industrial internet CONSORTIUM

Industrial Analytics for Discrete Manufacturing

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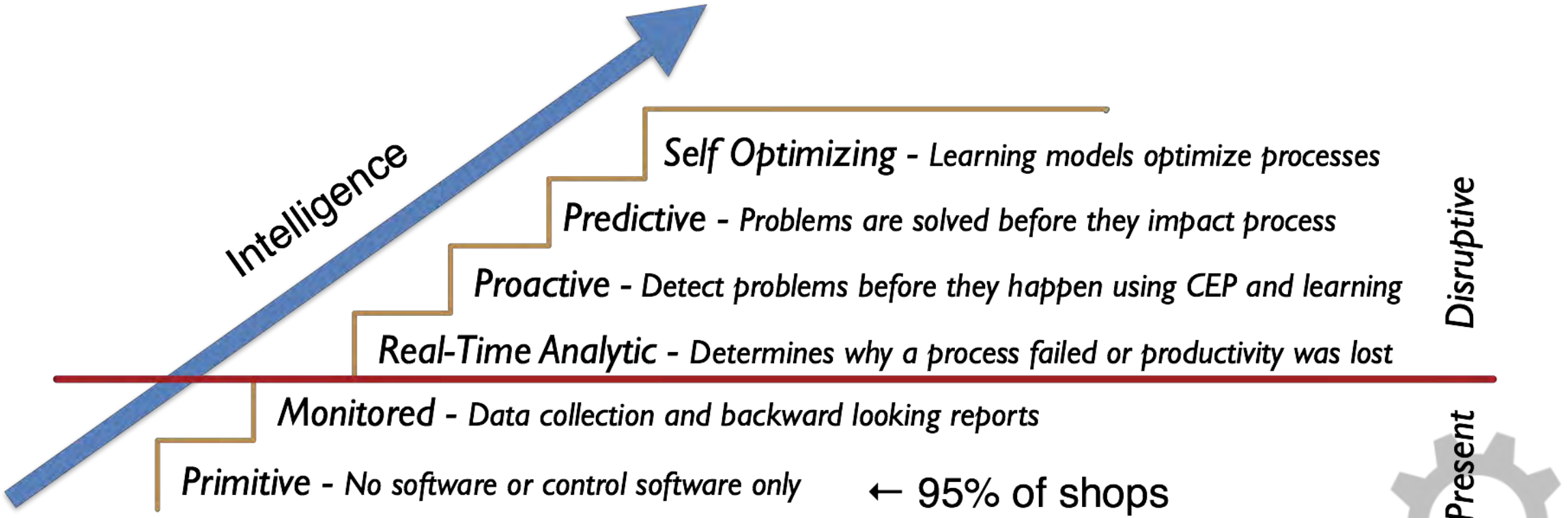
Intelligence



