Production Monitoring for Performance and Energy Efficiency Improvements

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University of South Florida

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Outline

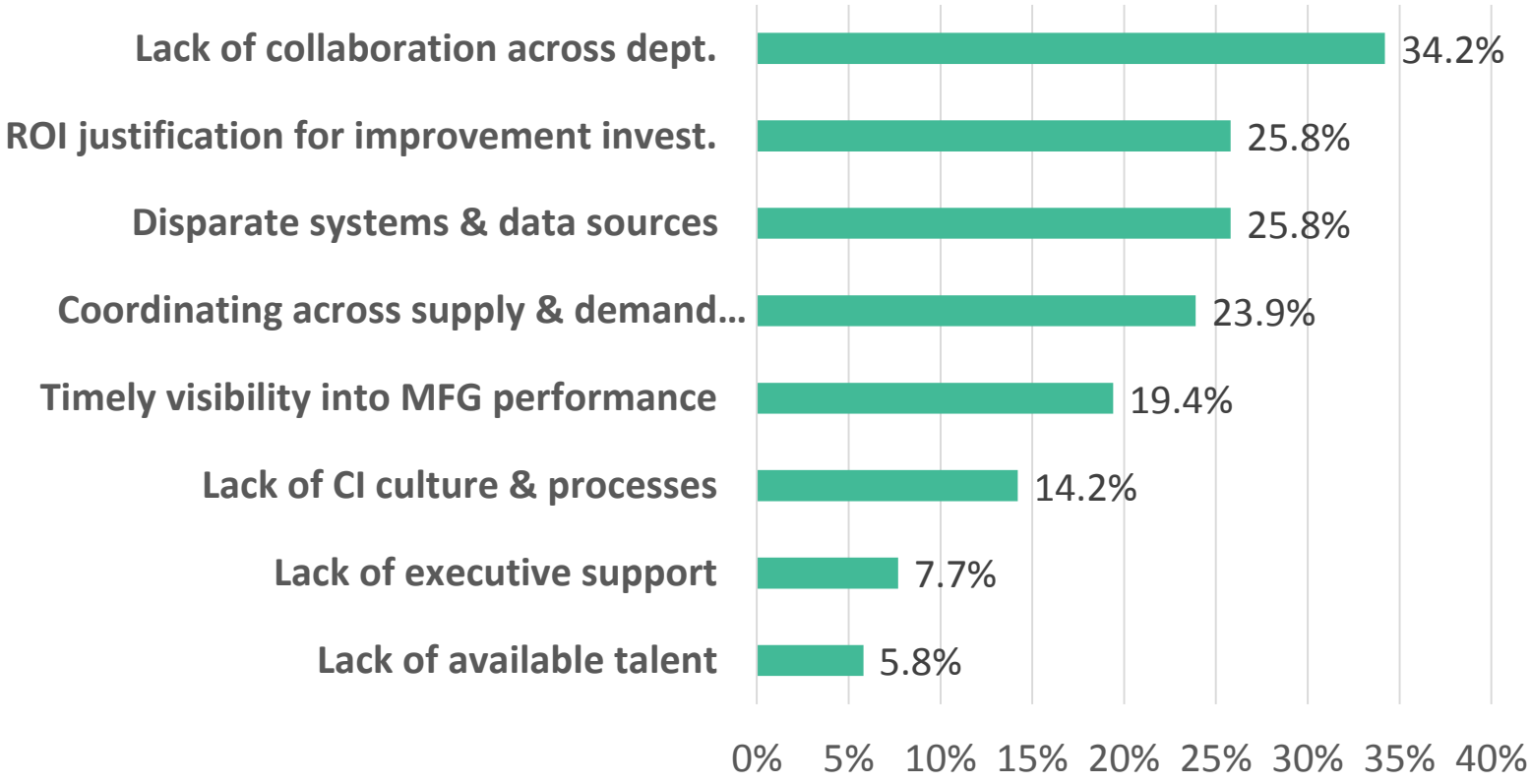
Background: Manufacturing Challenges and Concerns

