IVS 2019 - Industrial Valve Summit Conference
Bergamo (Italy) - May 22/23, 2019

# Additive Manufacturing: Re-shaping the Oil & Gas industry

Case Study: Re-design, printing and testing of butterfly valve disc.


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# SAIPEM ORGANISATION:
# AGILE AND DECENTRALISED MODEL

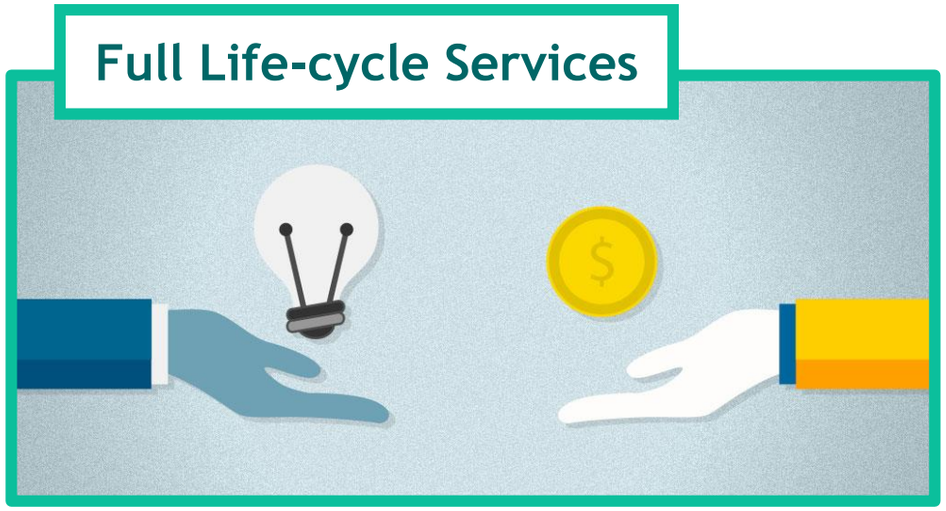
## SAIPEM CORPORATE

**Focused on group strategic guidance and governance**


**DIVISIONS**

**Autonomous business entities**

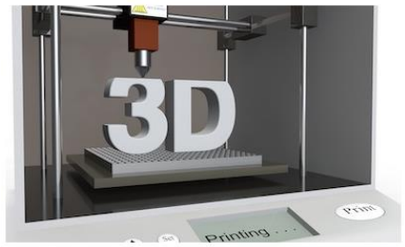
XSIGHT BY SAIPEM



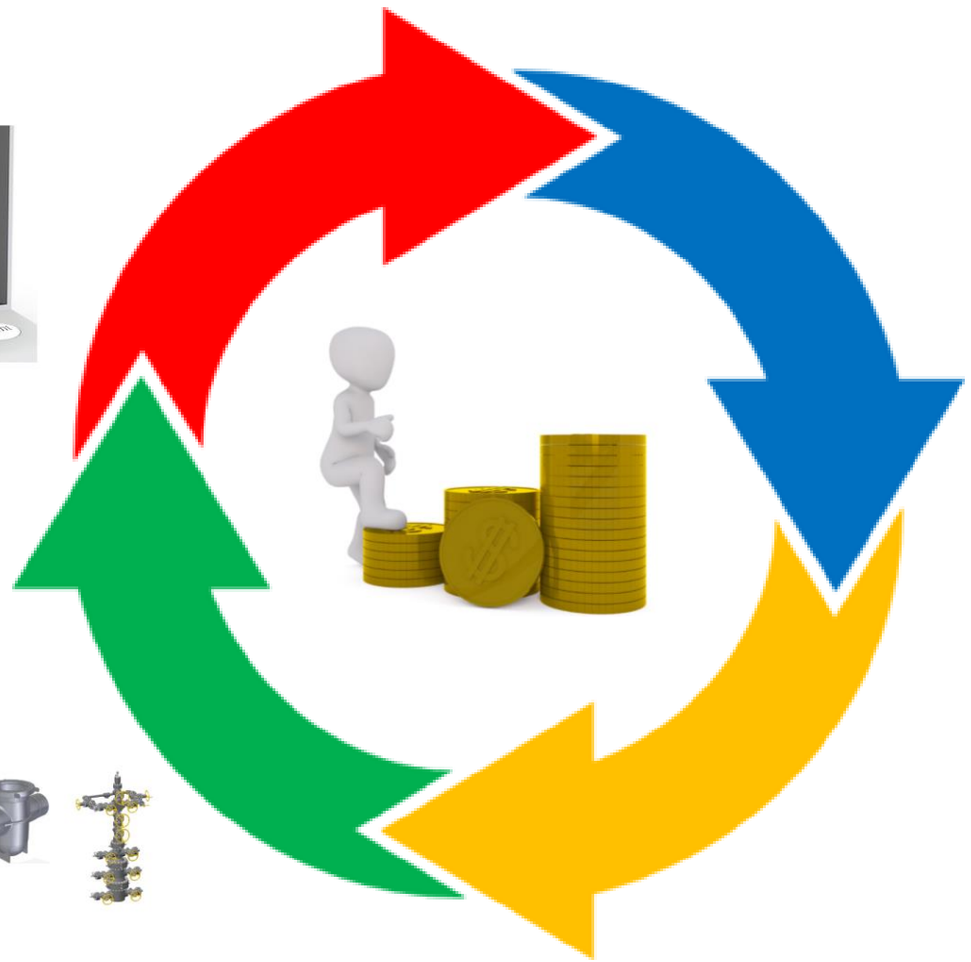

**Adding value by capitalizing on years of EPCI experience**

# AN ECOSYSTEM FOR INNOVATION

VENDORS




