

Industrial 3D Printing is coming to Mainstream CNCs



Dr. Jason B. Jones, Co-founder & CEO
Hybrid Manufacturing Technologies
www.hybridmanutech.com



Conclusions

• Finishing is needed for metal AM parts

- Governed by
 - feedstock
 - layer height



Hybrid manufacturing is a clean, precise, scalable

Most metal AM parts require machining

• Self-contained architectures limit AM (in some ways)

- no in-process finishing
- manual transfer to downstream processes



~25 years



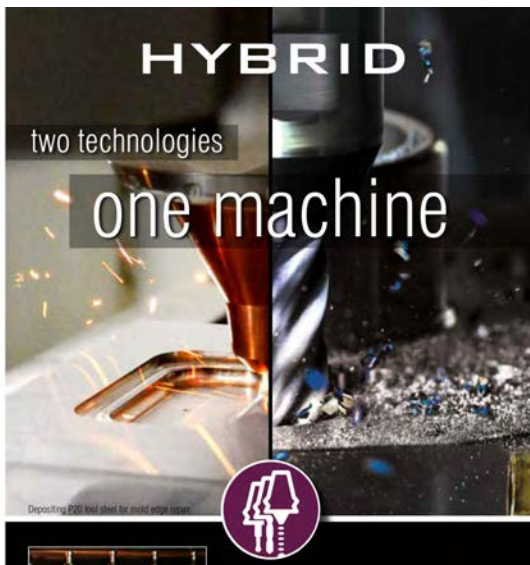
• Hybrid integrates AM with other tools

- deposition
- finishing
- inspection



CNC = open architecture

Multi-tasking trend



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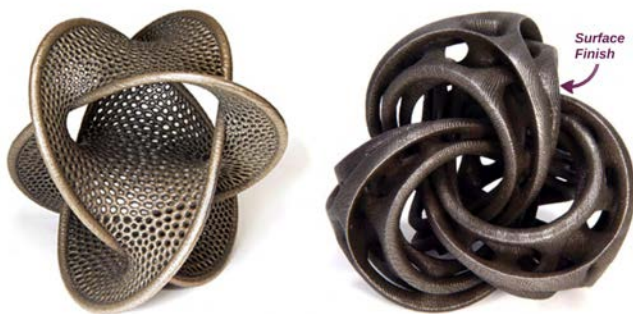
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CNC = open architecture

