Development of Industrial Assessment Metrics and Procedures

LMAS

Funding Sources: National Center for Defense Manufacturing and Machining, U.S. Air Force

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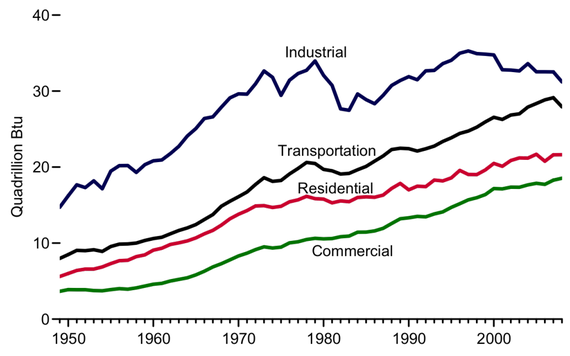
Motivation

- Manufacturing processes are resource intensive
  - 31% of total U.S. energy usage is due to industrial activities (U.S. EIA)
  - 19% of total world global warming potential (GWP) emissions (Herzog 2009)
- Growing environmental concern has made it important for manufacturers to fully understand and characterize their processes, tools, and equipment to meet increasing regulations and customer demands

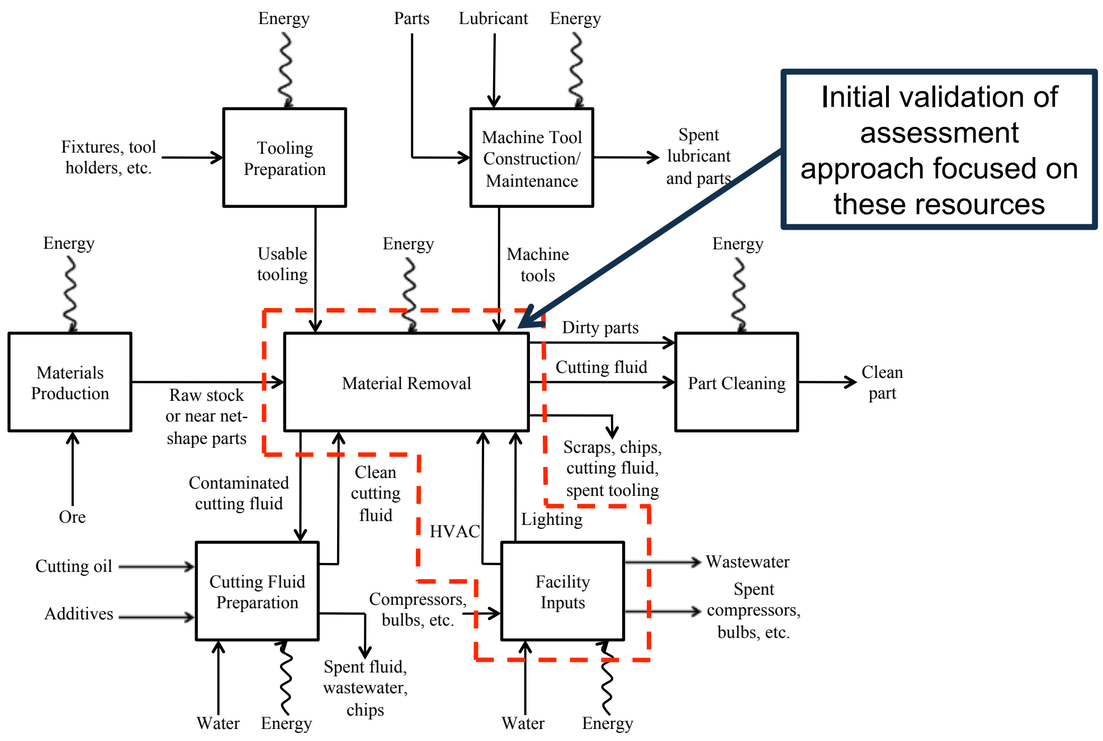


U.S. energy consumption by sector (U.S. EIA)

Introduction

- The goal of this project was to develop a standardized methodology to assess manufacturing facilities at the cell and process level
- Three sustainability assessments of various manufacturing facilities were performed in order to inform the development of the standardized methodology
- Resources studied: Tooling, Energy, Industrial Fluids, Raw Material, Water, Waste, and Human Impacts

Resource Flows in Machining



Metrics Development

- The metrics were defined around the functional unit of the production of a part
- Facility data, when available, was amortized over the number of machine tools and parts produced
- The metrics fell into the following categories:
  - Power demand and energy consumption (e.g. idle power demand, processing energy consumption per year, etc.)
  - Production efficiency/OEE (e.g. availability, efficiency, etc.)
  - Process consumables and facility over head charges (e.g. coolant consumption, water consumption, tool life, etc.)
  - Process waste (e.g. rework rate, scrap rate, etc.)
  - Return on investment (e.g. ROI)
  - Human safety (e.g. max noise level, injuries per year, etc.)

Remmele Engineering

- Site: Remmele Engineering, Big Lake, MN
- Date: November 18-19, 2010
- Process(es) Studied: Two machine tools performing similar machining operations
  - Hydromat Rotary Transfer Machine Tool
  - Citizen Swiss Machine Tool
- Key Goals:
  - Baseline resource usage of machines to create gripper component
  - Comparative analysis of resource use between machine tools
  - Compare older and newer machines

GKN Aerospace

- Site: GKN Aerospace, St. Louis, MO
- Date: December 15-16, 2010

GKN AEROSPACE

- Process(es) Studied: The resource consumption for the production of a test piece
  - Cincinatti H5-1000 Machine Tool
- Key Goals:
  - Assess the sustainability of the Magnum test cell
  - Establish a baseline of the resource usage of the cell for future assessments

General Electric (GE) Aviation

- Site: GE Aviation, Madisonville, KY
- Date: February 8-10, 2011
- Process(es) Studied: Turbine airfoil hole drilling line
  - Grinding
  - Smear electrical discharge machining
  - Current electrical discharge machining
- Key goals:
  - Baseline resource usage of machines to create finished airfoil
  - Compare older and newer machines

Conclusions & Future Work

- Results from the assessments can be used to identify savings opportunities in existing processes
- The data collected in these assessments can be used to establish a baseline/standard to which manufacturing or machining processes can be compared against
- Using this baseline, process level improvements can be explored to increase the resource efficiency of the machine tools and processes
- More assessments are needed to establish a baseline and further refine the methodology

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