OEMs

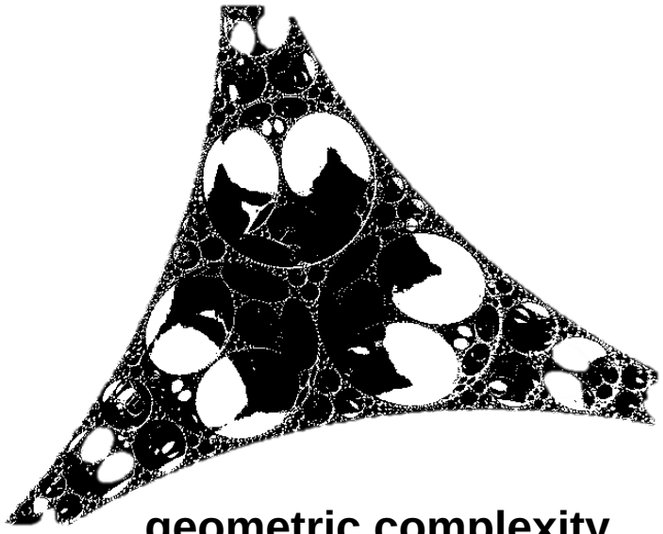


XSIGHT BY SAIPEM

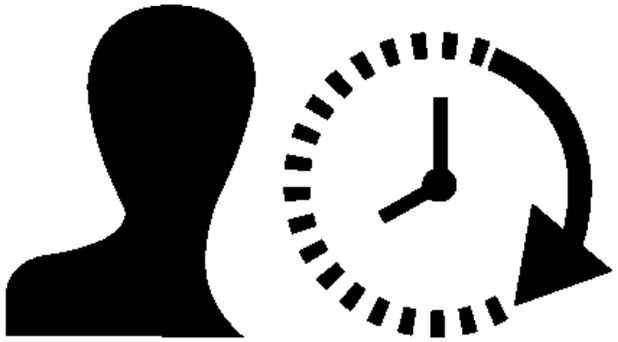
END USERS

Definition & Creation of new Ecosystem and Business Model

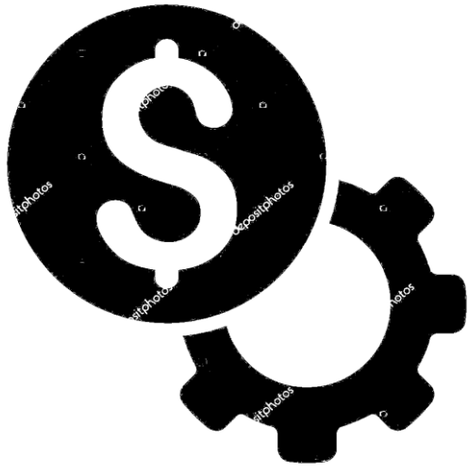
# WHY ADDITIVE MANUFACTURING ?



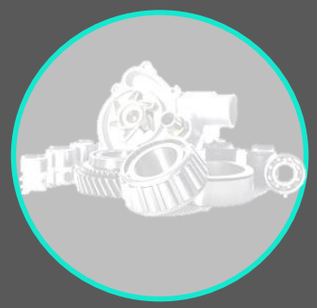
**geometric complexity**



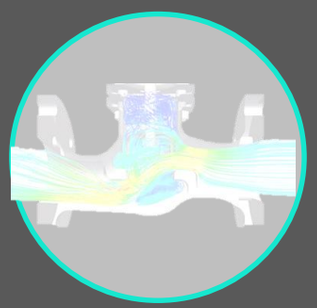
**Time saving**



**Money saving**



Spare Part Optimization



Technology & Design Improvement

Fast Repairing

Rapid Prototyping

# BUSINESS CASE

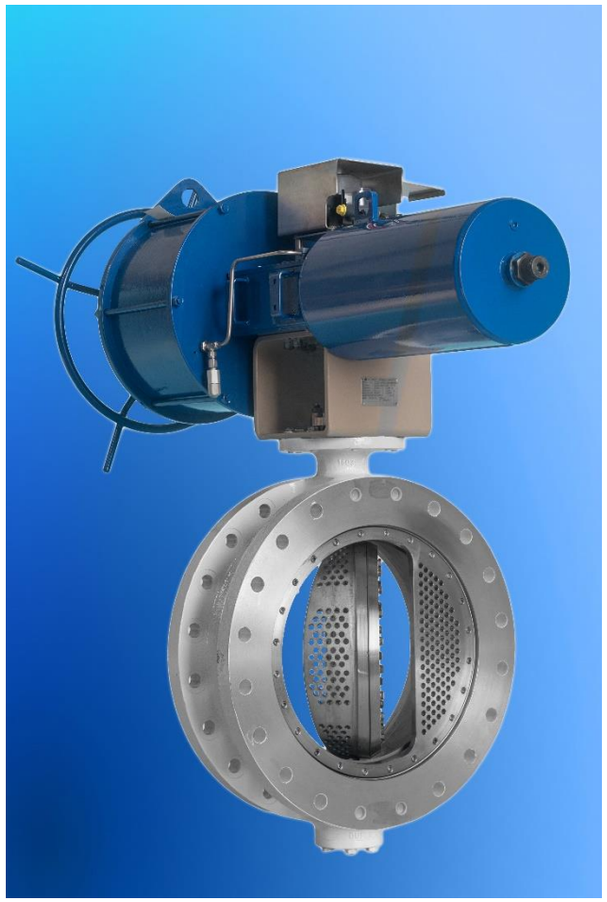
## Realization of butterfly valve disc

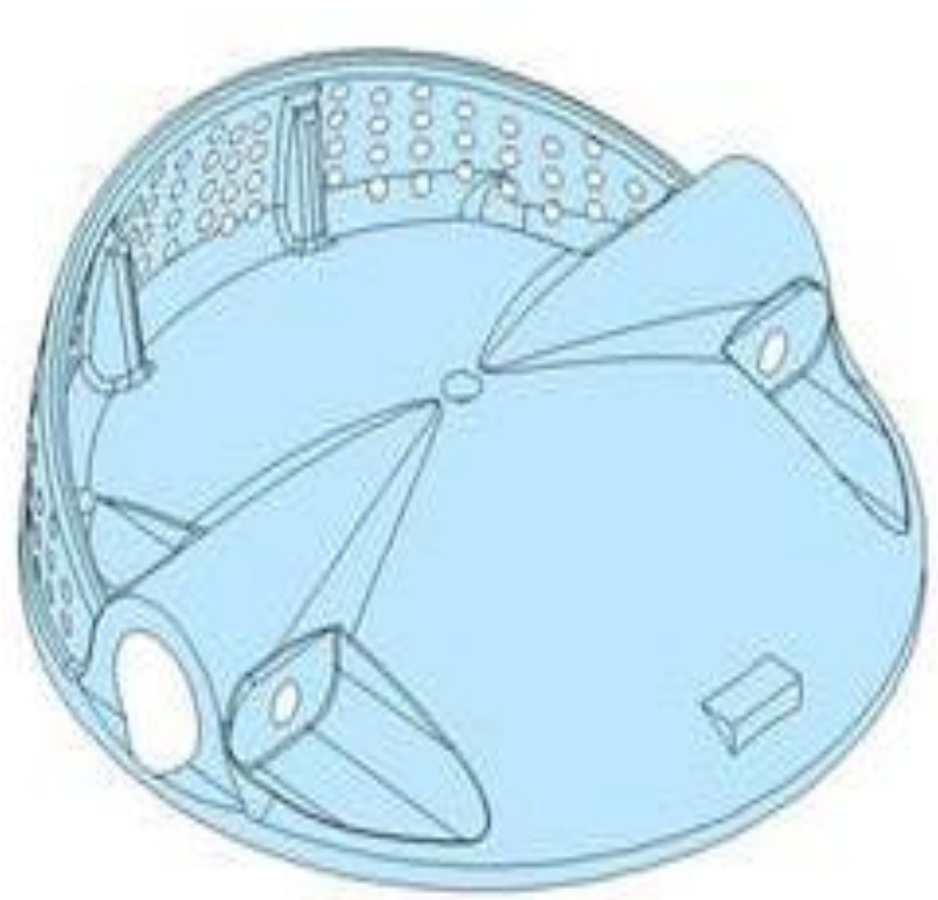
Size: 8’’