Overview of Production Monitoring and Asset Management Solutions

Energy and Power Modeling Research

Next Steps

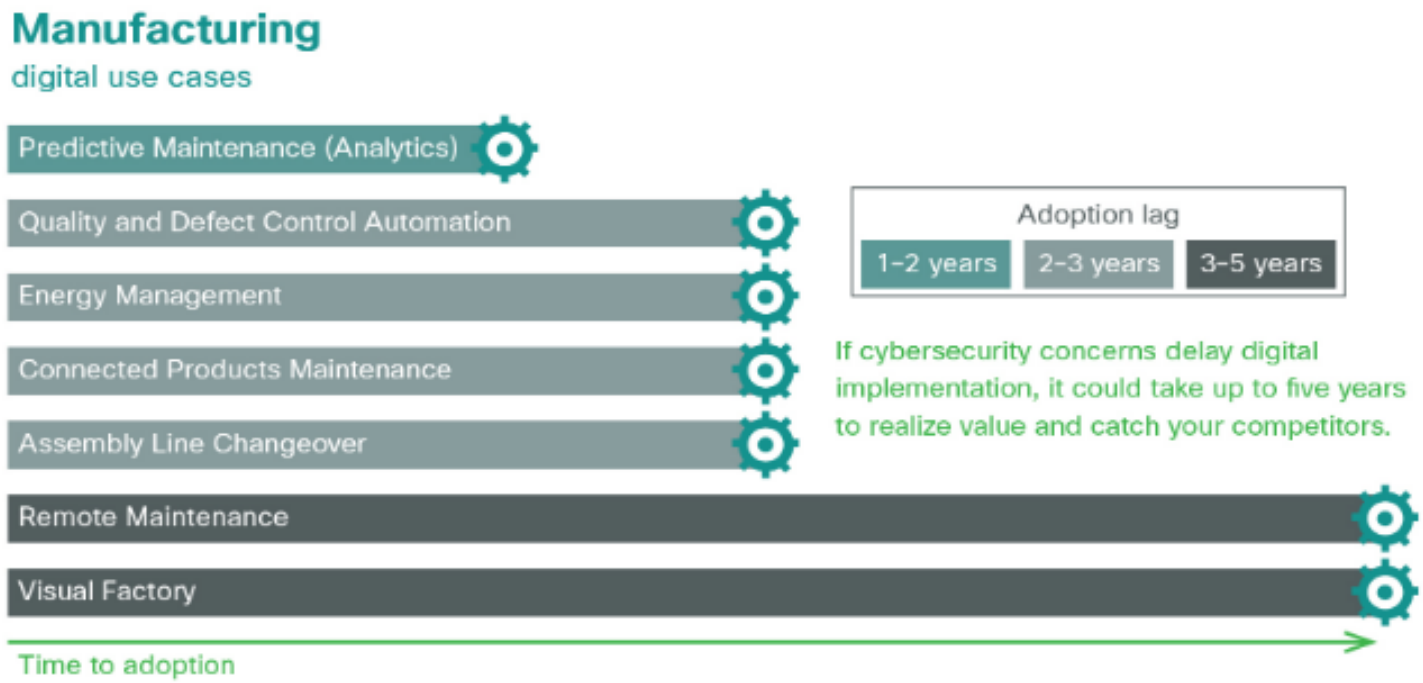
Top Manufacturing Challenges



LNS Research (2014) “Smart Connected Operations: Capturing the Business Value of the Industrial IoT” (n = 500+)

