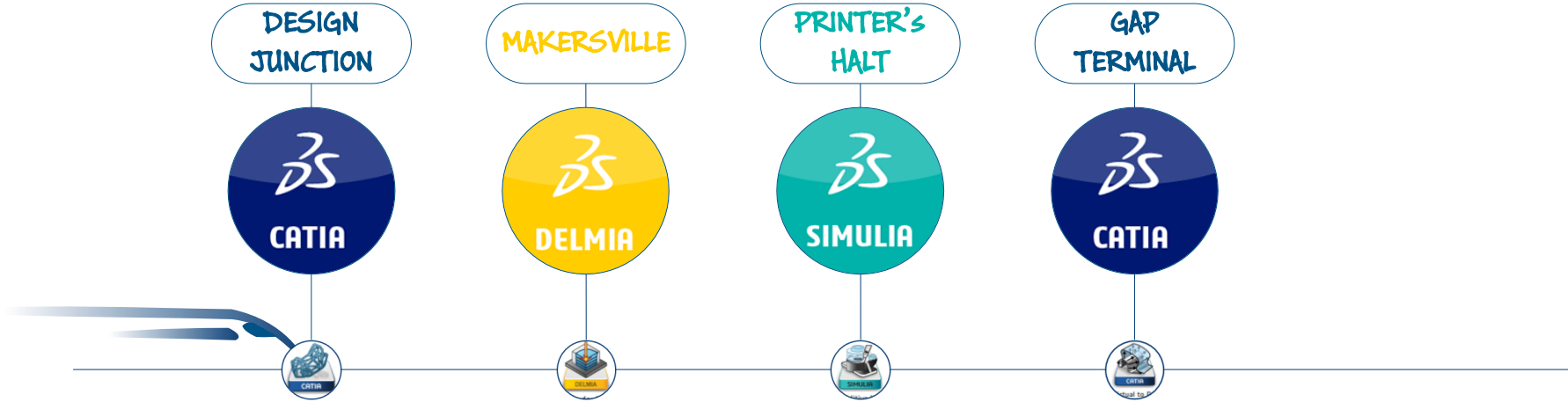
What is Print to Perform?



Print to Perform Features

Functional Generative Design

CREATE

- Topology
- Concept shape
- Trade-off study
- Refined shape

Process Planning

PREPARE

- Build Setup
- Build orientation
- Supports
- Scan path strategy
- Process Reuse
- Machine Output

Virtual Printing

PREDICT

- Stress
- Distortion
- Thermal History
- Material properties
- Microstructure
- Porosity
- Melt pool
- Phase transformations

Shape Compensation

COMPUTE

- Vector field transformation
- Distortion Compensation
- Deviation analysis
- Production shape

Companion Learning for a Vertical Start

Platform

companion.3ds.com

Gateway to the 3DEXPERIENCE Platform
3DEXPERIENCE R2018x
Duration: 4 Hours

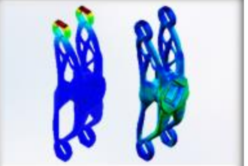
Design

CATIA Functional Generative Design Essentials
3DEXPERIENCE R2017x
Duration: 24 Hours

Process Planning

DELMIA Additive Part Preparation Essentials
3DEXPERIENCE R2017x
Duration: 4 Hours

Process Simulation



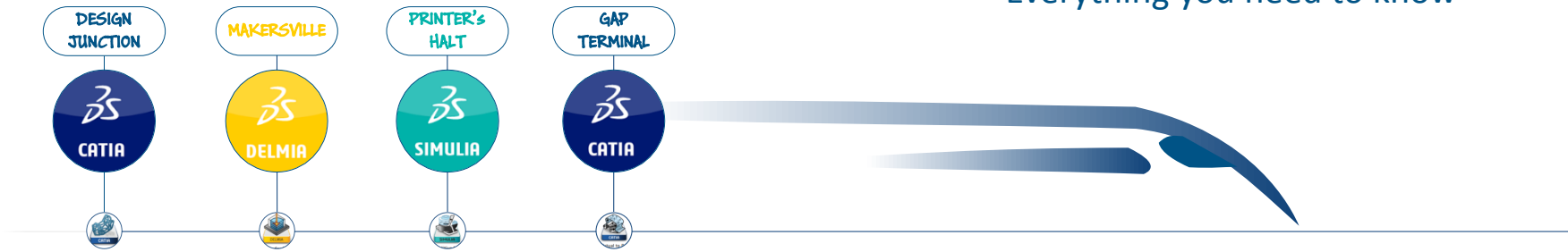
SIMULIA Additive Manufacturing Scenario Essentials
3DEXPERIENCE R2018x
Duration: 8 Hours