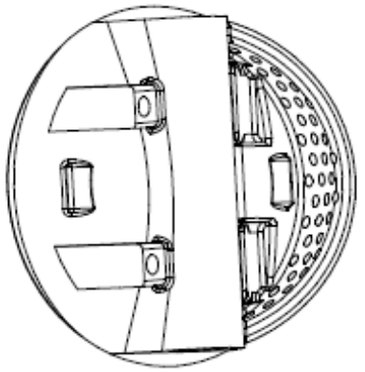
Pressure Class: ANSI Cl.150

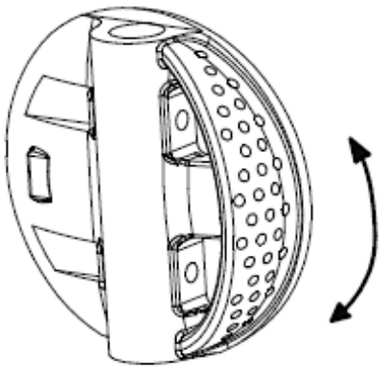
Material: Inconel 625

Features: anti-cavitation trim







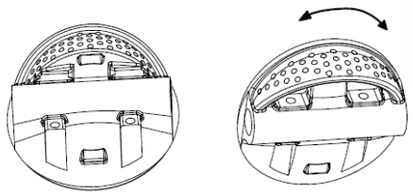


# MANUFACTURING CYCLE

Main steps to print and test  anti-cavitation disc of butterfly valve 8" 150# - Inconel 625