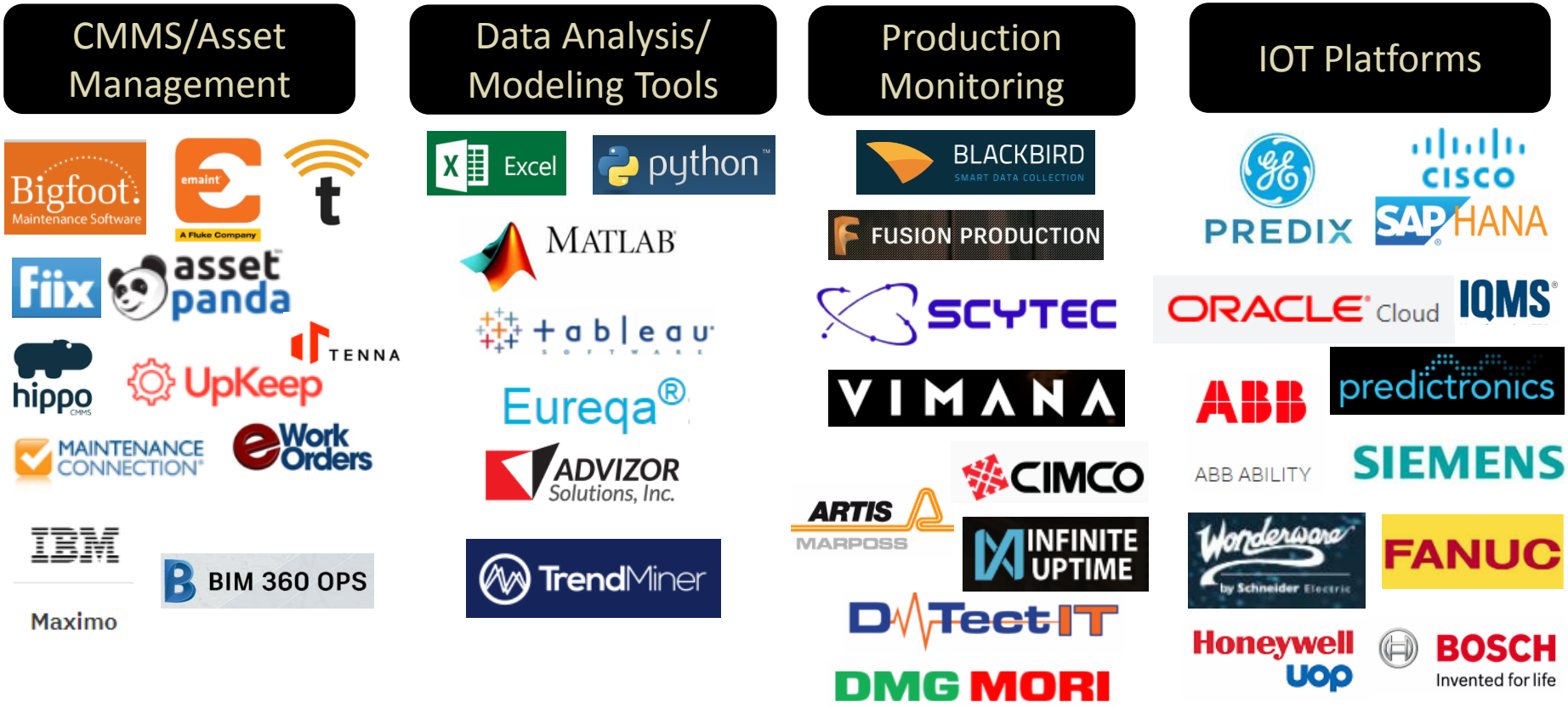
Cybersecurity Concerns

Figure 2. When Cybersecurity Concerns Delay Digital Initiatives, Growth Potential and Market Position Suffer



Cisco (2018) "Advancing Automation: Cybersecurity in Industrial Environments"

Solutions to Improve Equipment Maintenance and/or Performance



based on **open architecture** that adheres to **multiple communications standards**

quickly set up prototype applications

enable OEM partners to **communicate** with **legacy software** and **systems**

remove the **guesswork** from production and maintenance planning

use **data-driven** knowledge to **elevate performance**

connects your products, plants, systems, and machines

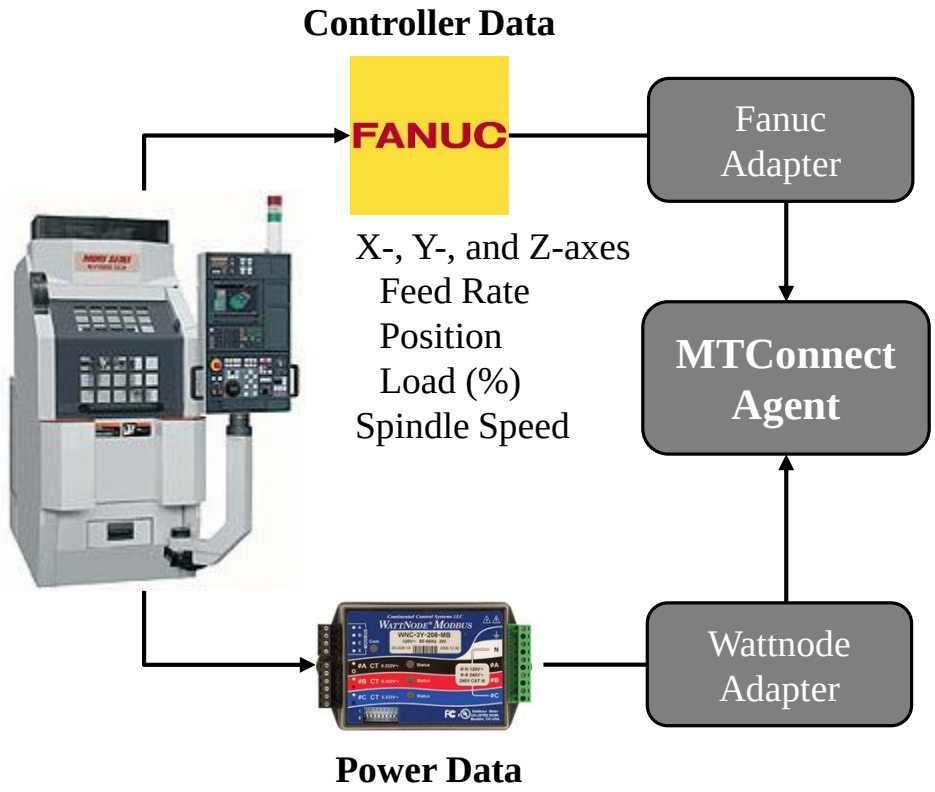
can also be used stand-alone **on premise**

highly scalable cloud services

Engaging Users Across Functions & Web-Based Tool Demo Video

Diaz-Elsayed (2015) "Managing Factory Operations with the Internet of Things" Autodesk University
Demo Video: https://www.youtube.com/watch?v=wrKViMRI0Go