Manufacturing Taxonomy

Continuous Process

Discrete

Food

Automotive

Medical

Aerospace

High Volume/Low Mix

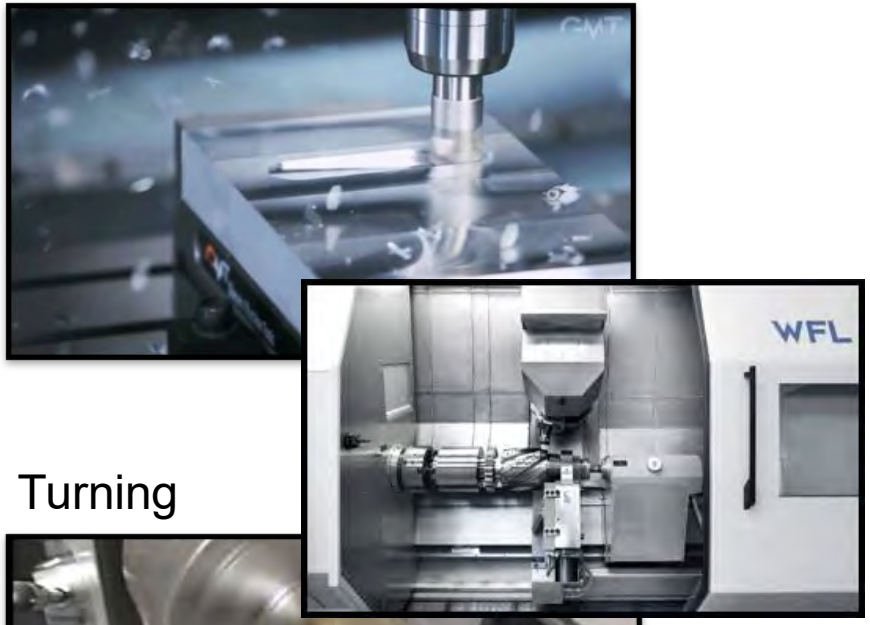
Low Volume/High Mix

Products

Discrete Manufacturing

Traditional

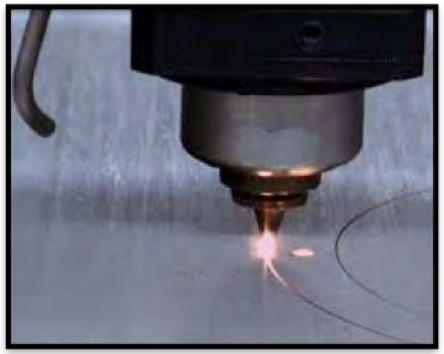
Milling



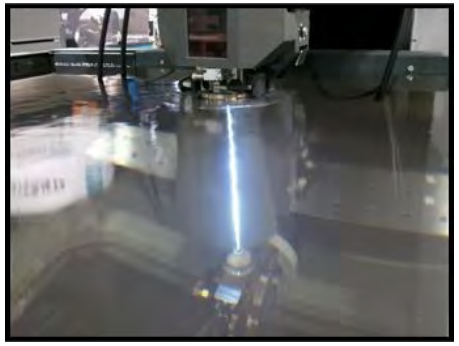
Turning