1

Re-Design



Sharing of STEP file by Valve Vendor

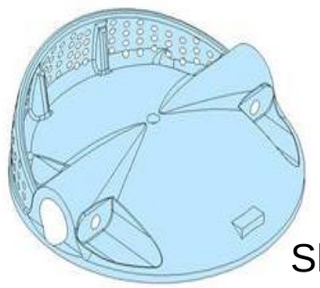
START

2

Purchasing of Inconel 625 Powders

3

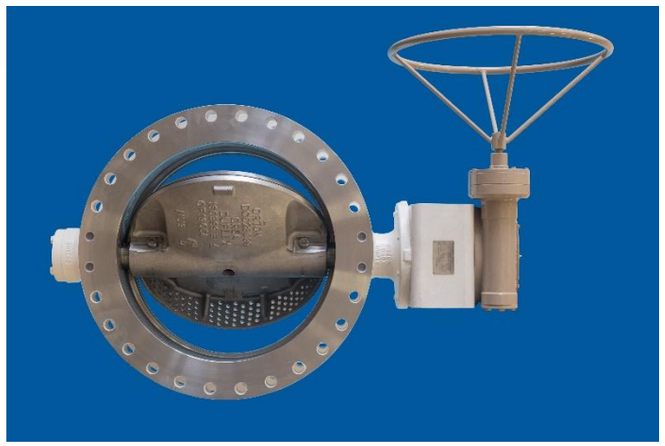
Printing & Milling



4

Shipping

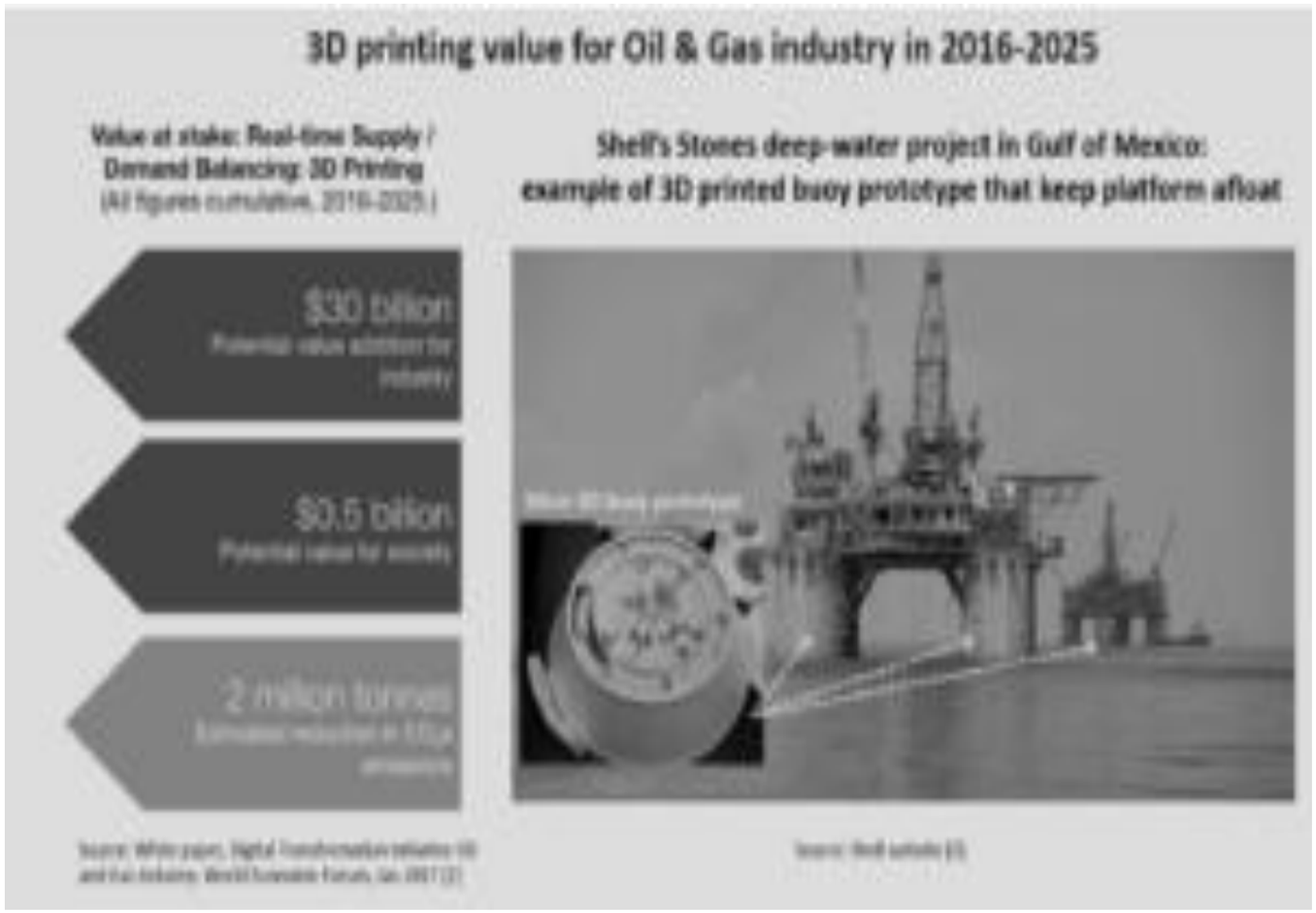
5



Assembling and Testing & Validation

# 3D PRINTING OPPORTUNITIES IN OIL&GAS INDUSTRY

## WHAT IS GOING ON (NOW)



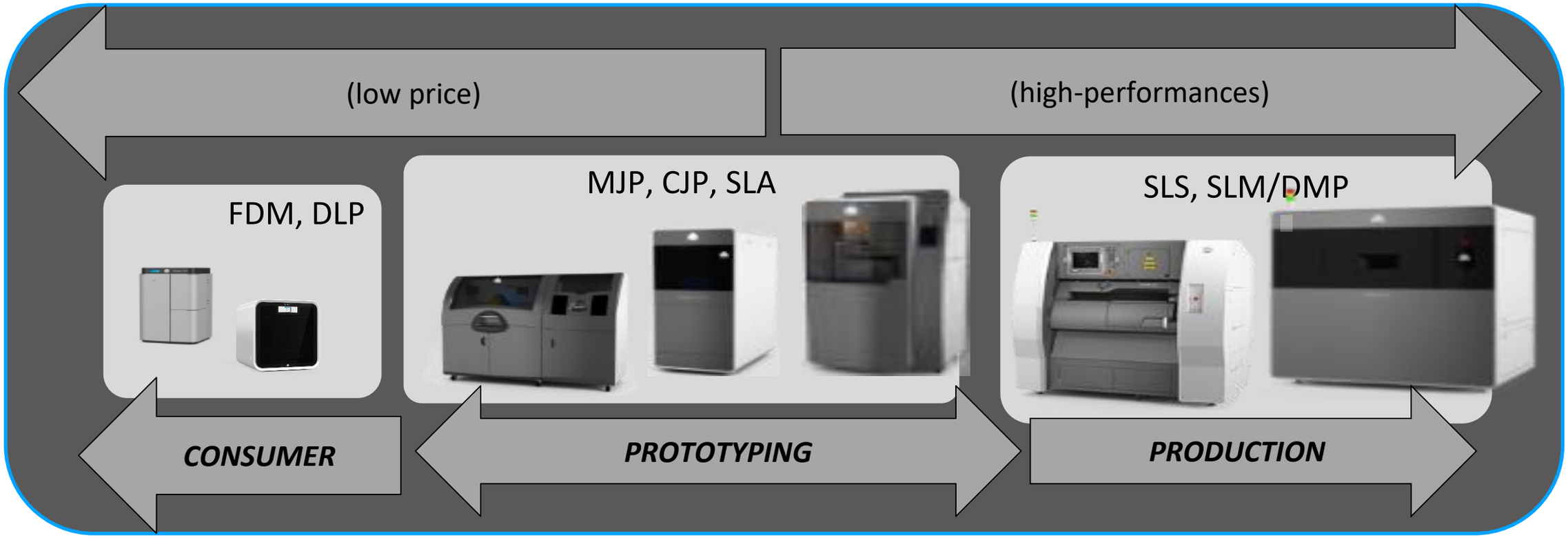

**Wordwide….**

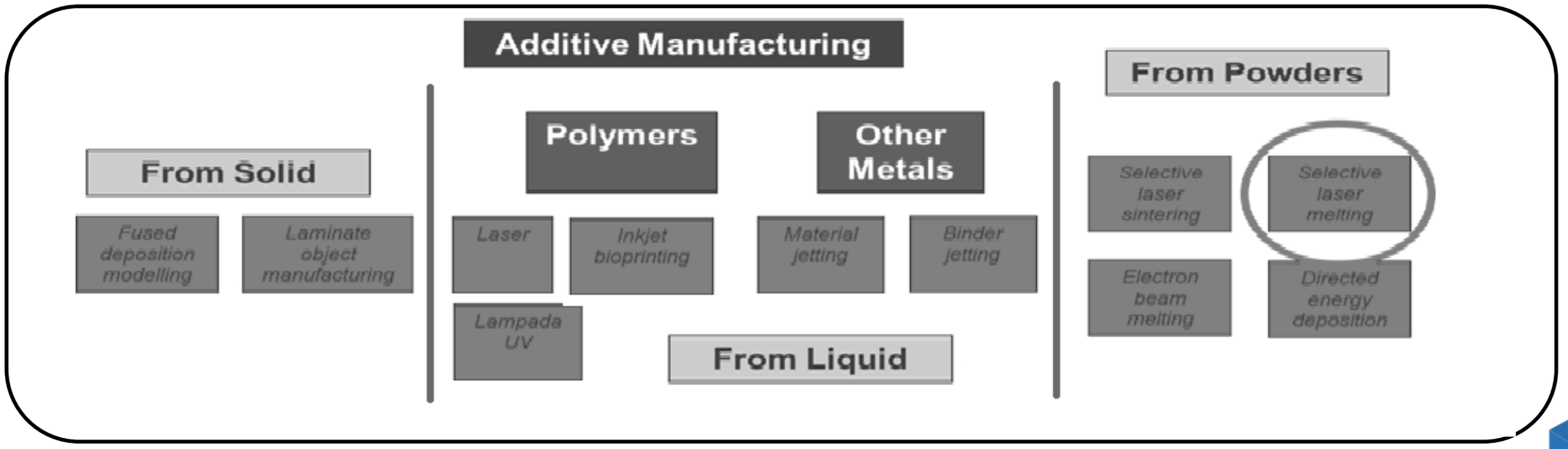
- 50% time reduction in turbine development, thanks to 3D prototyping;
- huge investments increase in additive manufacturing solutions;
- registration of the first 3D printed part certified for O&G (2017, manifold for Titanium pipes).

**…in Italy**

- Production applications: quality control and process qualification.
- engine improvement and HotGasPath components with new elements redenifited and validated.