Energy Modeling of a CNC Machine Tool



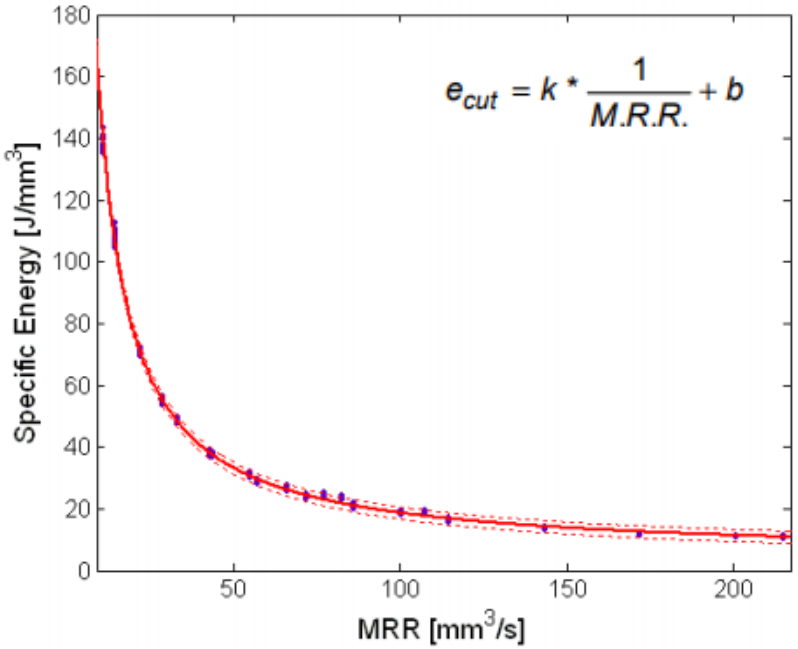
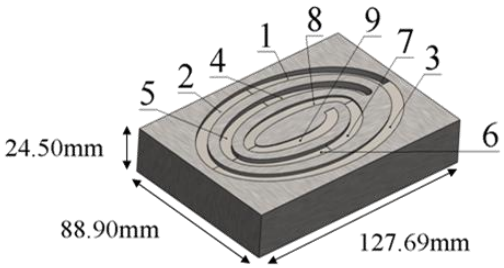


Figure 4: Specific energy as a function of M.R.R.

Diaz et al. (2011) "Energy consumption characterization and reduction strategies for milling machine tool use"