Multi-tasking trend

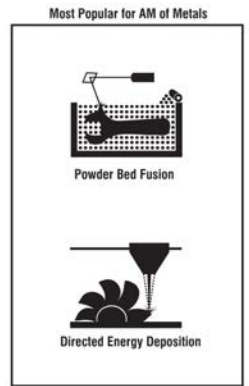


Source: www.bathsheba.com/



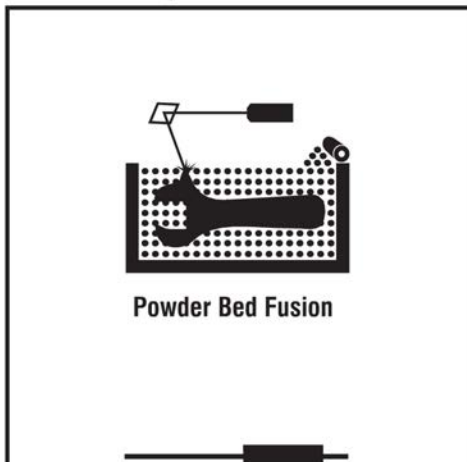
Finishing i

- Governed by
 - feedstock
 - layer height



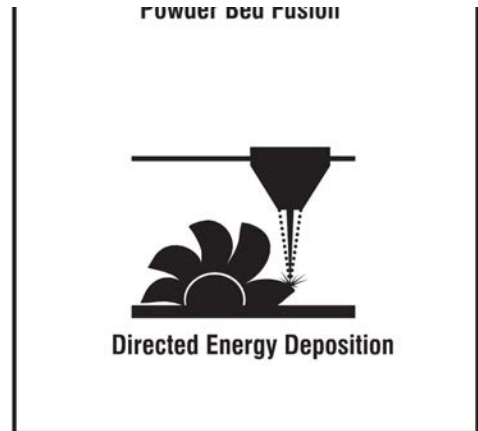
Self content

Most Popular for AM of Metals



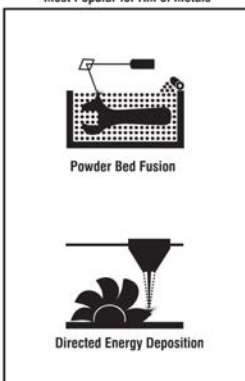
Powder Bed Fusion

POWDER BED FUSION

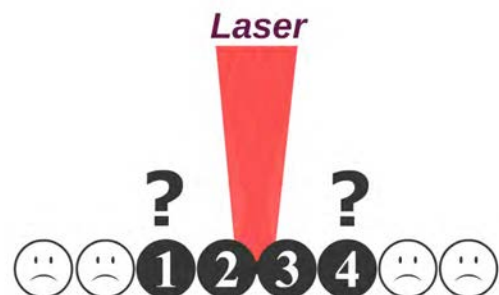


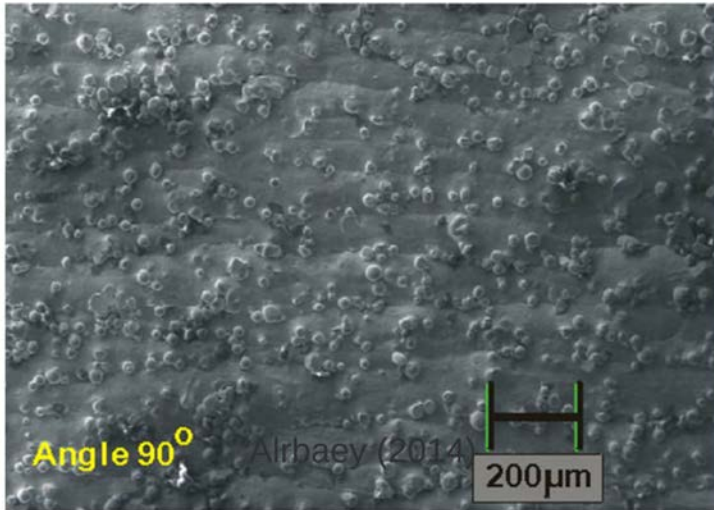
Directed Energy Deposition

Most Popular for AM of Metals



= powder feedstock
(or wire)





Feature resolution > 4-10x powder diameter



Most metal AM parts required machining

• Finishing is

- Governed by
 - feedstock
 - layer height



- feedstock
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Conclusions

- **Finishing** is needed for metal AM parts
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 - layer height
- **Self-contained** architectures limit AM (in some ways)
 - no in-process finishing
 - manual transfer to downstream processes
- **Hybrid integrates** AM with other tools
 - deposition
 - finishing
 - inspection



~25 years



2015



CNC = open architecture

Multi-tasking trend

• Self-contained

- no in-process finishing
- manual transfer to downstream processes

• Hybrid integrates

direct

Prototyping

Manual post-processing & transfer to downstream processes



Prototyping

Manual post-processing & transfer to downstream processes



~25 years

AM with

- feedstock
- layer height



Prototyping + some end-use parts

Manual post-processing & transfer to downstream processes

Form 1 by Formlabs
Released: May 2013
Desktop Stereolithography

• Self-contained

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- manual transfer to downstream processes

