NCDMM Overview & Sustainable Manufacturing

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Mission Statement

Deliver optimized manufacturing solutions that enhance the quality, affordability, maintainability, and rapid deployment of existing and yet-to-be developed defense systems. Collaborate with government, industrial, and academic organizations to promote the implementation of best practices to key stakeholders through the development and delivery of disciplined training, advanced technologies, and methodologies.

Created as a non-profit organization to develop and deliver manufacturing solutions to the Department of Defense and its industrial base. The successes of the NCDMM help assure the readiness and sustainment of needed defense systems. These successes are widely recognized by Air Force, Army, Marine Corps, and Navy organizations as well as their contractors.
About the NCDMM

Primary Program Sponsor
• Manufacturing, Science and Technology (MST) Division of the Aviation and Missile Research, Development and Engineering Center (AMRDEC) – Huntsville, AL

Customer Base
• DoD Facilities – Depots, Arsenals, Shipyards, Program Offices, etc.
• Primes and tiered suppliers – Lockheed Martin, Boeing, BAE Systems, etc.
• Extended Enterprise – (SMEs)

Locations
NCDMM Headquarters on campus of Alliance Partner Kennametal Inc., Latrobe, PA
Letterkenny office located in the Letterkenny Industrial Development Authority Building, Chambersburg, PA
NCDMM provides a robust offering of advanced and innovative manufacturing services in a number of markets.
NCDMM Alliance Partners (88)
Manufacturing Consortium

Objective
• Enable manufacturers to better support defense outsourcing opportunities

Manufacturing Consortium
• Established in western PA
• A national program
• Over 200 various-sized manufacturing firms
• Many firms classified as small disadvantaged businesses HZ, WO, VO, 8A, DV and others
• A growing national organization of small and medium size manufacturing businesses engaged in the defense supply chain
**Project Examples/Savings**

**Chinook - Bulkhead Optimization**

*Objective:* Reduce weight and improve reliability of floor frame bulkhead

*IMPACT:* 15% Weight Reduction

**Navy Propulsion Shaft Machining**

*Objective:* Reduce shaft taper inspection time from 74 man hours to 24

**IMPACT/COST AVOIDANCE:** $8M

**Picatinny Arsenal XM982 Excalibur**

*Objective:* Eliminate a production bottleneck from 40 hours/part to 1.5 hours/part

*IMPACT/COST AVOIDANCE:* $75M

**795 Armor Drill Kits – OIF/OEF/CONUS**

*Objective:* Provide Armor Drill Kit to Drill Up Armor in the Field

*IMPACT:* Reduced installation time 30%

**Black Hawk Ti Rotor Component**

*Objective:* Improve manufacturability from 60 to 95 pieces/week

*IMPACT/COST AVOIDANCE:* $2.2M

**Edge-of-Part Composite**

*Objective:* Reduce cost of trimming composite wing skins

*IMPACT/COST AVOIDANCE:* $225M
Sustainable Manufacturing

**What is Sustainable Manufacturing?**

“Sustainable Manufacturing is the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, and are economically sound and safe for employees, communities and consumers.” (per the U.S. Department of Commerce)

**Why Sustainable Manufacturing?**

- Government regulations, penalties, and tax incentives
- Continuous improvement / Cost savings / Remain competitive
- More with less in these times of budget cuts and constraints
- Drives a positive culture in the organization
- Positive public image
- **Resource Responsibility vs Resource Entitlement**
DoD Sustainable Manufacturing
- some initially identified opportunities -

• Consider systems view
  – Can we optimize the factory performance balancing lead time?
    • production rate and quality constraints with environmental impacts/energy savings?

• Machine tool design
  – Energy recovery…”hybrid machine tool”?

• Machine tool operation
  – Process sequence effects
  – Increased productivity (cycle time reduction) → increased efficiency
  – Tooling and fixturing impacts (reduce accel/decel?)

• Supply chain (primes→sub tiers →shops/depots, arsenals, ALCs)
  – Green Mfg. Assessments
  – Track materials, embedded energy/water/resources/social metrics
  – Transportation can be big contributor to environmental impact in mfg.

• Re-Manufacturing and re-use
  – Manufacturing systems and machines “leased” and returned?
  – Re-cycling of machines, tools and systems; design for recycling
  – Total Life Cycle considerations including material recycling
NCDMM Sustainability Activities

- Sustainable Aerospace Manufacturing Initiative (SAMI)
- Energy Monitoring for Defense Readiness and Availability (EMDRA)
- Sustainable Cell Initiative (SCI)
- Mission Ready Sustainability Initiative (MRSI)
- Others
Objective
Worked with AFRL/RMX to define, establish and document sustainable manufacturing optimization projects to be executed under the SAMI Program.