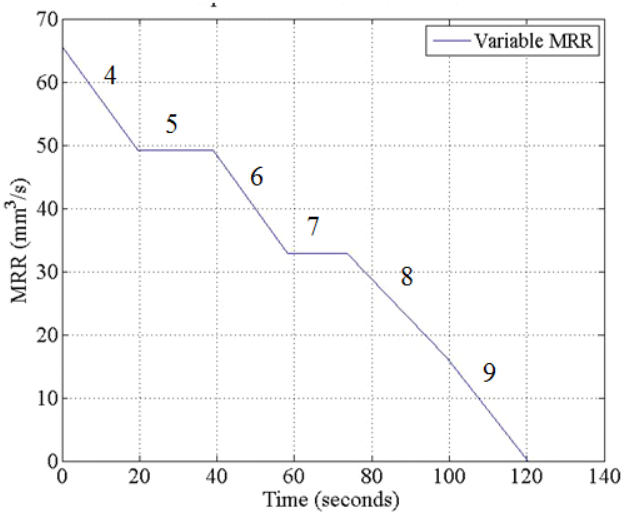
Energy Modeling for Varied MRR

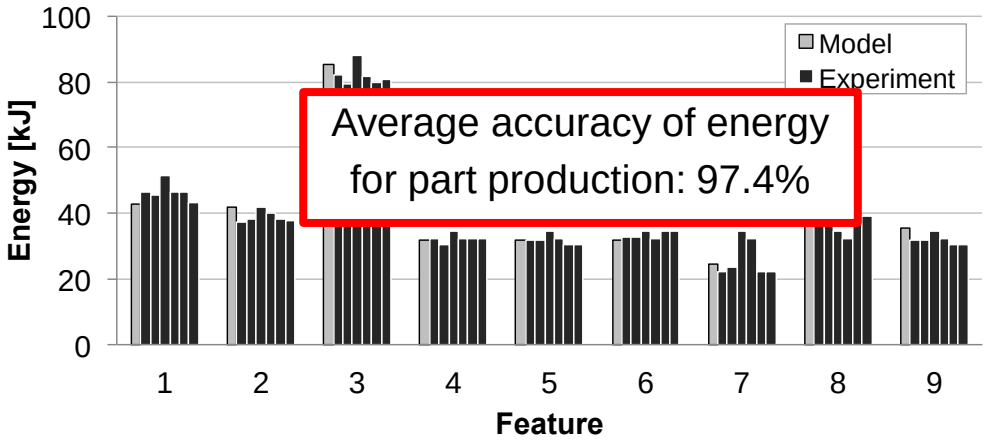


$$E_{const} = (k * \frac{1}{MRR} + b) * V$$

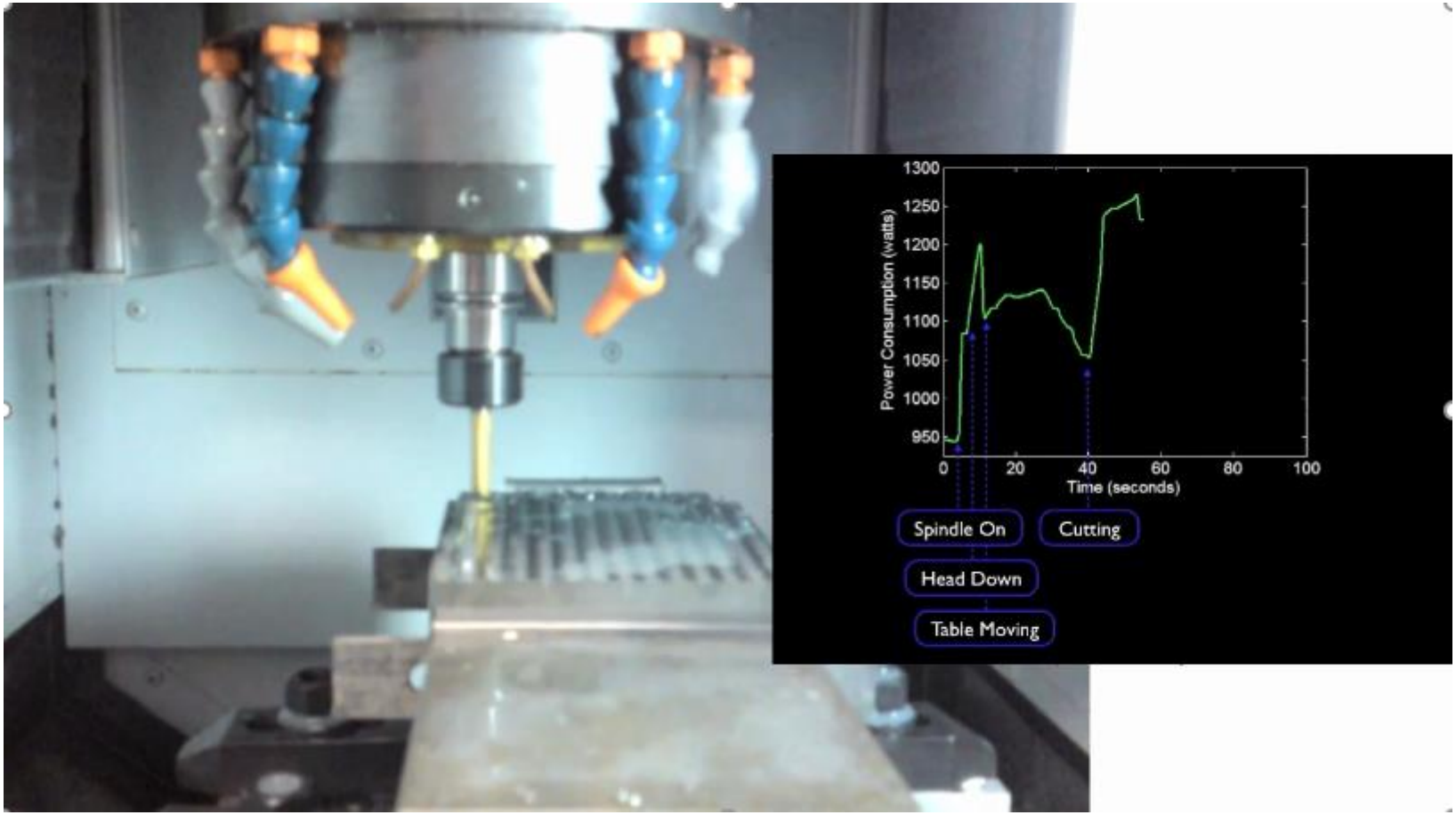
$$E_{\text{var}} = N * \Delta t \sum_{i=1}^{N} (k + b * MRR_{avg,i})$$