• Hybrid integrates

transfer to downstream processes



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CNC = open architecture

Multi-tasking trend



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- inspection



~25 years



1 with other tools

CNC = open architecture

Multi-tasking trend

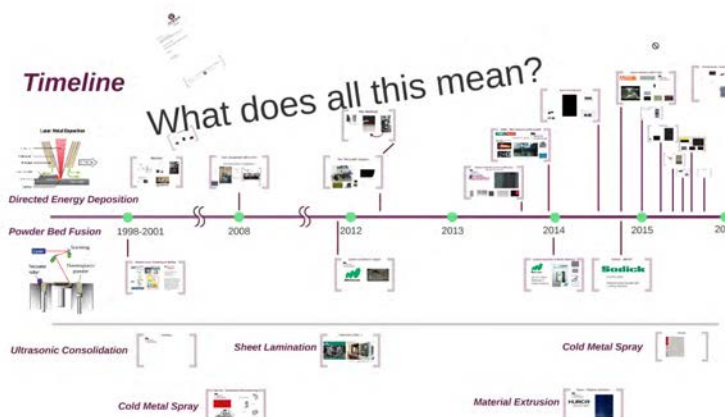
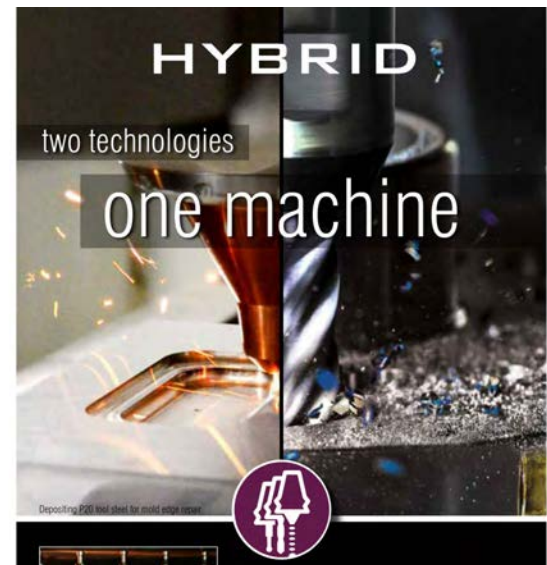
In-process



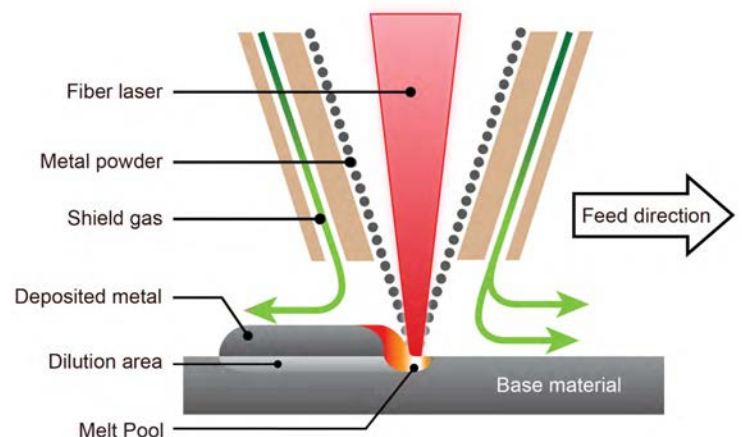
Source: <http://www.sophiedahl.com/2014/02/just-try-typer/> [28 April 2015]

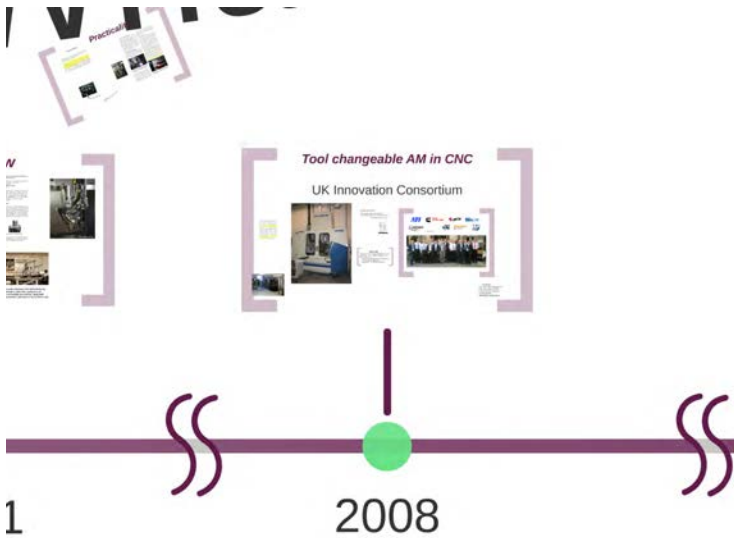
By in-process I mean at least in the same set up