Non Traditional

Laser



Wire EDM

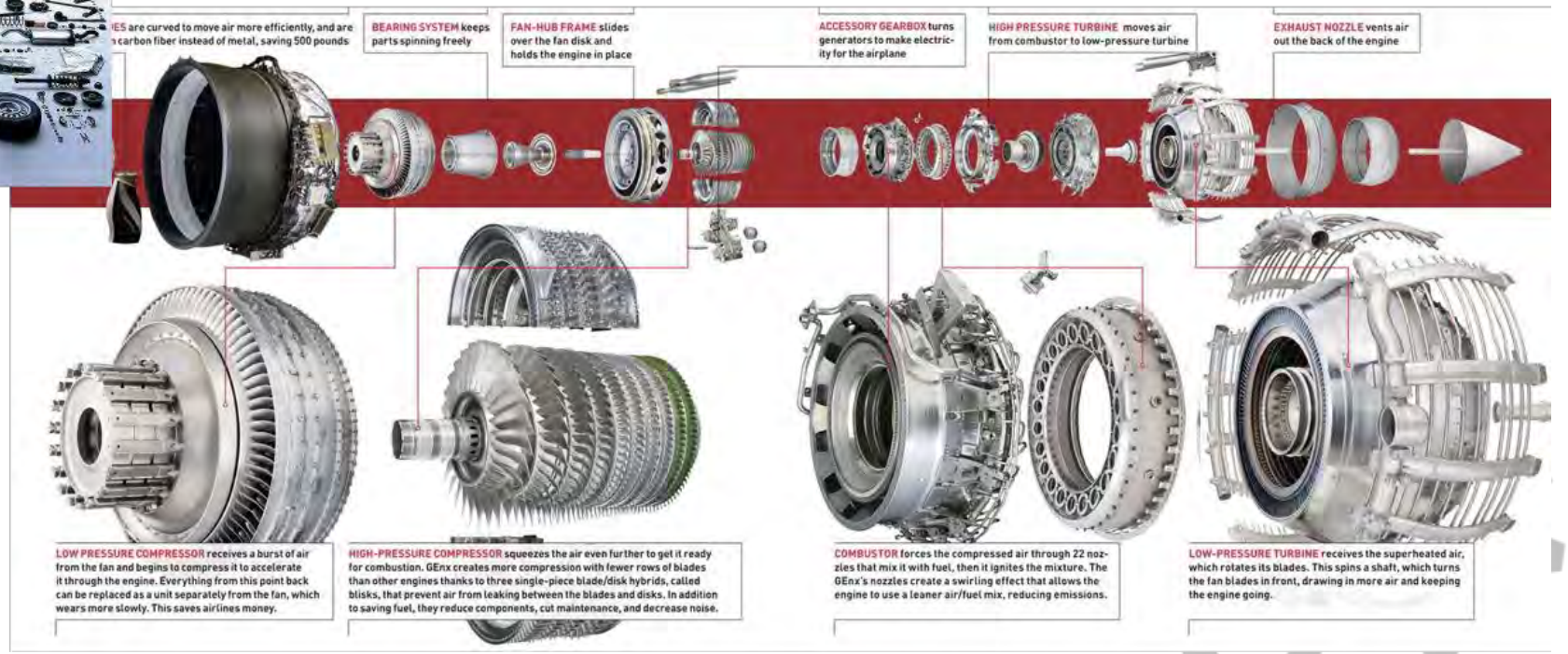


Hybrid Additive

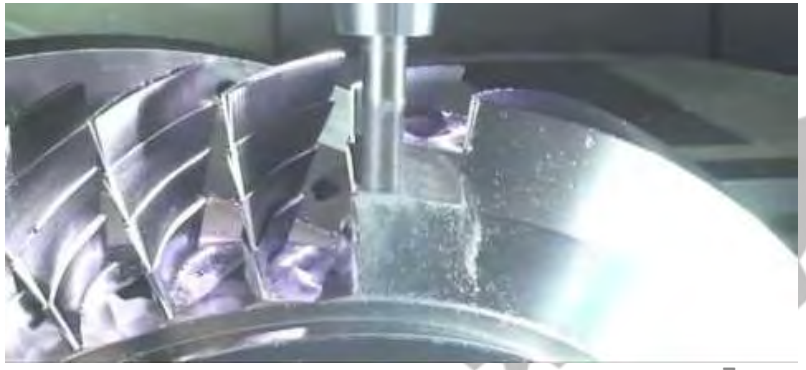
Water Jet

Additive

Everything We Use



Machine Tool Analytics



Context Required

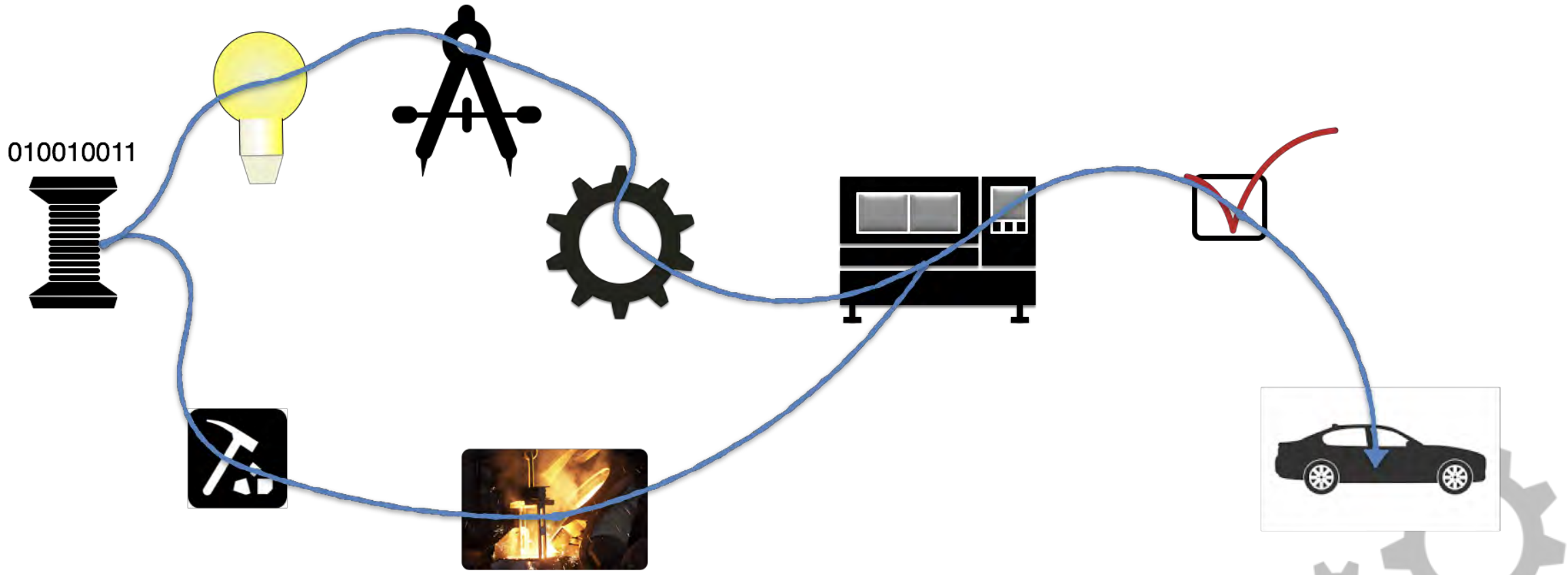
- Equipment
  - Machine Tool Capabilities
  - Cutting Tools