# SEVERAL TECHNOLOGIES AVAILABLE



# COMPARISON OF METAL 3D PRINTING TECHNOLOGIES

now two different solutions are available, each with advantages/disadvantages

it is a compromise choice to make based on the desired applications

CONSOLIDATE > energy beam on a powder bed
**("SLM/DMLS")**

*Pros:*

- *accuracy and refinement of the part;*
- *density.*

*Cons:*

- *very high investment and management costs;*
- *Powders management;*
- *complex process, difficult media removal;*
- *Skills required;*
- *production and material change times;*

NEW > derived from the MIM process
**("A.D.A.M.")**

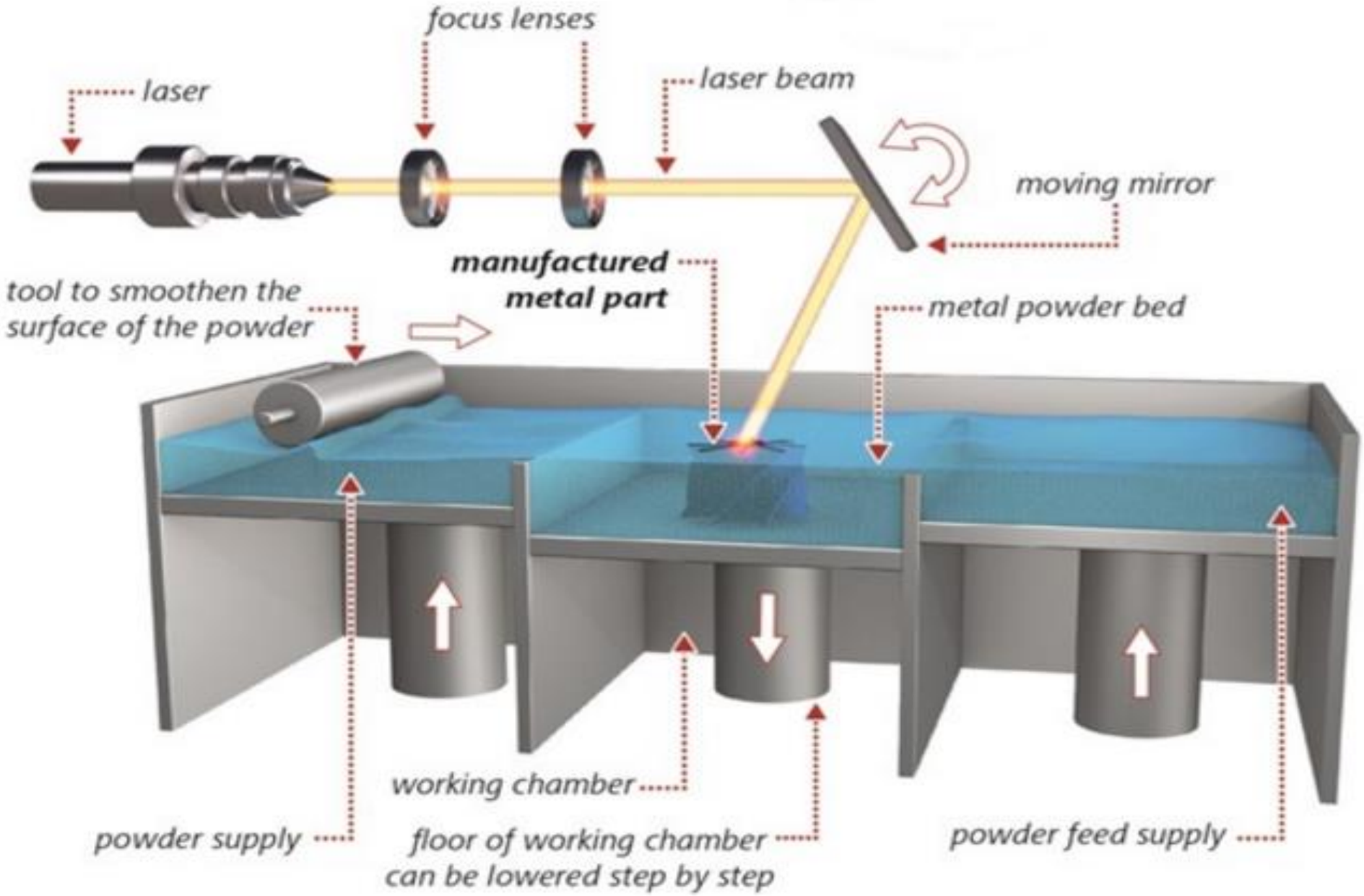
*Pros:*

- ✓ *No powders*
- ✓ lower investments and costs
- ✓ *Easy of use, fast materials change*
- ✓ *Immediate support removal*