Corrective ribbon ~ rework in-process



Laser Metal Deposition





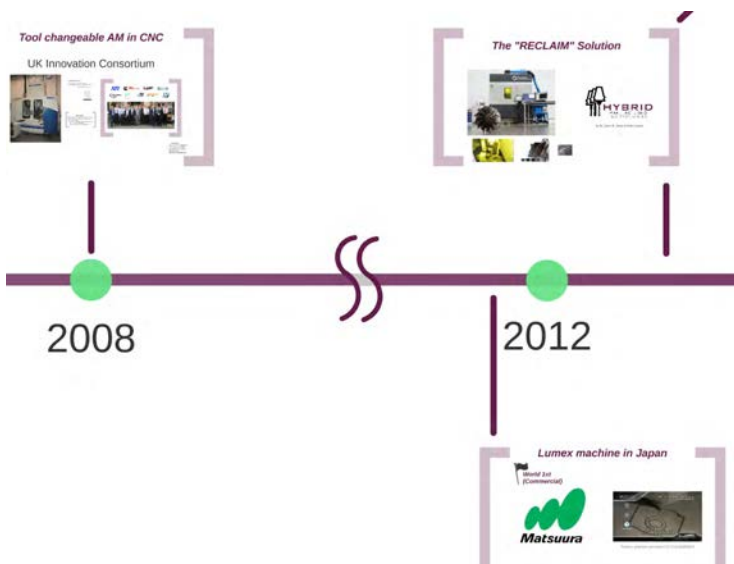
Tool changeable AM in CNC

UK Innovation Consortium

Images showing a Bostomatic 32GS machine and a group photo of the consortium members. The group photo includes logos for ATI, Turbo Technologies, DeMONTFORT UNIVERSITY, Delcam, electrox, mtc, peTEC, RENISHAW, and TWI.

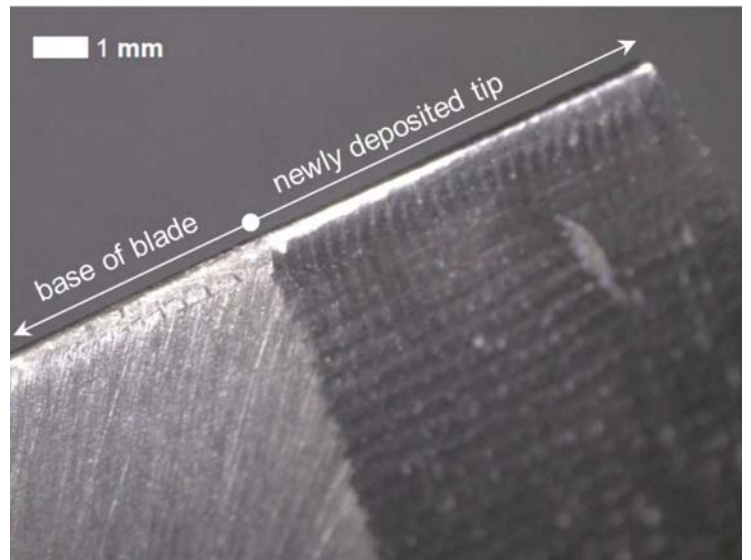
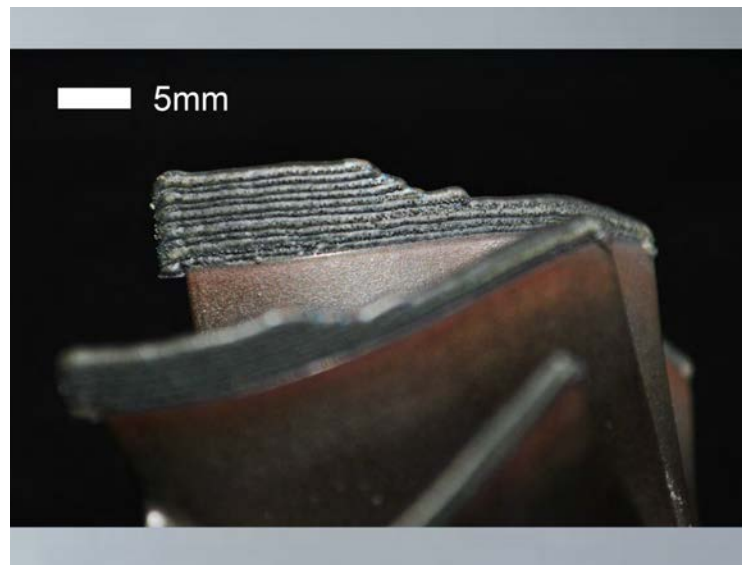
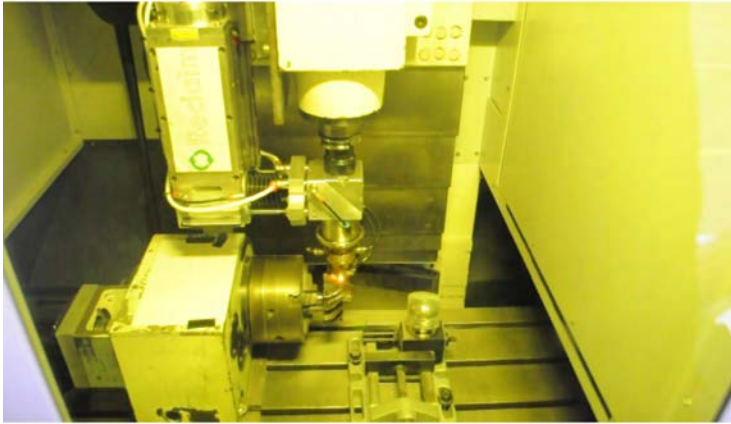
Group photo of consortium members and logos: ATI, Turbo Technologies, DeMONTFORT UNIVERSITY, Delcam, electrox, mtc, peTEC, RENISHAW, and TWI. (Since July 2011)