- Process
  - Materials
  - Hardness
  - Geometry
  - Feature
  - Paths

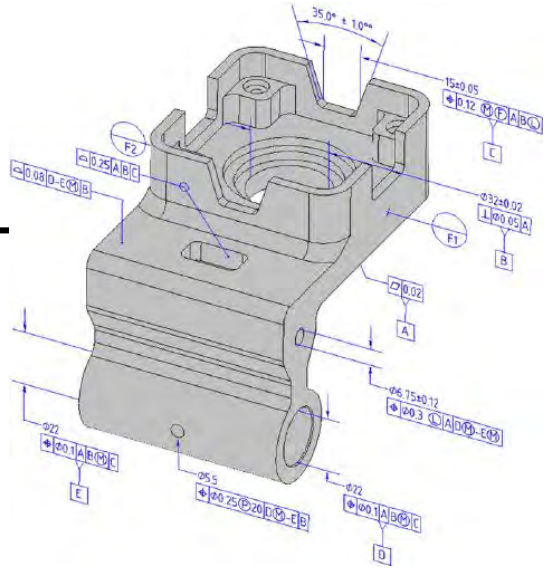
Titanium

Aluminum

Digital Thread

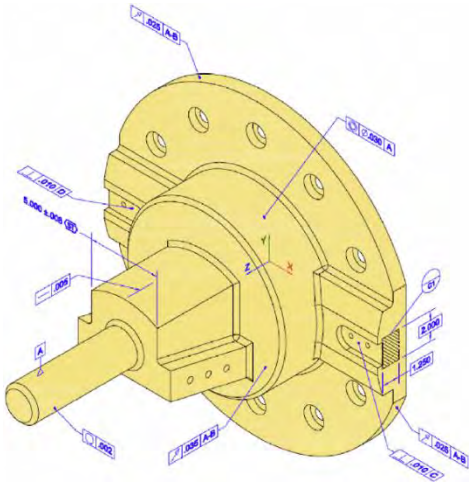


Context and Meaning



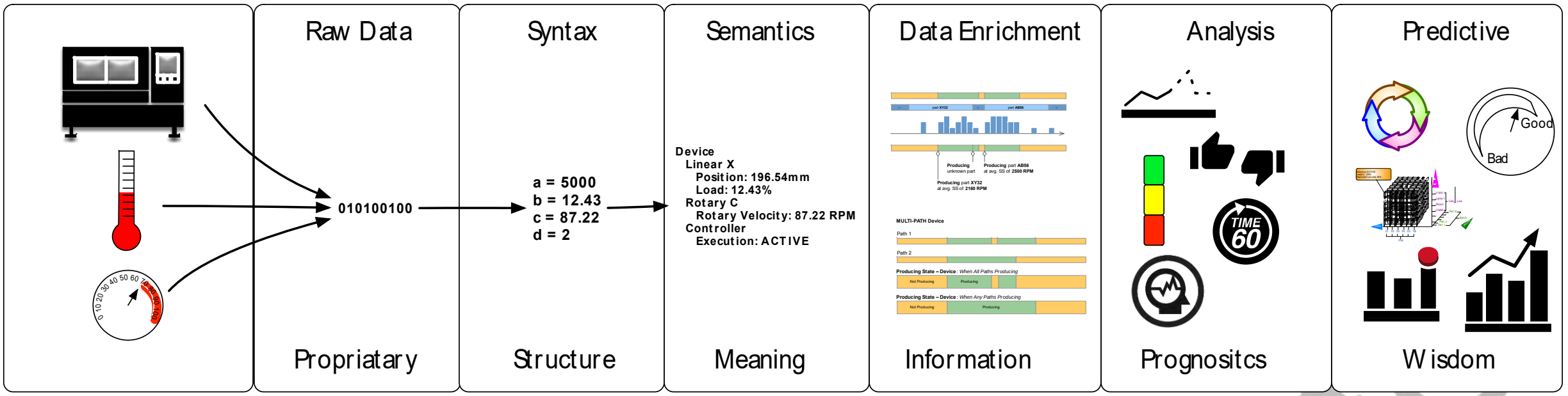
- Unstructured Data Analysis Will **NOT** Work
- Context is key to analytics

- Need semantic models for the complete digital thread
- Geometry, Process, Material, Quality, Finish, Fastening, etc.