*Cons:*

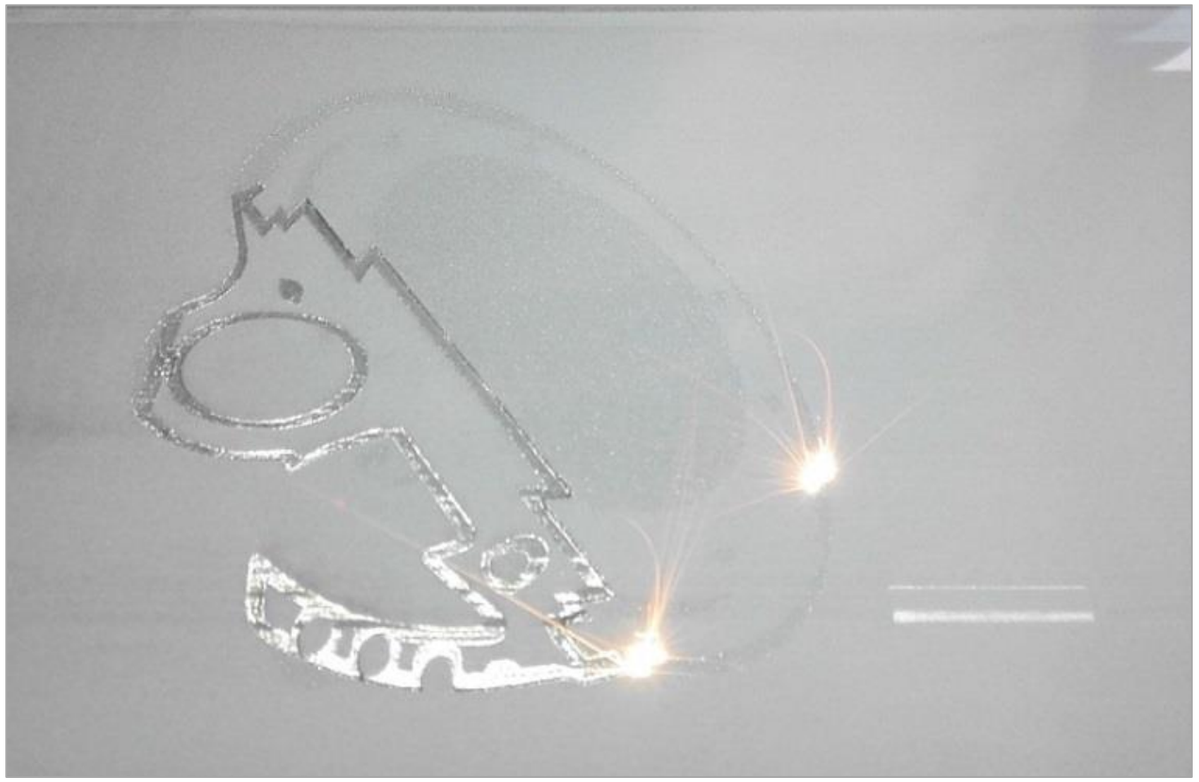
- ✓ *Less part precision and density.*

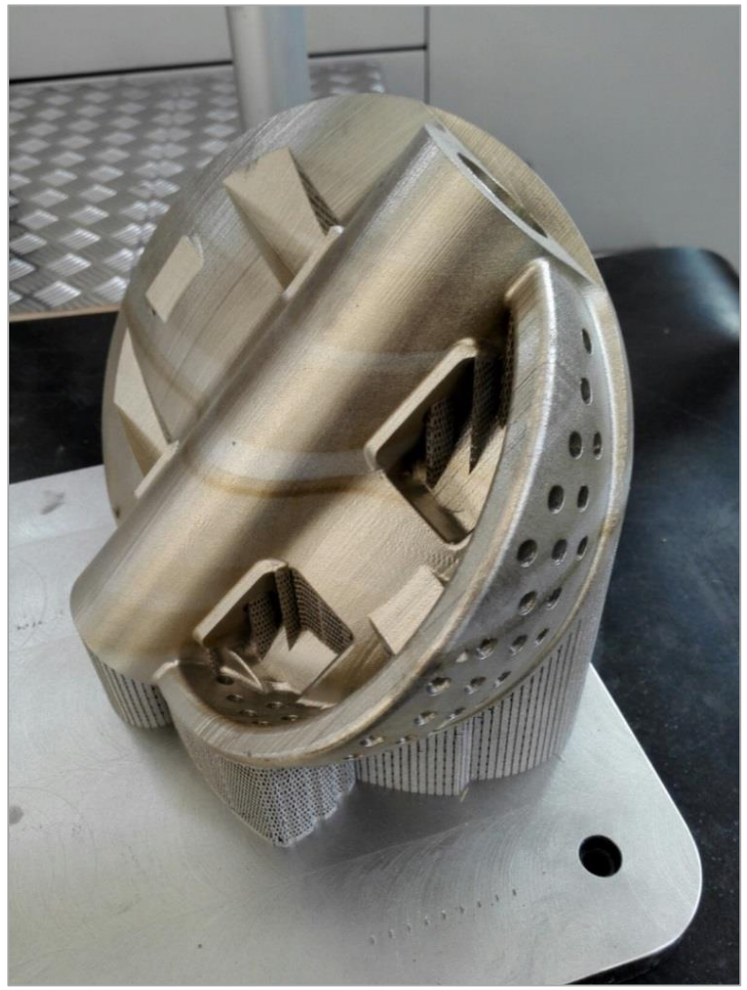
# Selective Laser Melting (SLM) – High Density Solution



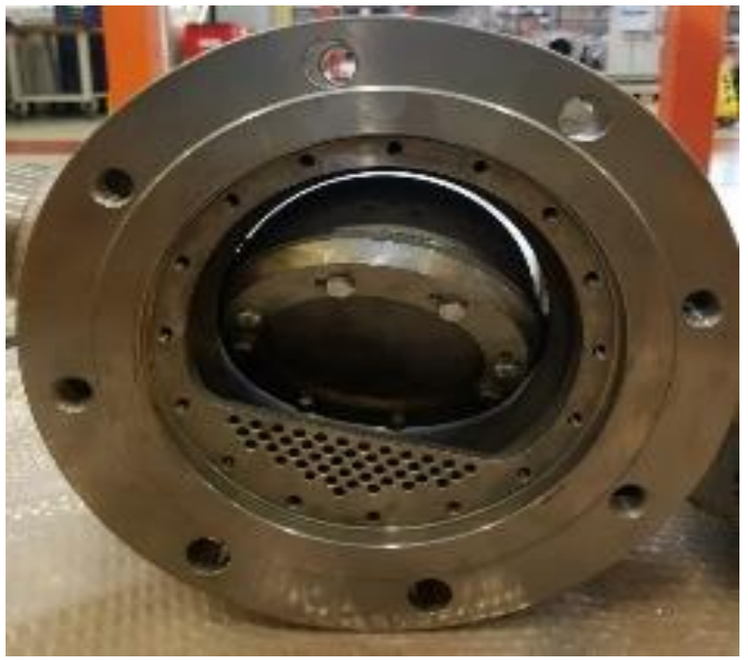
# LEAD TIME

| | 3D Printed | Casting |
|---|---|---|
| Raw Material lead time | 37 Hours | 5-7 weeks |
| Heat Treatment | Not required | 1 week |
| Machining time | Ideally the component is already finished | 1-2 weeks |
| **Total Lead Time** | **37 Hours** | **7-10 weeks** |





# VALVE ASSEMBLING



Assembly at IMI ORTON facility

# VALVE TESTING

- Antistatic test
- Tightness Test
- Functional test
- Disc strength Test

Test parameter defined with ASTM B 564-17 UNS N06625 (Group 3.8 of ASME B16.34)

**Antistatic test**
Reference standard: EN 12266-2
Test reference F21
Acceptance Criteria: R<shall not exceed 10 Ω

# VALVE TESTING

## HYDROSTATIC SEAT TIGHTNESS TEST

Reference Standard: ISO 5208

- SEAT TEST PRESSURE: 1.1 X valve rating → 22 BarG
- TEST DURATION: 120 second
- ALLOWABLE LEAKAGE: ISO 5208 Rate A (no visible leak)

TEST WAS REPEATED 5 TIMES
TEST WAS EXECUTED ON BOTH DIRECTIONS

TEST RESULT ON SHAFT SIDE:
SATISFATORY

TEST RESULT ON DISC SIDE:
SATISFACTORY

# VALVE TESTING

## PNEUMATIC SEAT TIGHTNESS TEST

Reference Standard: ISO 5208

- SEAT TEST PRESSURE: 6 BarG
- TEST DURATION: 120 second
- ALLOWABLE LEAKAGE: ISO 5208 Rate A (no visible leak)