$$E_{part} = \sum E_{const} + \sum E_{\text{var}}$$



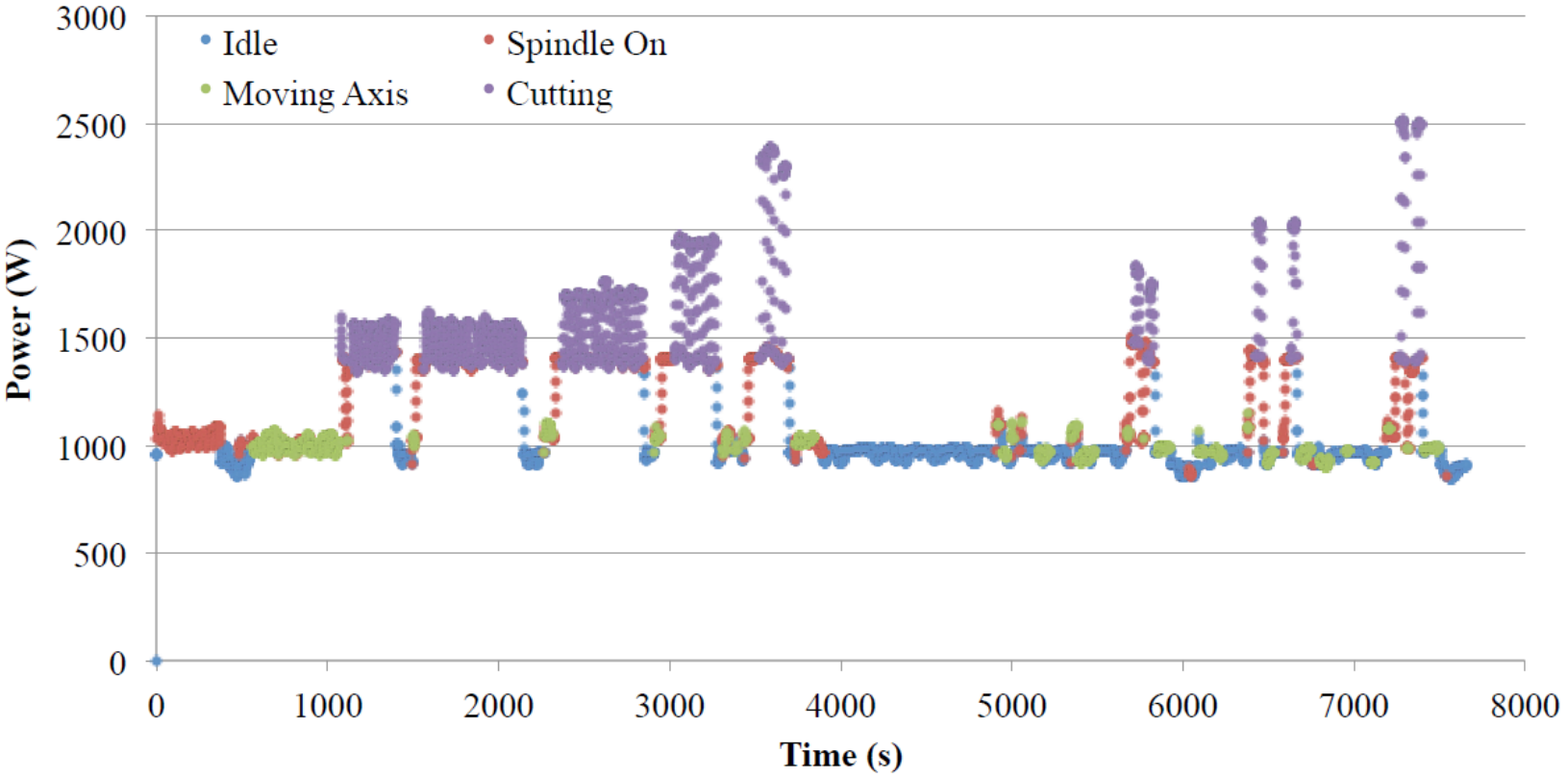


Source: Diaz et al. (2012) "Environmental Impact Characterization of Milling and Implications for Potential Energy Savings in Industry"