Statement of Work
1) Conducted an industry survey to identify current sustainability initiatives, best practices, and identify barriers to sustainable manufacturing efforts.
2) Benchmarked existing energy efficient machining processes.
3) Established a manufacturing sustainability assessment tool.
4) Conducted targeted assessments at aerospace supply chain facilities, identifying opportunities for sustainable manufacturing improvements.

Benefits:
Produce military systems with less energy consumption, minimized environmental impact, and reduced environmental footprint associated with manufacturing without compromising performance or increasing cost.
Leverage Prior Organic Industrial Base (OIB) Manufacturing Assessments Process

Customer/Stakeholder: U.S. Army

Weapon System: Multiple

- OIB Site assessments completed for:
  - Tobyhanna Army Depot
  - Bollinger Shipyards
  - ARDEC PIF
  - Bluegrass Army Depot
  - Picatinny Arsenal PIF
  - Hill Air Force Base
  - Rock Island Arsenal
  - Watervliet Arsenal
Industry Survey Results

- Collaboration with industry and academia on sustainable manufacturing
- NCDMM and Berkeley’s Laboratory for Manufacturing and Sustainability (LMAS) partnered to develop the survey
- 38 organizations responded to the survey
- Key results were collected:
  - 60% responded having formal green initiatives
  - 60% are funding through operational budgets
  - 25% are using some type of renewable energy
  - Reducing energy costs was the primary driver (37%)
  - >50% have no way of tracking environmental metrics and don’t anticipate tracking them within the next 2 years

Assessment Process

- AFRL identified the need for an assessment tool to identify a consistent method for measuring sustainable metrics
- NCDMM subcontracted TechSolve to host a workshop to establish assessment criteria
- NCDMM led a team who reviewed 6 different existing assessment tools
- The team conducted 3 on-site assessments at:
  - Remmele Engineering
  - GKN Aerospace
  - GE Aviation
A Product “Life-cycle”
- focus on manufacturing -

Manufacturing
NCDMM Assessment Protocol

The NCDMM utilizes a three part process to conduct on-site assessments within the USAF industrial base. The flow diagram describes the process leading up to and including conducting an onsite assessment.

Step 1: With AF Approval, present the program to a potential participating facility. Identify a process or product for assessment and collect the required preliminary information.

Step 2: Work with the facility to populate the pre-assessment questionnaire with all additional information required prior to onsite visit.

Step 3: Conduct onsite visit and collect data on the identified process or product. Compile the data to create a report on the findings.

Key
- Inputs
- Process
- Outputs
- Resources
Energy Monitoring for Defense Readiness & Availability (EMDRA)

Current Approach:
- Single energy meter to measure entire plant

What is **not possible**:
- Understand patterns in energy usage per machine tool or cell
- Understand product sustainability
- Granular control over sustainability and environmental impacts

**Limited Data == Ineffective Decisions**

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Energy Monitoring for Defense Readiness & Availability (EMDRA)

Objective
Establish an industry accepted test methodology and technique to monitor health, performance, and energy consumption at the machine tool level. Provide an unbiased insight into the tool energy efficiency of a specific machine.

Statement of Work
1) Evaluated current machine tool and energy efficiency standards
2) Developed a test methodology and technique for evaluation
3) Validated the established test methodology
4) Led to the development of the Baseline Energy Consumption (BEC)* test and metric to standardize assessment of the energy consumption of metal cutting machine tools.

* BEC metric has applications in return of investment calculations, quantification of energy efficiency improvements, carbon footprint analysis, as well as health and maintenance of machine tools.

Benefits:
Reduction in energy consumption, improved productivity, and reduction in unscheduled machine tool maintenance.
EMDRA Led to VIPER Development

- Baseline Energy Consumption (BEC) Model led to the development of VIPER
- Software platform for real-time analysis of energy usage and environmental impact of global manufacturing systems
- Apply energy metering and sustainability measurement per-machine, cell, line, shop, enterprise

What is possible:
- Real-time decision making to improve sustainability
- Machine-level and process-level optimization of sustainability
- Granular control of process and product impacts

Rich Data == Effective Decisions
VIPER Technology

- Built using successfully commercialized ManTech projects
  - EMDRA project for developing Baseline Energy Consumption standard for machine tools
  - SAMI project for developing sustainability assessment metrics

- Build on top of vimana
  - Industry leading platform for real-time manufacturing data analysis
  - Real-time complex event processing
  - Historical machine learning and elastic data storage
  - Improve shop floor efficiency, productivity, and sustainability
Objective: To develop a machining cell that will serve as a benchmark for sustainable machining technology. This cell will incorporate sustainable manufacturing technologies that will conserve energy, reduce waste streams and minimize overall environmental impact.