Image of a Bostomatic 32GS machine. Text on the right: 'Inception (late 2007) "What do you think a laser cladding head i... David'.

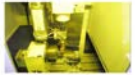


The "RECLAIM" Solution

Image of a machine and a group photo. The group photo includes logos for ATI, Turbo Technologies, DeMONTFORT UNIVERSITY, Delcam, electrox, mtc, peTEC, RENISHAW, and TWI.



The "RECLAIM" Solution



by Dr. Jason B. Jones & Peter Coates



2012

2013

Lumex machine in Japan

World 1st
(Commercial)

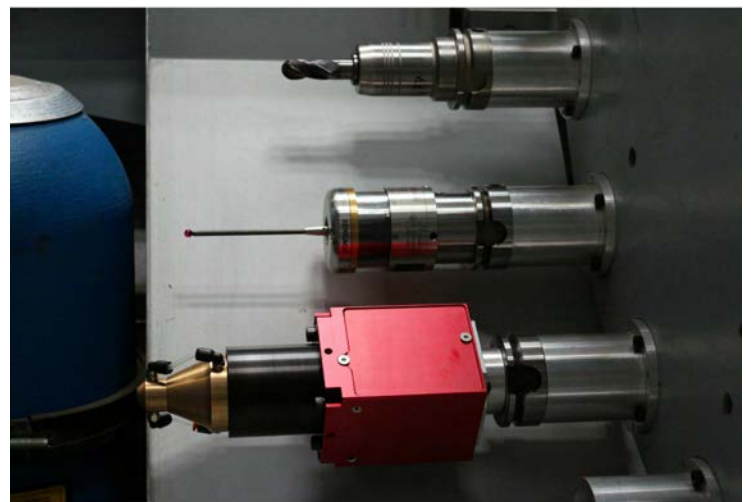
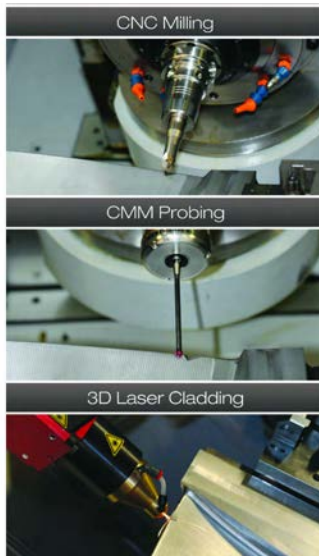


Hamuel & Hybrid Launch at EMO 2013

EMO 2015 - Hall 1 Stand A21

World 1st
(Commercial)