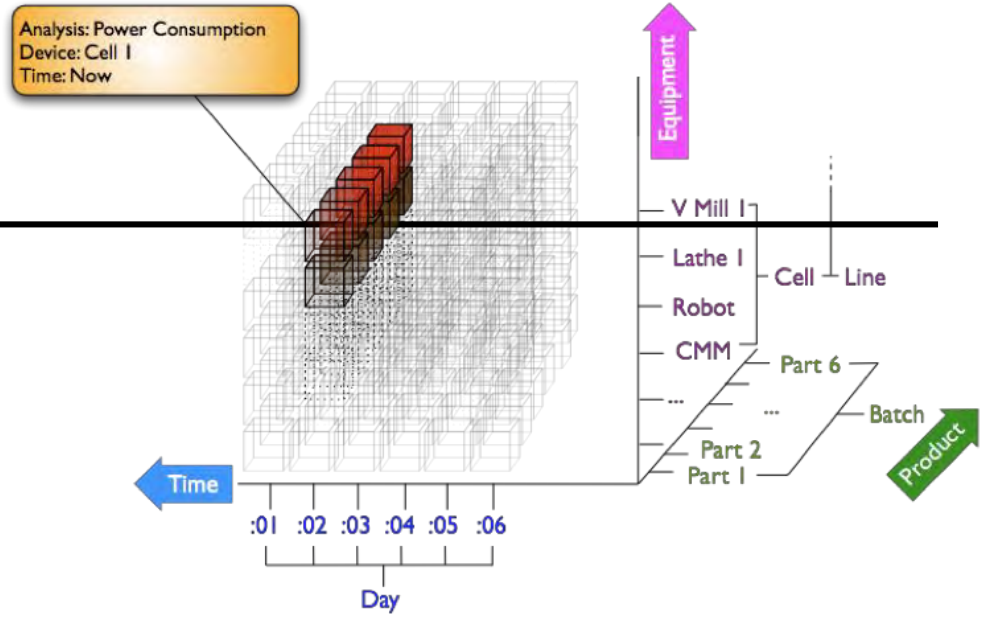
Industrial Data Value Addition

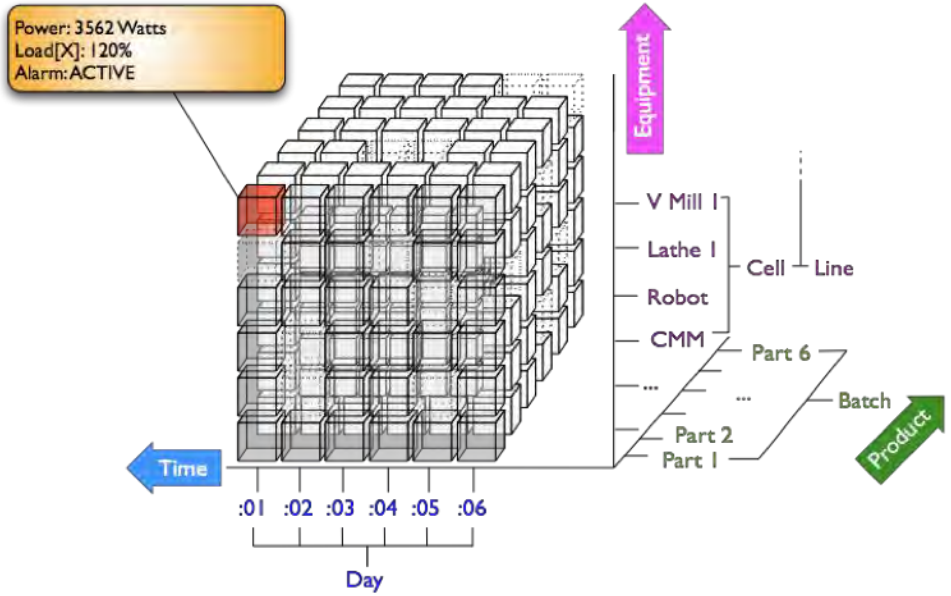
Value

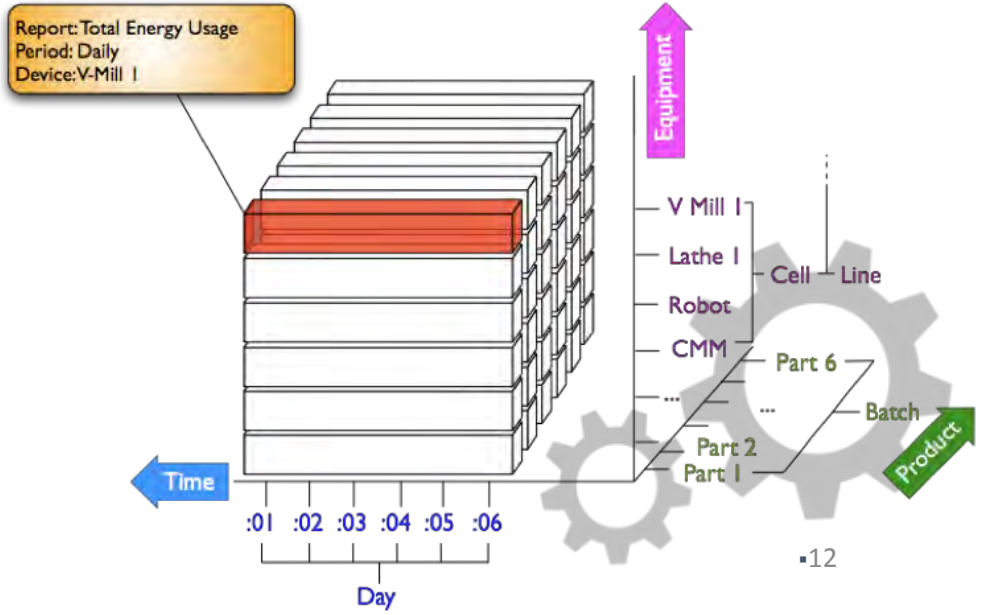


Multidimensional

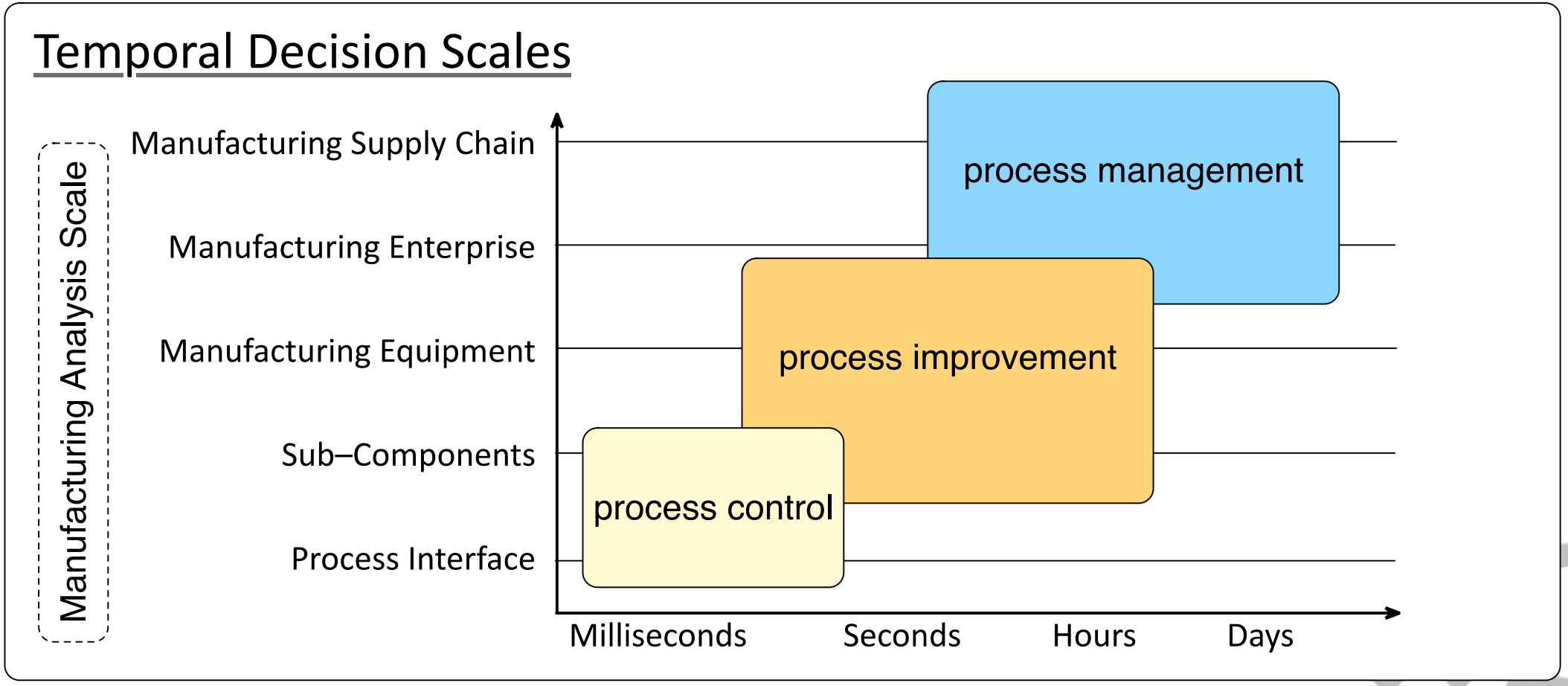
1. Store Everything – Can't create data
2. Distributed analysis: Slice data across any plane, including: time, machine organization, parts – Find patterns and correlations
3. Everything must have context