TEST WAS REPEATED 5 TIMES
TEST WAS EXECUTED ON BOTH DIRECTIONS

TEST RESULT ON SHAFT SIDE:
SATISFATORY

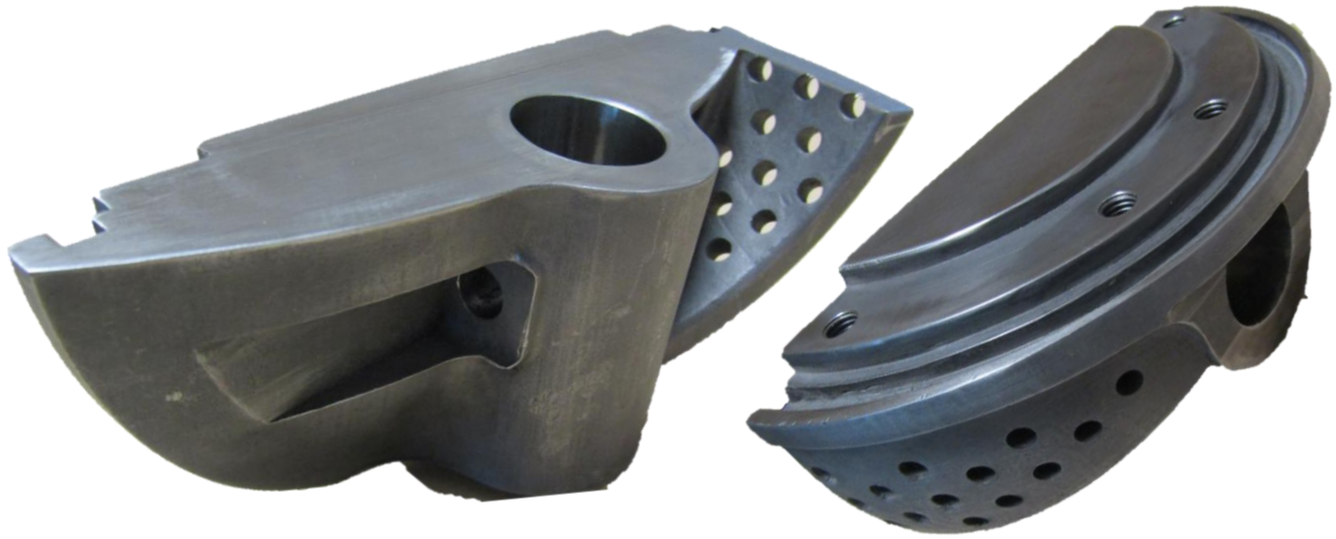
TEST RESULT ON DISC SIDE:
SATISFACTORY

OTHER TESTS: DISC STRENGHT TEST
AS PER EN 12266-2 Test reference P20

# VALVE TESTING

Disc cut in sections and specimen realized.

- Tensile test at room temperature
- Tensile test at high temperature (400°C)
- Impact test at room temperature
- Impact test at low temperature (-196°)
- Micrographic examination



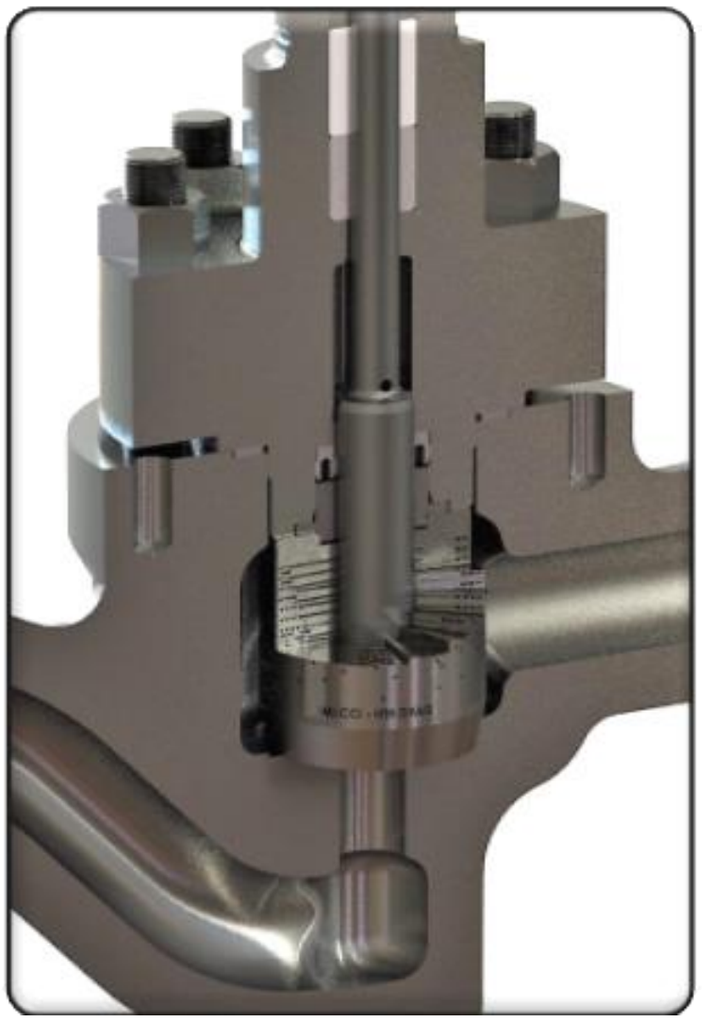
| Test Temperature | Allowable Yeld strength | Measured Yeld Strength | Allowable Tensile strength | Measured Tensile Strength |
|---|---|---|---|---|
| Room Temperature | > 414 MPa | **751 MPa** | > 827 MPa | **953 MPa** |
| 400°C | >286 MPa | **605 MPa** | > 760 MPa | **828 MPa** |

| Test Temperature | Allowable Absorbed Energy | Measured Absorbed Energy |
|---|---|---|
| Room Temperature | > 27 J | **129 J** |
| -196°C | >27 J | **105 J** |