Shape Compensation

CATIA Virtual to Real Shape Morphing Essentials
3DEXPERIENCE R2017x
Duration: 2 Hours

The Guide to Digital Additive Manufacturing

Everything you need to know



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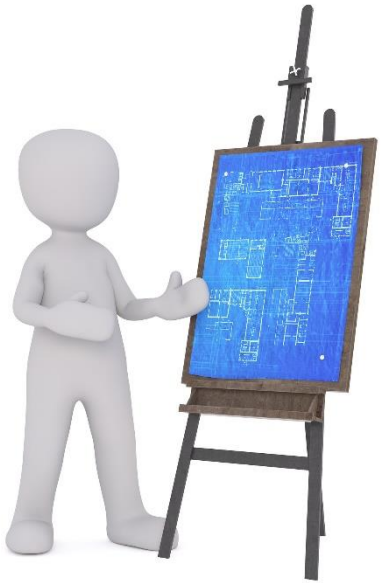
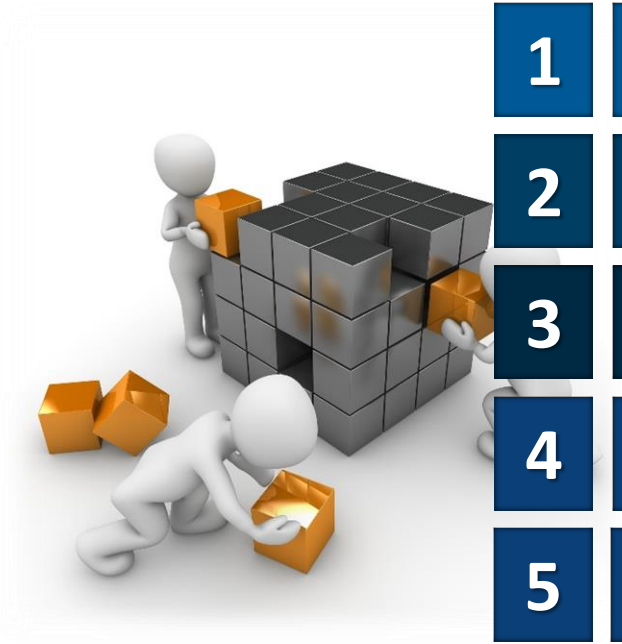
How to Succeed with Additive Manufacturing



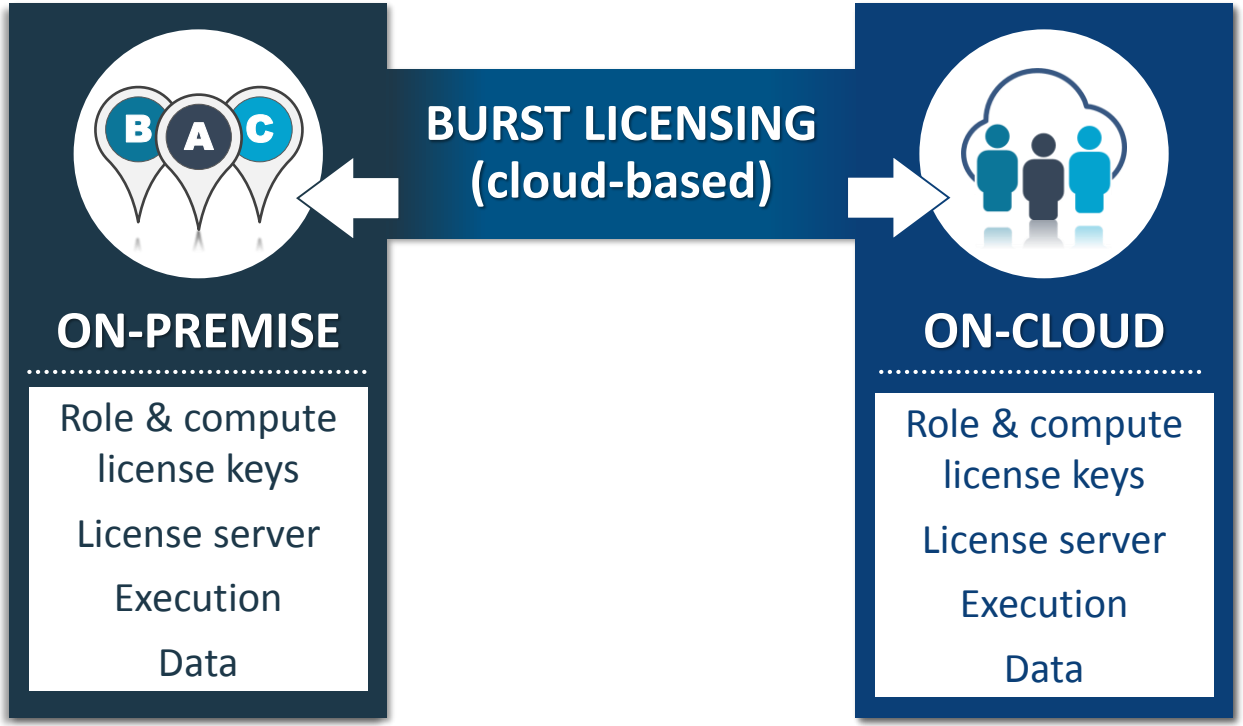
1. Make sure the organization is connected
2. Involve all experts from the get go
3. Decide if it is a good idea to build the part using AM
4. Use documented design guidelines
5. Recreate the end-to-end physical process in a virtual environment before going to print

