Digital Manufacturing Testbed: Rationale and Launch Overview

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Digital Manufacturing Testbed: Rationale

“Manufacturers Need to Adopt Innovative Ways to do More with Less”

Barriers
- **Complexity** to Integrate Across Digital Platforms
- Product Requirements
- Product Design
- Process Design
- Supply Chain (tracking + fulfillment)
- Service and Sustainment
- **Sunk Cost** Trap (technical capacity of installed assets)
- **Skill Gap** (technical & human)

Causes
- Technical Knowledge
- In-House Know How
- **Adoption Risk** / Aversion
- Technologies + Methods
- **Time** (staff and production)
- **Business Case** to Invest
- Captive Asset Base
- Reference (benefits/cost)
- Trusted, **Non-Biased Advice**

Effects
- **Long Lead Time**
- Production Inefficiencies
- **Sub-Optimal Supply Chain**
- **Added Steps**, Lost Time
- **Erosion of Competitiveness**
- Individual Companies
- Supply Chains
- Communities
- **Intellectual Property Risks**

Remedies
- Comprehensive Engineering, Manufacturing and Supply Chain **Proving Ground**
- Leadership in **Discovery**
- Collaborative Environment
- Accessible Space
- Validate and **Demonstrate**
- Proof-of-Concept / Pilot
- High TRL, Adoption Ready
- **Disseminate** Knowledge
- In-House and On-Site

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Smart Manufacturing Proving Ground

Address Challenges for Sustaining Competitive Advantage

- Quality, Due Date Precision, Production Cost and Yield, Responsiveness
- Unscheduled Downtime, Cost / Resource Control
- Supply Chain Efficiency, Risk Mitigation, Workforce Readiness

“Optimize digital information flow between and across the enterprise to accelerate the transition to Industry 4.0”

Discover
- Controlled, Integrative Enterprise Platform
- Overcome Barriers to Digital Information Connectivity
- Generate Preliminary Data for Federal Grants
- Develop Content for Demonstration Showcase and Education Programs

Impacts
- More Modern, More Capable Manufacturers and Supply Chain
- Stronger Workforce, More Attractive Industry and Communities

Demonstrate
- Showcase New Methods, the “Art of the Possible”
- Validate Smart Technologies and Applications
- Modernize Manufacturers and their Supply Chain

Disseminate
- Product and Process R&D
- Next-Generation Workforce Development
- Active Translation Service, with MEP
- Support Innovation and Industry Growth

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Facets of Success and Launch Overview

- Cross-Cutting Physical and Cyber-Physical Assets
- Adaptable, Flexible Configurations

Prepare Manufacturers and their Workforce to:

- Address Digital Information and Connectivity Barriers
- Evaluate Architectures, Tools, Methods and Costs to Optimize Approach
- Receive + Automatically Translate Digital Product Specifications and Design Systems into Machine Instructions
- Provide Customers Real-Time Production Status and Quality Trends During Fulfillment
- Automatically Monitor Input Costs and Workflow
- Anticipate and Mitigate Unplanned Downtime
- Leverage Digital Technologies to Human-Proof Processes
- Automatically Monitor Supply Chain

- Discover & Demonstrate (Technologies and Methods)
- Workshops + Technical Services
- Innovation and Prototyping Services

Additional Benefits:

- Improve New Product Introduction Time
- Improve Accuracy and Decision-Making, Minimize Human Intervention
- Tighten Relationships with Customers and Suppliers
- Reduce Lead Times from Product Conception to Production
- Reduce Cost of Documentation and Compliance
- Optimize Product Execution (on-time and on-cost)
- Reduce Operating Costs (nimbleness to optimize asset utilization and delivery times)
- Improve Product Quality and Process Uniformity

- Succeed in Partnership with Local, State, Regional and Industry Participation
- Cross-Cutting Physical and Cyber-Physical Assets
- Adaptable, Flexible Configurations

Outreach

Sustainment

Activities

Infrastructure

Digital Manufacturing

Enterprise Testbed
Scope of Industry and Regional Engagement

Technical Leadership Centers:
- Manufacturing Design Lab (MD Lab)
- Digital Enterprise Center (formerly PLM Center)
- Dauch Center for the Management of Manufacturing Enterprises (DCMME)
- Composites Manufacturing and Simulations Center (CMSC)
- Purdue Discovery Park (>25 Centers and Institutes, dozens of members)

Regional Initiatives and Workforce Development:
- Wabash Heartland Innovation Network (WHIN)
  - 200 Manufacturers in 10-county region, backed by $40M grant
- Leader in Advancing Smart Manufacturing Competencies and Pathways
  - Thousands of K-12 participants in programs and activities
  - Dozens of School Districts and Educators

Innovation Accelerators:
- Purdue Research Park (Innovation and Entrepreneurship Hubs)
- Purdue Aerospace District and WestGate at Crane NSWC
- Purdue Foundry and Elevate Ventures
Infrastructure Overview

2018
• Benchmark other Testbed models
• Interview Dozens of Manufacturers
• Design and Plan Core Building Site
• University Design Review, with PPI “Smart and Connected Factory”
• Alternate, Low-Cost, Rapid Option
• IMI Final Design, Registration, Bid