HAMUEL
REICHENBACHER
A member of the SCHERDEL group



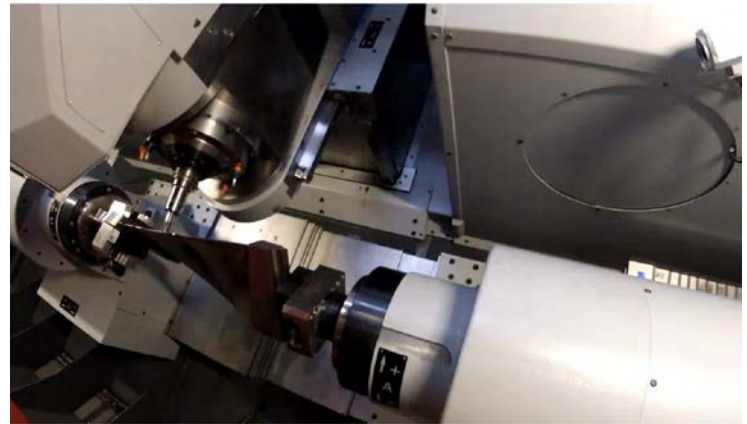
The World's **FIRST** Hybrid Machine

100% Automated Adaptive Repair Solution









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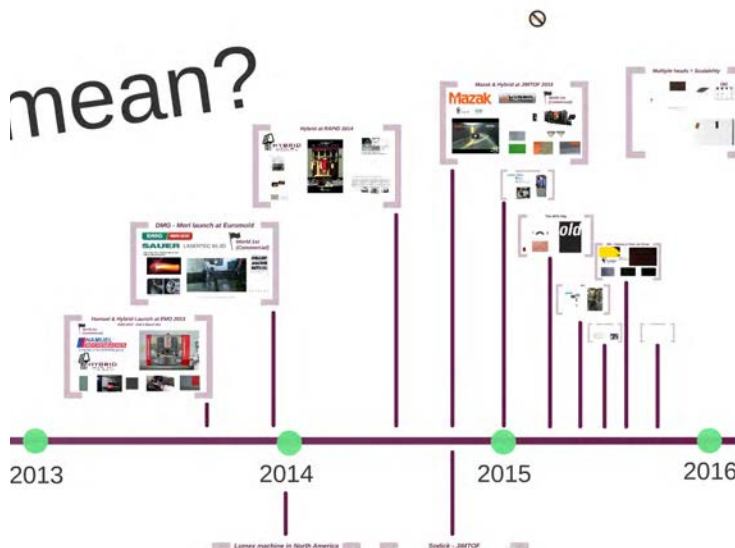










Hybrid at RAPID 2014










Table 1 – Hybrid CNC machines which have been retrofit with tool changeable laser cladding

Machine tool platform	A) Bostomatic BD18	B) Hamuel HSTM 1000	C) GF HPM 450U
No. Axes	4	5	5
Machine type	Vertical milling machine horizontal rotary Axis	5 axis mill-turn machine with synchronized horizontal rotary axes	Compact 5 axis, vertical milling with tilt-rotary table
Size of machine (XYZ mm)	450x300x300	1450x400x570	600x450x450
Laser power (W)	200	400	1,200
Spindle speed (rpm)	10,000	16,000	12,000
Powder hoppers	1	2	4
Application(s)	Impellers/Parameter dev.	Complex blade repair	New part manufacture

Image of the hybrid systems



Table 1 – Hybrid CNC ma

Machine tool platform
No. Axes
Machine type
Size of machine (XYZ mm)
Laser power (W)
Spindle speed (rpm)
Powder hoppers
Application(s)