How to Succeed with Print to Perform

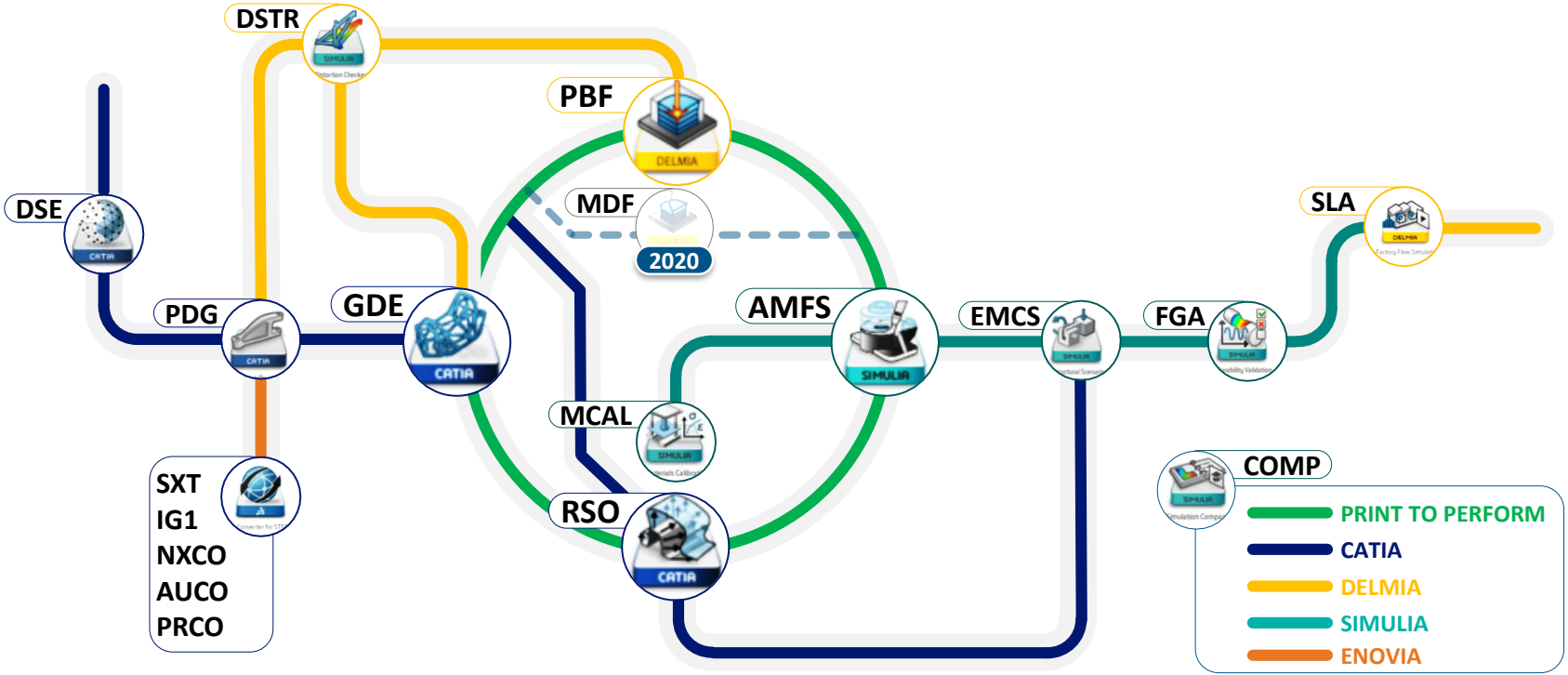


1. Involve all domain experts from the start
2. Convert questions into simulation tasks
3. Follow the best practices
4. Determine if the part is in tolerance or not
5. Simulate until satisfactory build quality