Austenitic microstructure free from micro fissures

# OTHER IMI COMPANIES

IMI CCI®




2018: disc stacks <2″
2019: disc stacks <8″

# CONCLUSIONS

## Customer support during the whole project life cycle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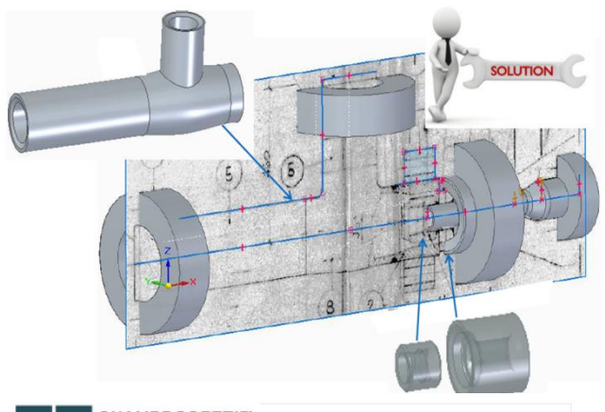
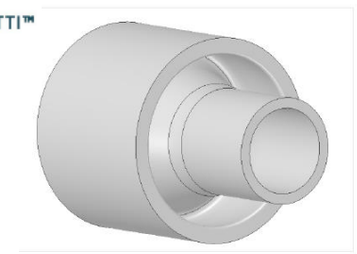
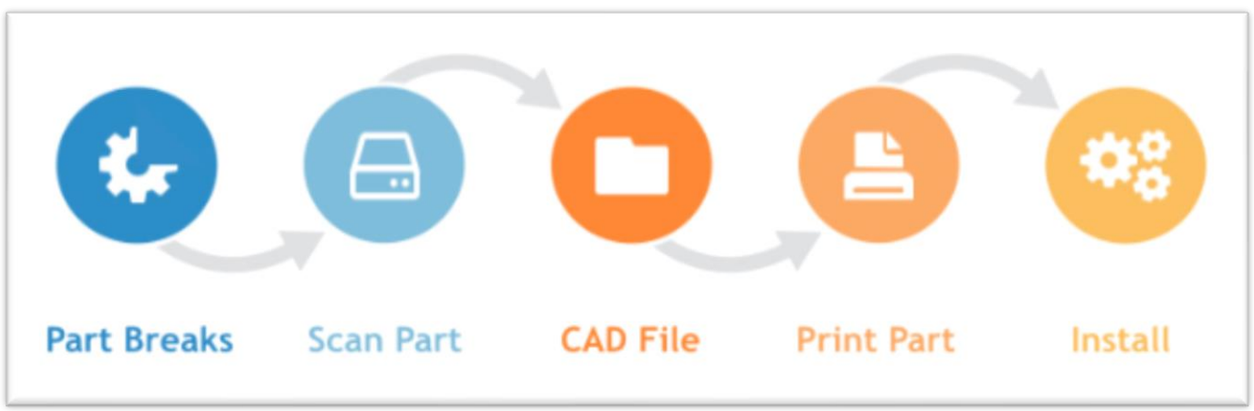
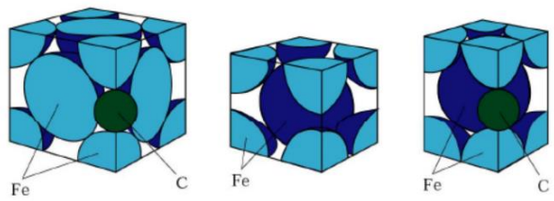



SNAMPROGETTI™ UREA TECHNOLOGY

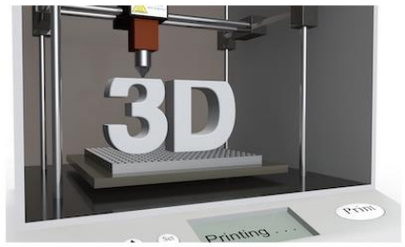


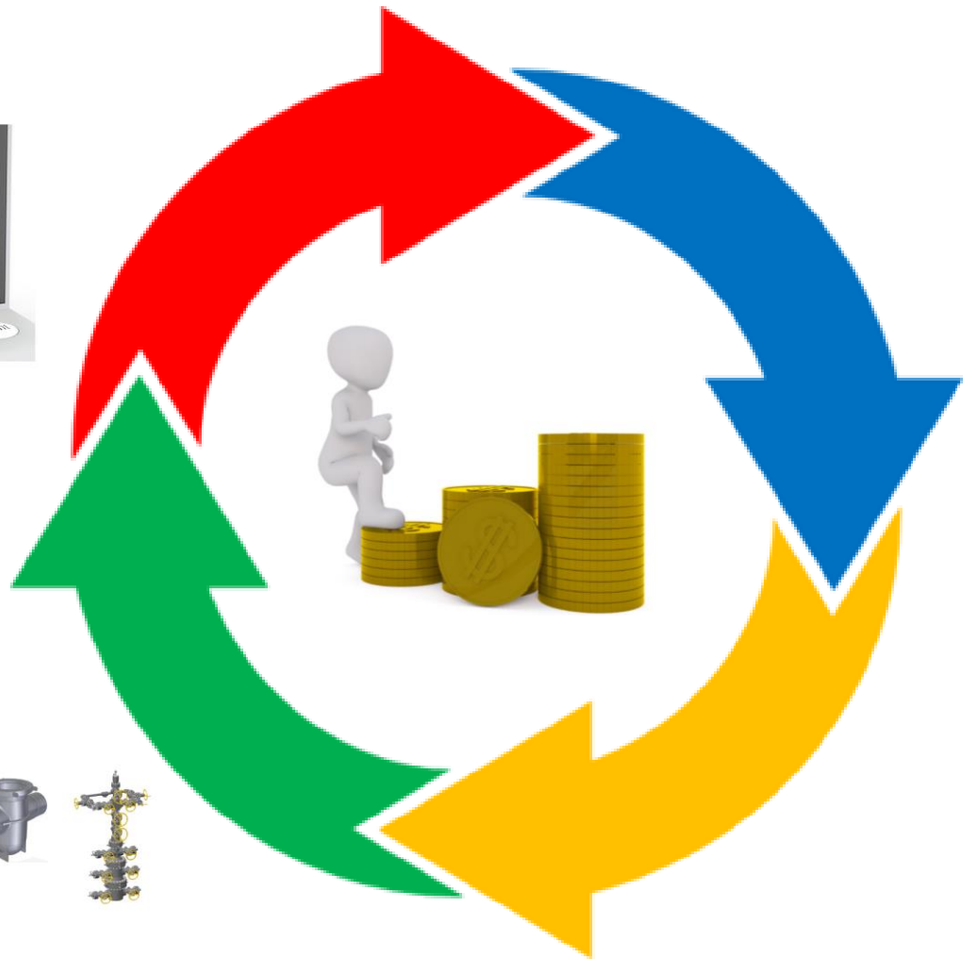



# NEW BUSINESS MODEL

VENDORS



XSIGHT BY SAIPEM

END USERS

OEMs

# Thank you!

## Do you have questions?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