Program evaluated the following:

- Machine cell monitoring technology
- Advanced cutting tool technology
- Cutting fluid recycling system
- Tool path optimization software
- High pressure coolant experimentation
- Lean manufacturing technology
- Cutting tool simulation software
SCI - Advanced Tool Optimization

**Roughing Process**
- 0.75” dia, x5 FL x No Ports
- 0.75” dia, x5 FL x 1 Port per Flute

**Axial Depth of Cut (ADOC) Process**
- 0.75” dia, 2,125 LOC x 5 FL No Ports
- 0.75” dia, x5 FL x 2 Ports per Flute

**Finishing Process and Corners**
- 0.5” dia, x8 FL x 1 Center Port
- 0.5” dia, x5 FL x 1 Port per Flute

**Face Milling – Beyond Blast**
SCI - Machining Efficiency thru Simulation

Cutting Tool Path Process Optimization
- Volumill Universal versus conventional machining
- Third Wave Systems tool path optimization
- Vericut Opti-path tool path optimization
- Tool Monitor Adaptive Control (TMAC) Real Time System
SCI - Energy Improvement thru Optimization

At beginning of project, baseline part took 458 minutes to machine. As a result of implementing high pressure coolant, advanced tools and simulation optimization, the baseline part now takes 127 minutes. Huge Energy Savings!
Manufacturing as part of the whole Life Cycle
Mission Ready Sustainability Initiative (MRSI)

Vision of MRSI
“Create a private sector led and financially self-supported initiative that will work collaboratively with DoD and the military Services to address rapid deployment of existing manufacturing efficiency strategies to enhance the mission ready sustainability of products and services supporting the war fighter while reducing cost and improving the global environment throughout the supply chain.”

Key Issues
• Strategic drivers include DoD Strategic Sustainability Performance Plan, the Air Force Energy Plan and Presidential Executive Order 13514 and 13423 which requires specific management strategies to improve sustainability
• Current and anticipated DoD budget reductions threaten to hinder progress
• Private sector has successfully calculated and reduced life cycle costs through implementation of corporate sustainability programs
• Many of these programs and initiatives can be shared with the DoD in ways that can assist in efforts to achieve program cost savings
Mission Ready Sustainability Initiative (MRSI)

Initial Program Deliverable
• Develop a MRSI Roadmap including specific, actionable sustainable strategies addressing a broad array of cost saving projects. This will be the driving document for the Steering Committee and Work Groups

Steering Committee
• Comprised of key private sector supporters (financial supporters)
• Representatives from OSD, Army, Navy, Air Force (committee liaisons- non-financial supporters)

Working Groups
• Potential groups include – chemical and materials, sustainable manufacturing technologies, supply chain, energy and water…
Other efforts / Socialization

- **Sustainable Chemical & Materials for Defense Forum**
  - Working with OSD on integrating sustainability into DoD acquisition programs
  - Helping to organize a track at DMC 2012

- **Co-chairing NDIA Mfg. Division, Technology Committee Sustainable Mfg. Sub-Committee**
- **Sustainable Manufacturing Conference Planning team**
- **Developed a users community on the VOICe Supply Chain Social Network**
- **Led 2 tracks at DMC 2010 bringing together industry, academia and the DoD**
- **Organized a workshop in St. Louis focused on developing a methodology and documented process to conduct assessments**
- **Attended and presented at numerous conferences and workshops**
Spreading the word…

Sustainable Cell Results Published in the Aerospace & Defense Manufacturing Engineering Magazine 2011

NCDMM Sustainable Activities published in Live Better Magazine 2012
Conclusions

- SAMI laid the groundwork to support the DoD’s sustainability strategic drivers
- The NCDMM has extensive experience conducting and managing industry assessments— from machine to cell to facility level
- The NCDMM recognizes the need to continue to support sustainable manufacturing efforts and continues to stay involved
- The NCDMM has numerous strategic partners and has organized a variety of workshops and round table discussions with industry, academia and DoD thought leaders
- The NCDMM has become a leader in sustainable manufacturing methodologies and continues to create a sustainability thread across all our program areas and within our services
- The NCDMM is currently working on developing the MRSI and integrating sustainability into DoD acquisition programs
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