Image of the hybrid systems

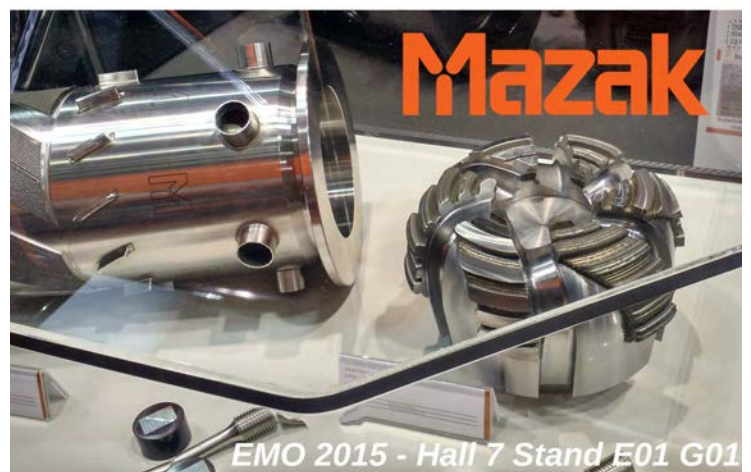
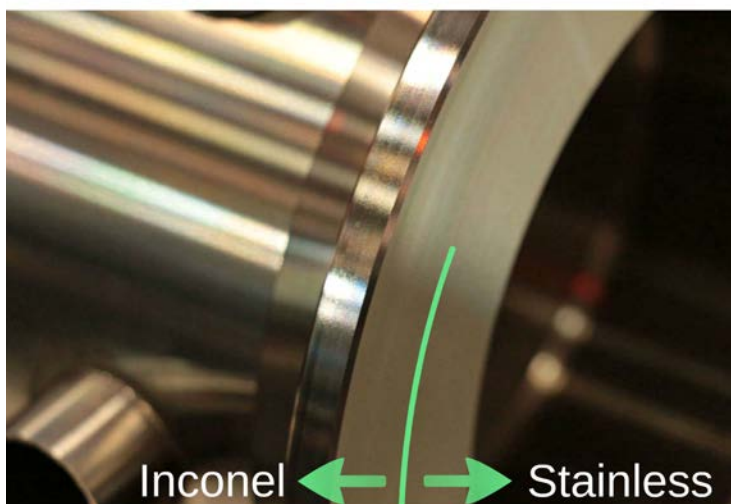
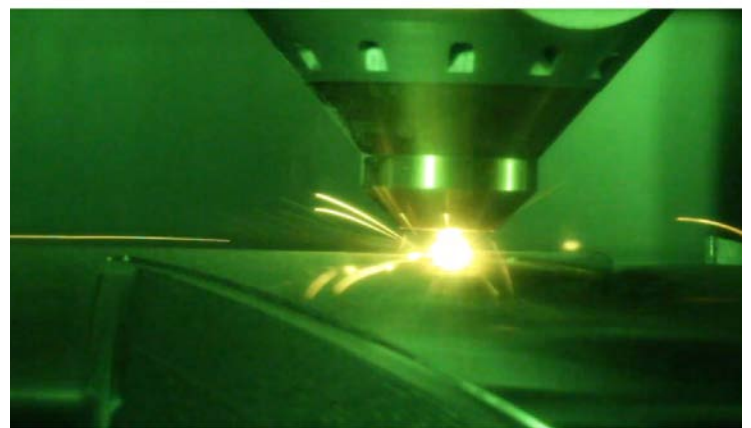
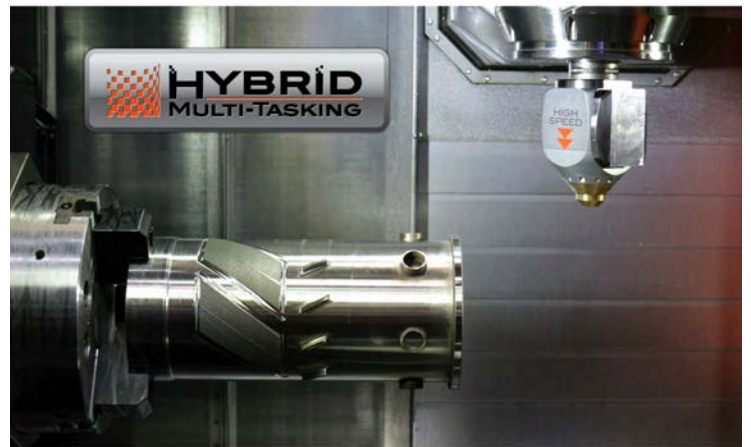
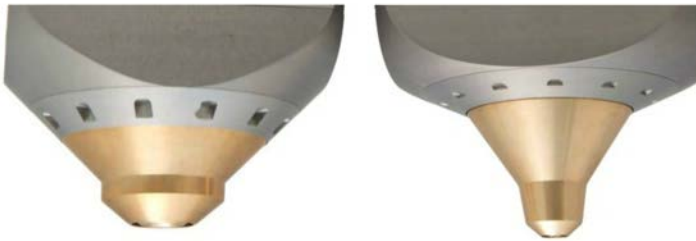


Aubín Award - RAPID 2014 Society of Manufacturing Engineers



Mazak INTEGREX i-400 AM + HMT AMBIT Multitask Tools





Mazak & Hybrid at JIMTOF 2014

Mazak

HYBRID
MULTI-TASKING

World 1st
(Commercial)

