Strategic Thrust: Factory of the Future

Air Force ManTech
Factory of the Future
Vision and Strategic Thrust Plan

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Integrity ★ Service ★ Excellence
Strategic Thrust: Factory of the Future
Thrust plan outline

• Factory of the Future: Rationale & Technical Challenges
• Vision/Definition
• FoF Sub-thrust Descriptions
  • Advanced Automation
  • Factory Command, Control & Communications (C3)
  • Flexible, Reconfigurable Factory Infrastructure
  • Exploitation of Emerging Processes
• Near-term Investments
• Summary
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Vision

FoF: The manufacturing facility (enterprise) that continuously adapts and rapidly responds to a warfighter demand characterized by accelerated change and heightened complexity.

- Small lots + custom configurations: Economy of scope
- Rapidly transitions new & innovative processes into the factory
- Leverages the efficiency of mass production and the flexibility of custom manufacturing
- Enables distributed factory operations
- Fueled by information via the Digital Thread
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**Sub Thrusts**

- Advanced Automation
- Factory C3
- Flexible & Reconfigurable Factory Infrastructure
- Exploitation of Emerging Processes

**Long-term Goals**

Flexible and reconfigurable automation systems working in close proximity with, and augmenting the human workforce.

- Low cost automotive style robots with aerospace precision
- Multi-function automated processes
- Human intelligence/physicality augmented by machines

Omniscient, omnipotent, “God’s eye”-view into all factory ops and resources.

- Real-time process monitoring and self-correction
- Dynamic scheduling, coordination and maintenance of processes
- Autonomous factory floor execution

**NASCAR model of Production, Repair and Maintenance.**

- Move the process to the product
- Eliminate reliance on costly, single purpose tools/fixtures/jigs/processes/etc.

**Accelerated adoption of game changing mfg processes.**

- Rapidly produce advanced product capability with
- Minimal material waste and shortened cycle times
- Value competitive with established processes
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Sub-thrust 1: Advanced Automation

• Definition: Flexible and reconfigurable automation systems working in close proximity with, and augmenting the human workforce.

• Features/Capabilities:
  • Robust sensing & metrology for precision location
  • Smart interchangeable end effectors
  • Adaptive control (Cloud based robotic OS)
  • Automated material handling/delivery
  • Human Augmentation (environment sensing & perception)
    • Augmented Reality
    • Machine Assist
  • Integrated with the existing factory systems

• Near-term Opportunities:
  • Precision Milling/Trimming using flexible arm robots
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Sub-thrust 2: Factory C3

• Definition: “God’s eye”-view into all factory ops and resources. Pervasive instrumentation and connectivity to enable real-time process monitoring and self-correction, dynamic scheduling of processes and maintenance, with autonomous factory floor execution available via the Digital Thread.

• Features/Capabilities:
  • Reliable machine tool and process sensors & enhanced control software
  • Robust, wireless factory communications infrastructure
  • Integration with existing factory control systems (MRP, ERP, MES, etc.)
  • Factory models & simulations driven by empirical data
  • Plug-and-play physical interfaces and architectures supporting ALL processes

• Near-term Opportunities:
  • Machine tool sensor development & integration tied to process optimization models
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Sub-thrust 3: Flexible & Reconfigurable Factory Infrastructure

• Definition: NASCAR model of Production, Repair and Maintenance. Modular, and reusable tools/fixtures/jigs/processes that can be quickly re-configured to respond to high mix production requirements while avoiding large capital and long lead time investments.

• Features/Capabilities:
  • Standard building blocks for tools and fixtures
  • Self locating assembly features
  • Precision metrology for rapid feature location in both local and global coordinates
  • Model driven reconfiguration with build information from the Digital Thread
  • Evolves to completely toolless, fixtureless manufacturing

• Near-term Opportunities:
  • Std building block definitions for aerospace; MobileMake; Mobile Work Instruction Projection
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Sub-thrust 4: Exploitation of Emerging Processes

• Definition: Accelerate adoption of game changing manufacturing processes that rapidly produce advanced product capability with minimal material waste, and shortened cycle time

• Features/Capabilities:
  • Predictive process/performance models
  • Closed loop adaptive control systems
  • Production capable processes/materials (Robust, Reliable, Repeatable: Polymers, Metals, Nano, Emerging Hybrid Materials, etc.)
  • Integration of additive and conventional processes
  • Direct Fab of mechanisms, assemblies, embedded components, and multi-functional systems
  • Direct write processes for electronics
  • Mask-less fabrication
  • Bio and Nano based processing
  • Data driven from the digital thread

• Near Term Opportunities:
  • In situ process control sensors and systems
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Summary of Near Term Wins

Sub-thrust | Near-term “Winnable Steps”: | Long-term Goal
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Advanced Automation | Automated fastener storage, sorting, cleaning, promoting, sealing, and kitting reduces cycle time and labor cost on F-35 | Flexible and reconfigurable automation working closely with, and augmenting the human workforce
Factory C3 | Process parameter information captured & tied to predictive modeling & optimization tools via the digital thread | Omniscient, omnipotent, “God’s eye”-view into all factory ops and resources
Flexible, Reconfigurable Infrastructure | Mobile work instruction projection at point of use across multiple cells/task domains | NASCAR model of Production, Repair and Maintenance. Move the process to the product
Exploitation of Emerging Processes | Initial electronics DW processes & matl’s characterized. Simple, AF relevant, product/feature set demonstrated | Accelerated adoption of game changing mfg processes
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Summary

• Future of AF (DoD) acquisition will **not** be long, large dollar production programs
  – The rapid evolution of our forces, enemies, requirements, innovations & funding will force manufacturing to become more agile

• **Next Generation Agile Mfg** will transform how the Air Force designs, manufactures, and sustains weapon systems in an acquisition environment of continuous change.

The Factory of the Future is the physical embodiment of the manufacturing facility that can continuously adapt and rapidly respond to warfighter demands characterized by accelerated change and heightened complexity.