2019
• MD Lab, 30-January 2019 Opening
• Expansion Project Q1-Q2
• Launch June (est)
• Further Expand Capabilities, Q3-Q4+
• First Workshop, Q4 2019 (~October)

Physical Capabilities
• Composite Materials and Forming
• Subtractive Machining
• Automation, Sub Assembly and Final Assembly
• Metrology
• Adaptable Configurations and Work Environments
• Material Flows: Work in Process and Warehousing
• Rapid Product + Process Development, Prototyping
• Supply Chain Integration

Infrastructure Highlights
• Jan: COMPOSITES MATERIALS and FORMING (MD Lab), to launch 30-January 2019
• Construction Bids (receive); Fully Launch Expansion Project
• SITE NECESSITIES INCLUDE: Integrative MES, Subtractive Tooling (basic), Assembly Area, Metrology (basic), Rapid Prototype (basic)
• Feb – Mar: Finalize Scope and Specifications for Equipment
• Apr – May: Finish Install
• Jun – Jul: Occupy + Commission

Adaptable Configurations
Recap
Digital Manufacturing Testbed: Will Address

**Trends**
- Industry 4.0
  - Automation and Data Exchange
  - Integration of Physical and Cyberphysical
  - Ubiquitous Interconnectivity
- Internet of Things
  - Sensors, Platforms, Architecture
  - Prevalence of Low-Cost Information
  - Analytics ➔ Insights
- Big Data and Deep Analytics
  - Manage and Leverage Information

**Value Drivers**
- Core Capabilities
  - Production Agility
  - Workforce Competence
  - Equipment Maintenance
- Competitiveness
  - Production Cost & Yield
  - Quality Assurance
  - Due Date Precision

**Industry Needs**
- Operational Performance (line, plant)
  - Timely, In-Shift Information
    - Cycle time, Flow / Throughput, Delivery
  - Adaptability, Resilience
    - Fulfillment, Change Orders, Job Changes
  - Human Factors
- Quality and Acceptance
- Leverage Information (enterprise)
  - Accessible Insights “eliminate paper”
  - Fiscal Control
    - Inventory, Spare Parts, Shipping, Receiving
    - Cost Accounting (materials/methods, labor, utilities)
Testbed Use Case

Objective

User Goal

Sub-Function

Testbed Capabilities

what

why?

how?

Develop Knowledge

Demonstration

Component Design and Manufacture

Systems Design: Scale for Efficiency & Speed

Supply Chain: End to End Enterprise

Optimize Quality and Productivity

Workforce Development

Validate

Prototype + Develop

Product Lifecycle Management

Operations Mgmt., Distribution, Logistics

Short Courses (seminars, badges, certificates, CEUs)

- PHYSICAL | metrology (contact + non-contact), characterization, disassembly
- DIGITAL | compare model to actual
- COST MODELING | materials selection, manufacturing methods
- MATERIALS SELECTION
- COMPONENT SIMULATION
- DESIGN for MANUFACTURE
- MANUFACTURING METHOD
- BETA TESTING, PILOT RUNS
- TECHNICAL REFINEMENT
- OPERATIONS + MAINTENANCE
- APPLICATION of DIGITAL TWIN | optimal interoperability throughout enterprise
- PRODUCT DEFINITION | 3D model, manufacturing variability
- DATA INTEGRITY | ubiquity, secure / appropriate access, computational efficiency
- DATA ACQUISITION + SENSORS
- INFORMATION MANAGEMENT | AI, IoT, deep learning
- PREDICTIVE MAINTENANCE
- ENTERPRISE STATILITY & CYBERSECURITY | line, plant (boundary layer / edge), supply chain, value chain, global net
- PRODUCT LIFECYCLE MANAGEMENT METHODOLOGY
- INDUSTRY 4.0 | methods, architecture, systems integration
- INDUSTRIAL ENGINEERING
- IoT APPLICATIONS / CODING
- LEVERAGING IoT and BIG DATA (mechatronics, maintenance, operations management)

"Optimize digital information flow between across the enterprise to accelerate the transition to Industry 4.0"
BACKUP
Leverage Institutional Strengths to Build a Stronger, More Capable Manufacturing Ecosystem

**Expertise to address chronic manufacturing challenges**
- Outreach to stakeholders across Indiana
- Deliver technical solutions throughout Indiana, in partnership with MEP
- Lead portal for workforce development and research

**Incumbent workforce education**
- Manufacturing talent pipeline, K-16
- Accessible, interconnected college to university pathways
- Courses and instructional development in areas of present and emerging demand
- Partnership with professional societies

**Digital Manufacturing Enterprise Testbed**
- Research to address digital information connectivity barriers to overcome chronic industry challenges
- Demonstration of new technologies
- Next generation workforce development
- Product scaling expertise and capacity for Indiana start-ups and growing enterprises

- Research consortia with Indiana manufacturers
- Develop methods and tools to solve imperative manufacturing challenges
- Dissemination channels for technology solutions and education programs
- Lead portal from Industry for technical support, workforce development and research