Print to Perform Availability



Print to Perform Expanded



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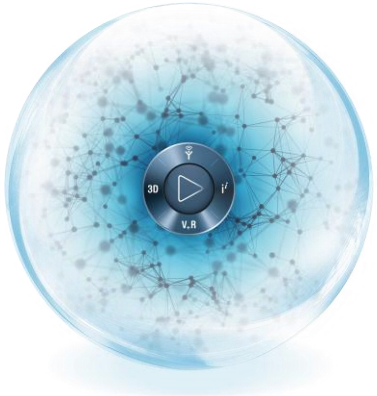
Print to Perform – A Bird's Eye View



End-to-End Strategy

Cross-Industry Technology

Connected Applications

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IF WE™

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Real World Process Validations

Attention to detail, for maximum fidelity

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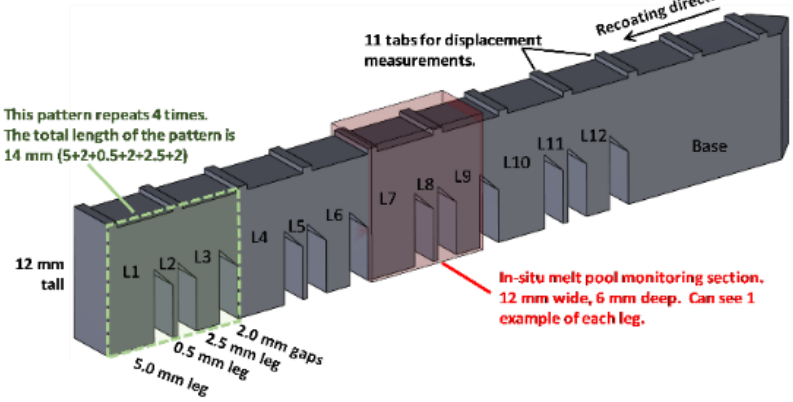
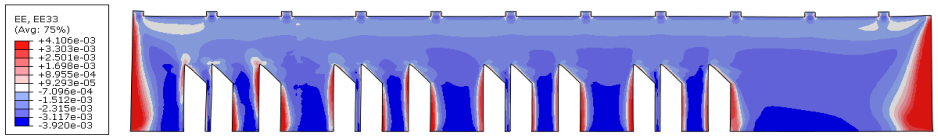
The NIST Award





Simulation result of Elastic strain in the z direction

Validation Efforts Summary

- SLM (**S**elective **L**aser **M**elting)
- SLS (**S**elective **L**aser **S**intering)
- LDED (**L**aser **D**irect **E**nergy **D**eposition)
- FFF (**F**used **F**ilament **F**abrication)
- FDM™ (**F**used **D**eposition **M**odeling)
- EDAM (**E**xtrusion **D**eposition **A**dditive **M**anufacturing)
- MJF™ (**M**ulti **J**et **F**usion)

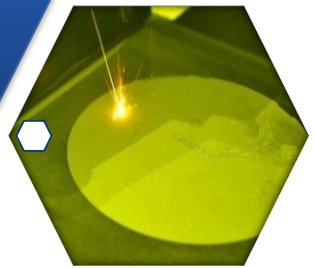
Process

Physics

Materials

METALS
- Ti-6Al-4V
- Aluminum
- Steel
- Inconel 718
- Inconel 625

POLYMERS
- PEI (ULTEM)
- ABS
- PA 11/12
- CFRP



- Temperatures
- Distortions
- Residual stresses
- Microstructure
- Mechanical properties

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Validation Efforts Reading

01 "Validation of a Generic Metallurgical Phase Transformation Framework Applied to Additive Manufacturing Processes"
London et al., TWI, Science in the Age of Experience, Boston, June 2018 (SLM)

02 "Additive Manufacturing Part Level Distortion Sensitivity Analysis within Abaqus on a Thinwalled, Tubular Structure"
Deering, NCNSC, Science in the Age of Experience, Boston, June 2018 (SLM)

03 "Simulation of Residual Stresses and Distortions in a 17-4 PH Part Produced by Laser Powder Bed Fusion"
Galles et al., ARL, Science in the Age of Experience, Chicago, May 2017 (SLM)

04 "Process Modeling and Validation for Metal Big Area Additive Manufacturing"
Simunovic et al., ORNL, NAFEMS World Congress, Stockholm, June 2017 (LDED)

05 "Finite Element Simulation of the Fused Deposition Modelling (FDM) Process"
Courter et al., Stratasys, NAFEMS World Congress, Stockholm, June 2017 (FDM)

06 "Prediction of the Degree of Bonding in the Extrusion Deposition Additive Manufacturing Process of Semi-Crystalline Polymer Composites"
Eduardo et al., Purdue, Science in the Age of Experience, Boston, June 2018 (EDAM)

07 "Improving Multi Jet Fusion (MJF™) printer design and print quality using validated process simulations"
Fradl et al., HP, Science in the Age of Experience, Boston, June 2018 (MJFTM)

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