SHIFT TO MATERIAL CENTERED MANUFACTURING

Dramatically changing the way we **machine** and **manufacture** parts.
Dramatically changing the way we **procure** and **supply** material.
Dramatically changing the way we have to **recover** and **recycle** metal.

New generation metal alloys to meet higher **physical demands**.
Concern about **availability** and **cost** of advanced metal alloys.
**Secondary stream** of metal supply every more relevant ("no scrap left behind").

Search for **innovative** recovery and recycling processes
Search for **advanced** supply and distribution.
Search for solutions of **100%** metal **return** into the supply chain.
TOP 20 AVIATION PROGRAMS: VOLUME MATTERS

- Airbus A320/Neo
- Boeing 737NG/MAX
- Boeing 787
- Boeing 777/X
- Airbus A350XWB
- Lockheed Martin 7-35
- Airbus A33/Neo
- Bombardier Global
- Embraer E-Jets
- Sikorsky H-60
- Gulfstream 650
- Su-30/T-50
- Airbus A400M
- Airbus A380
- Boeing 767/KC-46
- Boeing AH-64
- Gulfstream 500/600
- Gulfstream 550
- Lockheed Martin C-130J
- Dassault Falcon 7/8X

*Cumulative Deliveries Value in '15 $ Bns
PARTNERS ARE BRINGING THE 787 TOGETHER
AIRCRAFT PRODUCTION 2005 - 2024

Information is Largely Sheltered From The Storm; Long-Term Growth, Too

Market Value in '15 $ Bns

- Rotorcraft
- Business Aircraft
- Jetliners/Regional AC
- Fighters
- Military Transports/Trainers/Other
GAME CHANGING PARADIGMS

- Lean – Green – Blue
- Fly Safer, Lighter, Faster, Cheaper, Cleaner
- Advanced Materials: Al-Li, Ti-Al, Niobium, Comp., CMC, Stacked, Honeycomb plus revert programs
- Convergence of OPT and IT, Smart Factory (Industry 4.0, intelligent MFG)
AIRCRAFT ENGINE COMPONENT MATERIAL

- Low Pressure Compressor: Titanium
- Combustor: Super alloys
- Low Pressure Turbine: Gamma Ti Aluminum
- High Pressure Turbine: Super alloys / Powder Alloys
- High Pressure Compressor: Titanium / Super Alloys
- Engine Shaft: High Strength Steels, Super Alloys
- Fan: Titanium Composites
MATERIALS IN AEROSPACE

COMPOSITES
- PMC, MMC, CMC
- Carbon Comp.
- Graphite Comp.

ADVANCED ALLOYS
- Al - Based
- Ni - Based
- Co - Based

SANDWICH MATERIAL
- Al - Ti - Comp
- Ti - Comp
- Al - St - Comp

TITANIUM
- 6 Al V 4
- 5553
- Alpha - Beta

INTERMETALLICS
- Fe Aluminide
- Ni Silicide
- Ti Aluminide
Conquering Titanium

Pathway to High Performance Machining
AIRCRAFT PARTS

Structure parts

Plenum chamber housing

Engine parts

Compressor turbine vane

IMS

CONTRIBUTIONS TO
THE NEXT LEVEL

SOLAR
ATMOSPHERES
Machine
Our horizontal machines have the features necessary to elevate regular Ti-machining to HP-Ti-machining (450-500 sfm) including:

• Dynamic Stiffness
• High Structural And Thermal Stability
• Full Power-full Torque The Whole Rpm-range
• Volumetric Accuracy
• Powerful Controller (Adaptive, NURB, Etc.)
• Vibration Dampening Characteristics
• Advanced Spindle Design (Ceramic, Preloaded, Angular Bearings, High Balance Grade, Etc.)

MUST HAVE DESIGN FEATURES
Tooling
Cutting Tools:
Carbide With Elevated Cobalt
Coating AlTiN
Tangentially-arranged Inserts, Sharp Edges
Multi-Flute-Positive Cutting Edges, High Helixes, High Rake Angels

Tool-holder:
HSK 100 Or CATV-50/60, Hydraulic Chuck, Shrink-Fit

Workpiece Clamping:
Form And Pressure Clamping

Tool Assembly:
High Balance Grade, As Short As Possible, High Rigidity, Secure Torque Transmission, High Repeatability Accuracy.

Application
Two passes preferred (1mm, feed 1mm/rev), ramping in gradually, constant feed, no sudden shifts of feed and speed, pocket milling from mid to side, optimized programming (climb milling, waterline milling; z-type milling)

Note: Ti5553 1/3 less feed/speed, higher cutting forces, more machines stress due to lower frequencies.
For “extreme” part material, complexity & cutting parameters, CVD-D is the “GO-TO” material:

- Thermal Conductivity 50% Higher Than PCD
- Hardness (Vickers 10,000 Kg/Mm2) Double That Of PCD, Equal Or Higher Than ND
- Low Coefficient Of Friction (Close To Teflon)
- No Chemical Degradation Due To Binder Material
• Close Monitoring
• Accurate Accounting
• Precise Information 24/7
• Seamless Interfaces
• True Market Value
• Close Communication
• Reliable Segregation
• Reverts
• Advanced Services
• In Real Time – 24/7

Substantially REDUCING Cost, MITIGATING RISK, Exponentially INCREASING Yield.
INTEGRATING THE NEXT LEVEL IN MANUFACTURING NOW
INDUSTRY 4.0

Production Logistics:
- Automation Planning
- Material Flow Analysis
- Machining Layout

Production Planning:
- Process Analysis
- Cycle Time
- Simulation
- Technology

Production Start/Test:
- Process Visualization
- Remote Diagnosis
- Contingency

Production in Real Time:
- Autonomous Manufacturing
- Global Interfaces
- Material-In Process Monitoring
- Material-After Process Recording
INDUSTRY 4.0

Taking Manufacturing Corporations to the Next Level
You cannot solve *today’s* problems with *yesterday’s* solutions and expect to be competitive *tomorrow.*”

- Dr. Bert P. Erdel