Determinism



Example: Crowd Sourced Cutting Tool Optimization

Present: Feed – Forward Processes

- Processes
- Part

- Machine
- Tool

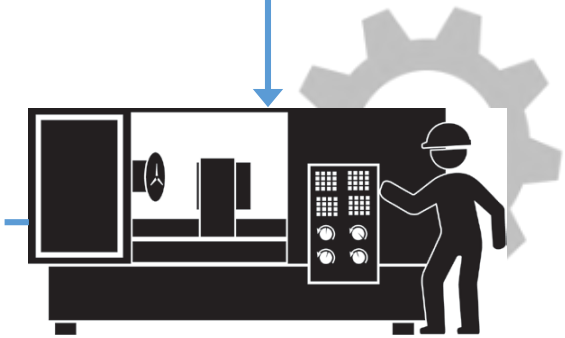
Was the part produced to plan?
- Faster or slower?
- Why?

- Part Program
- Setup Sheet
- Work Instructions

- Best Practices
- Improvement Opportunities
- Deviations from Plan

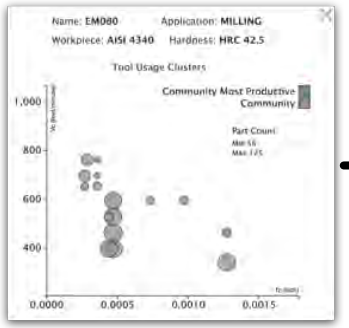
- Tool Breakage
- Poor Surface Finish
- Productivity Gains

- Process Actuals
- Feed/Speed
- Cycle Time
- Operator Feedback



No Robust Feedback mechanism to planning functions.

Crowd Sourced Manufacturing



Knowledge-Based Recommendations
- Optimized Conditions
- Optimized Asset Selection
- Optimized Throughput