HYBRID

mtc



Cyberman at Euromold 2014

cyberman

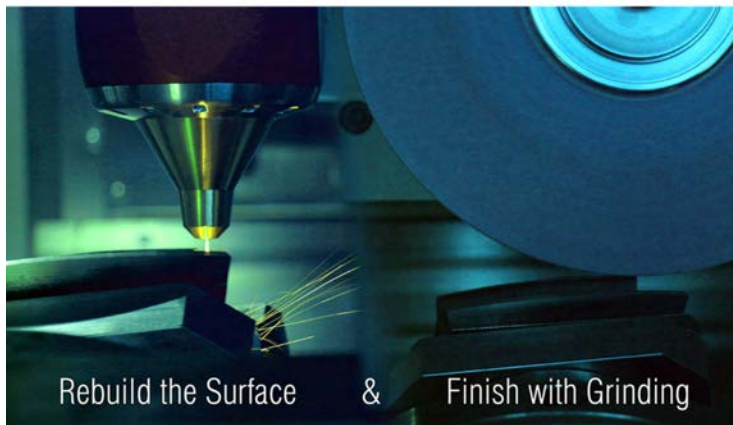
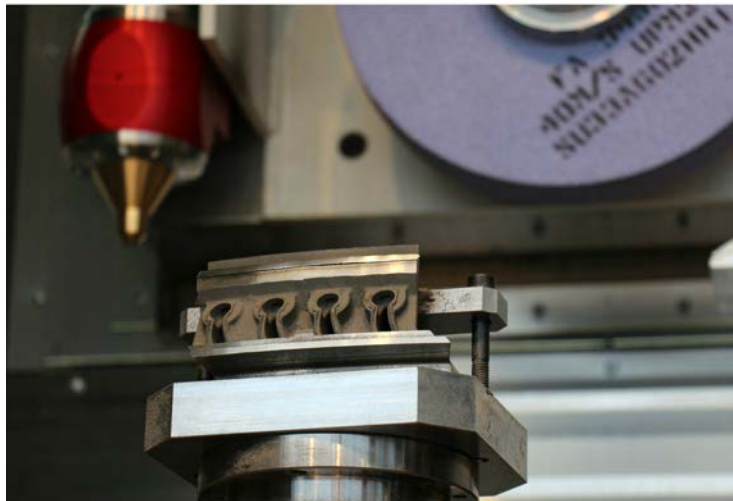


Elb + Hybrid at Pairs Air Show

ELB

HYBRID
MANUFACTURING
TECHNOLOGIES

World 1st
(Commercial)



Rebuild the Surface

&

Finish with Grinding

WORLD'S FIRST
HYBRID GRINDER

PRESENTED BY ELB & HYBRID

Elb + Hybrid at Pairs Air Show



World 1st
(Commercial)



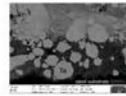
Applications



- repair of high value components (dimensional restoration)



- feature building onto parts "think outside the billet"

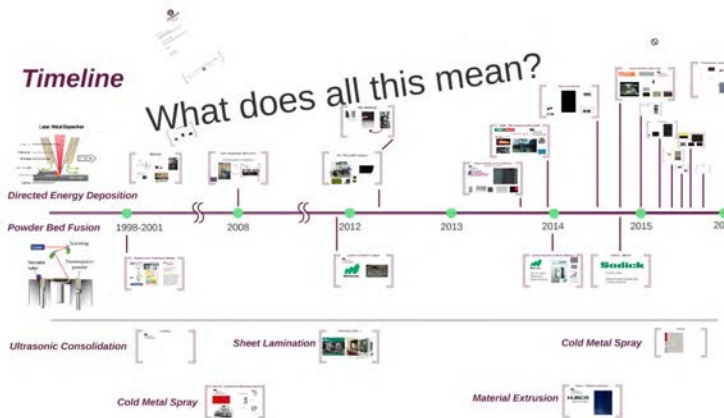


- multi-material product enhancement for high performance (hard facing, corrosion/oxidation resistance, etc.)

Can you grow parts from scratch?

Timeline

What does all this mean?



The time for CNC to be a spectator to the developments in Additive Manufacturing is past.

Hybrid Manufacturing Technologies



www.hybridmanutec.com



AM vs. CNC



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Multi-tasking trend



Hall 9 - Stand A15

The next generation of multi-tasking

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