Facility

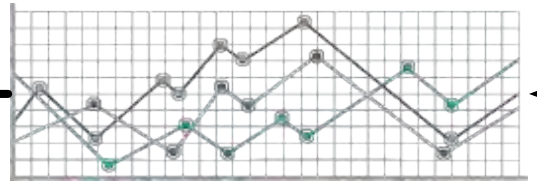
Programs
Instructions, & Plans

Community

Community Instructions, Plans
& Process Data

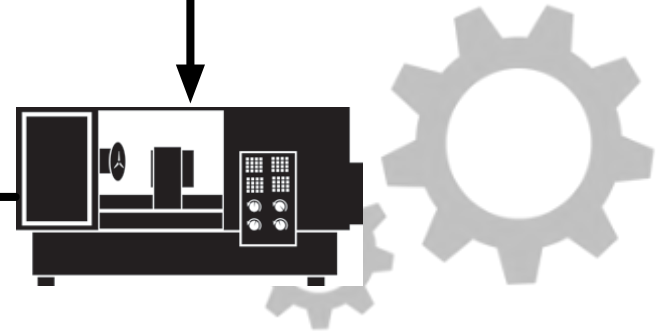
- Rules
- Analytics

Analytics = Data → Knowledge

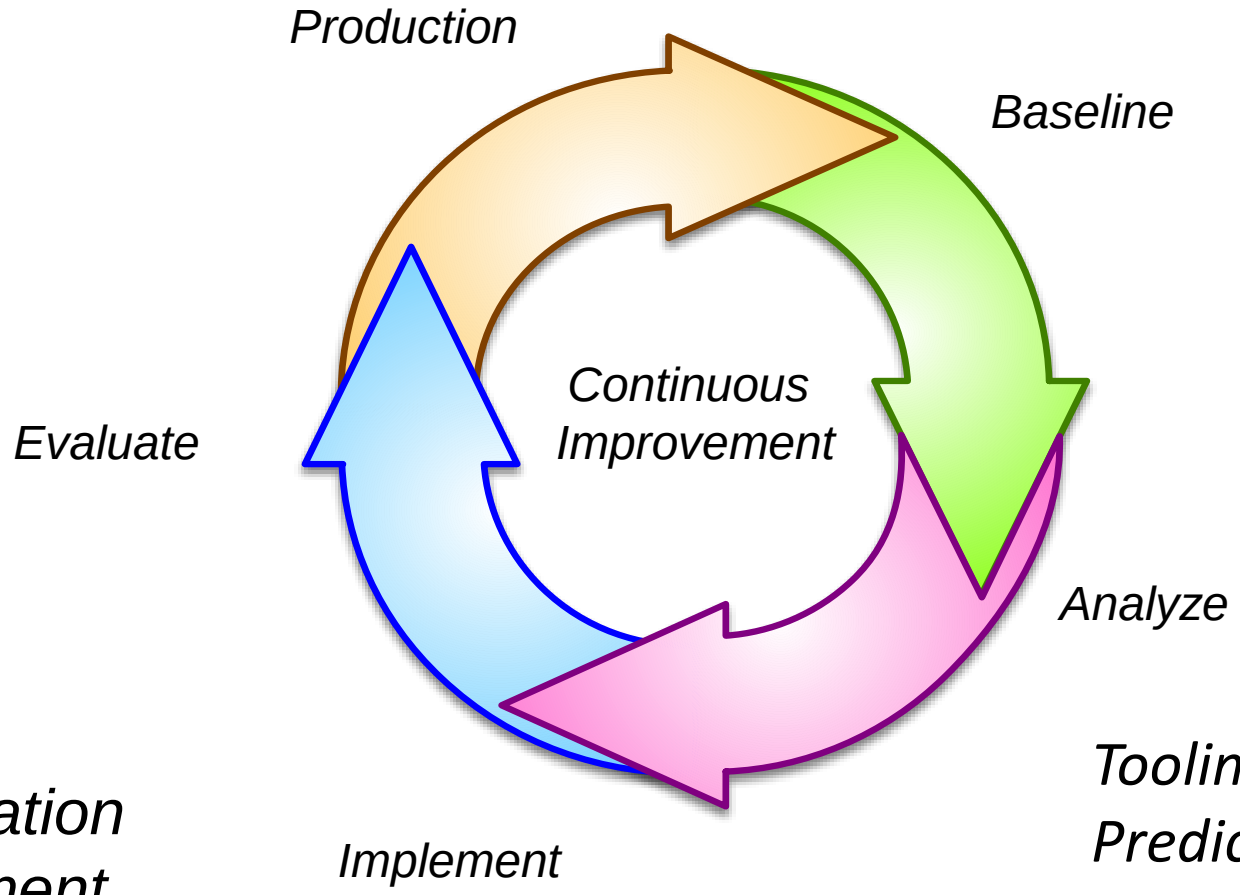


Process Data

MTConnect



Feedback Loop



Execution optimization
Process Improvement
Workforce Training

Tooling Optimization
Predictive Quality
Manufacturing Strategy
Design for Manufacturing

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Thank you