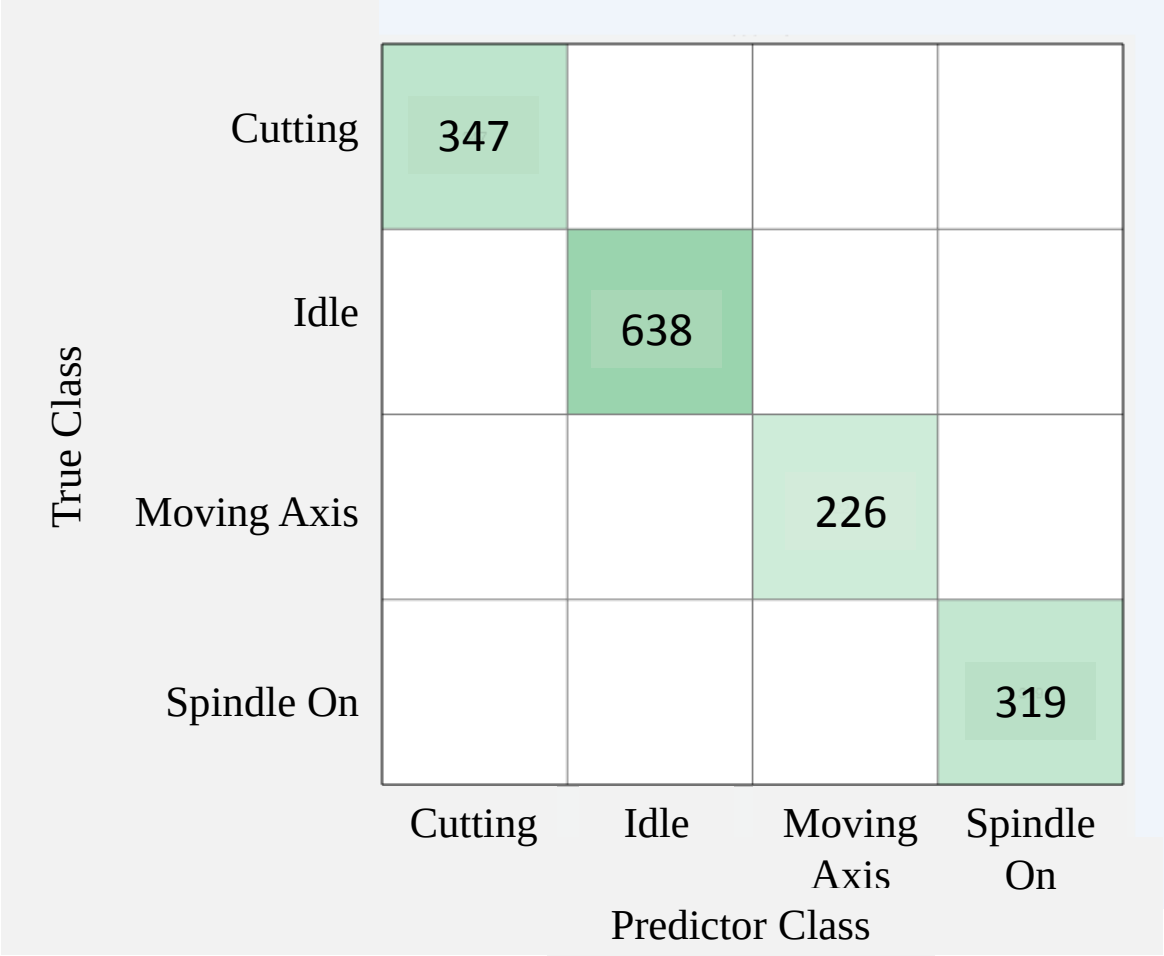


https://www.youtube.com/watch?v=_UOtoTBpex4

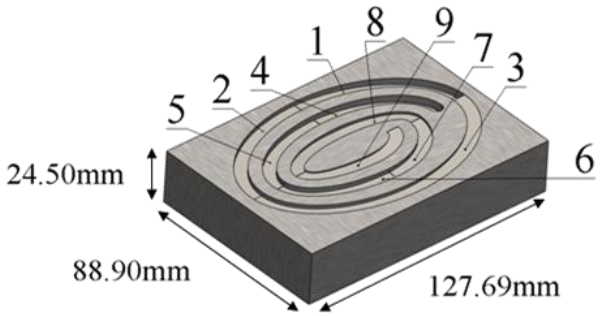
Classification of Machine Tool Modes

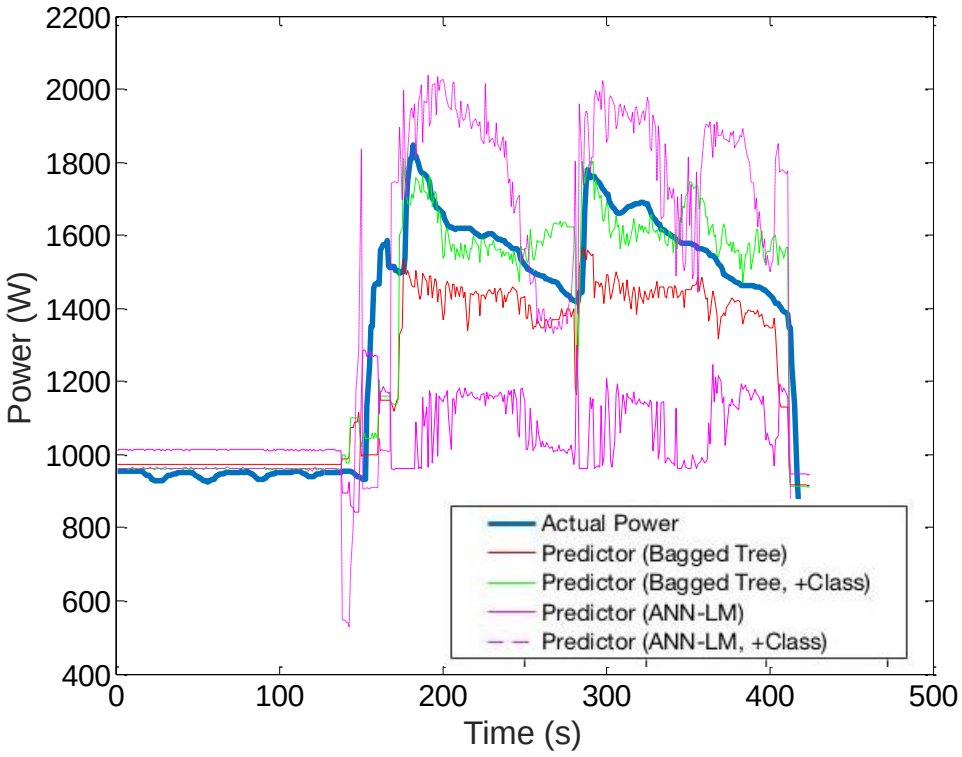


Classification of Machine Tool Modes



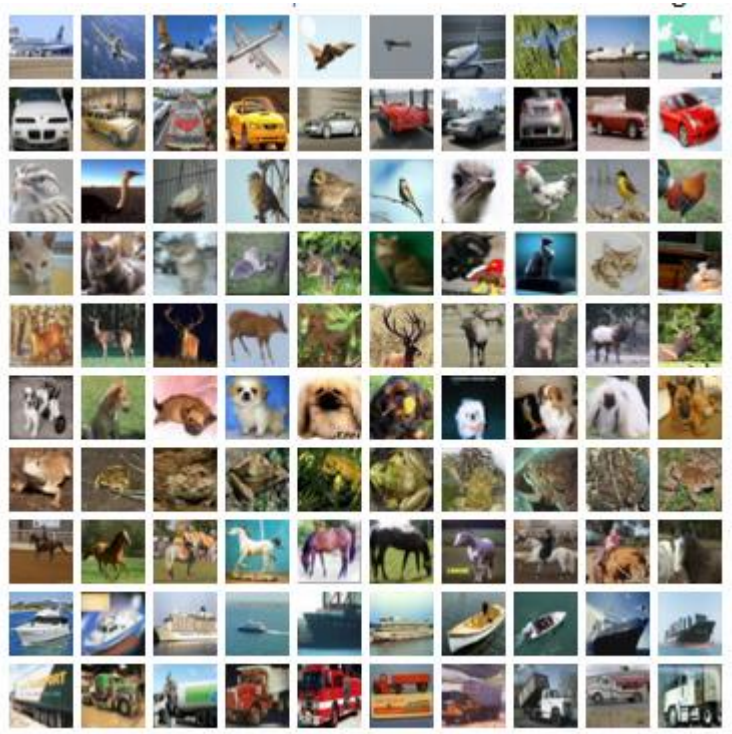
Estimating Power Demand





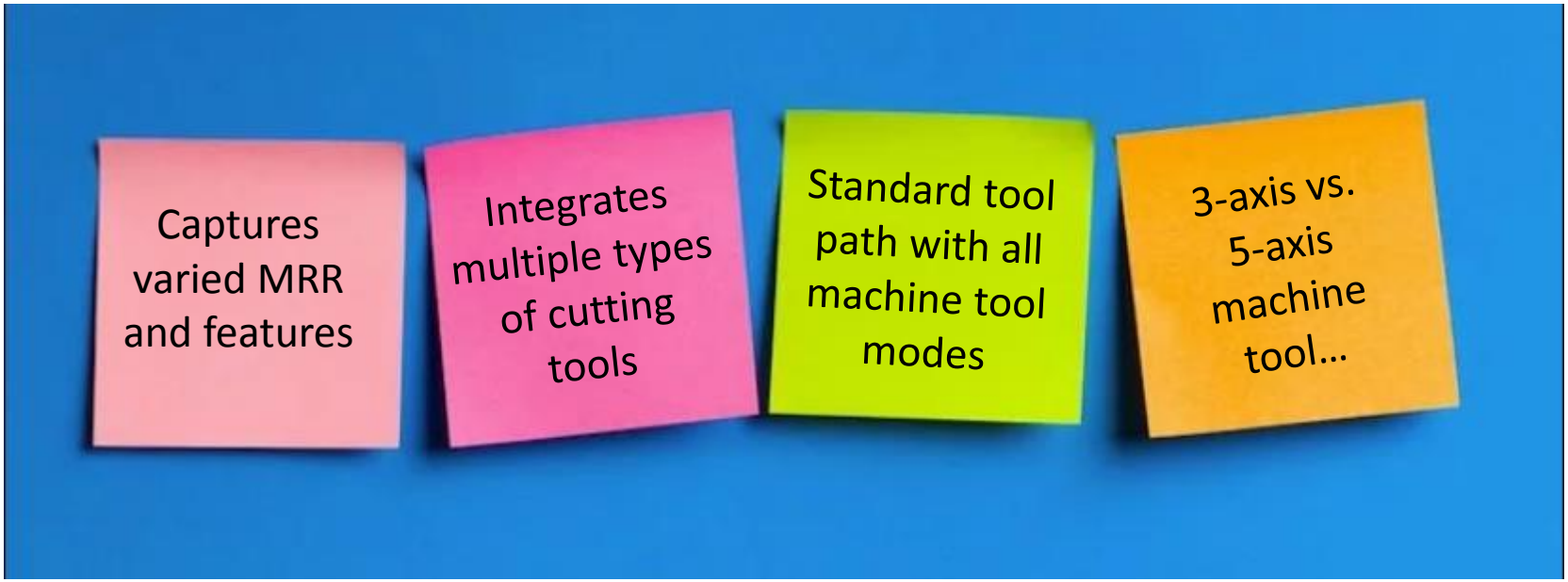
- Used controller and power data (via MTConnect) for slotting operations as training data
- Leveraged supervised machine learning
- 99.2% mean accuracy achieved

Standardizing the Data Analyzed



Standardizing the Data Analyzed

Defining standard part(s) and corresponding tool path(s) to train and test solutions



Questions?

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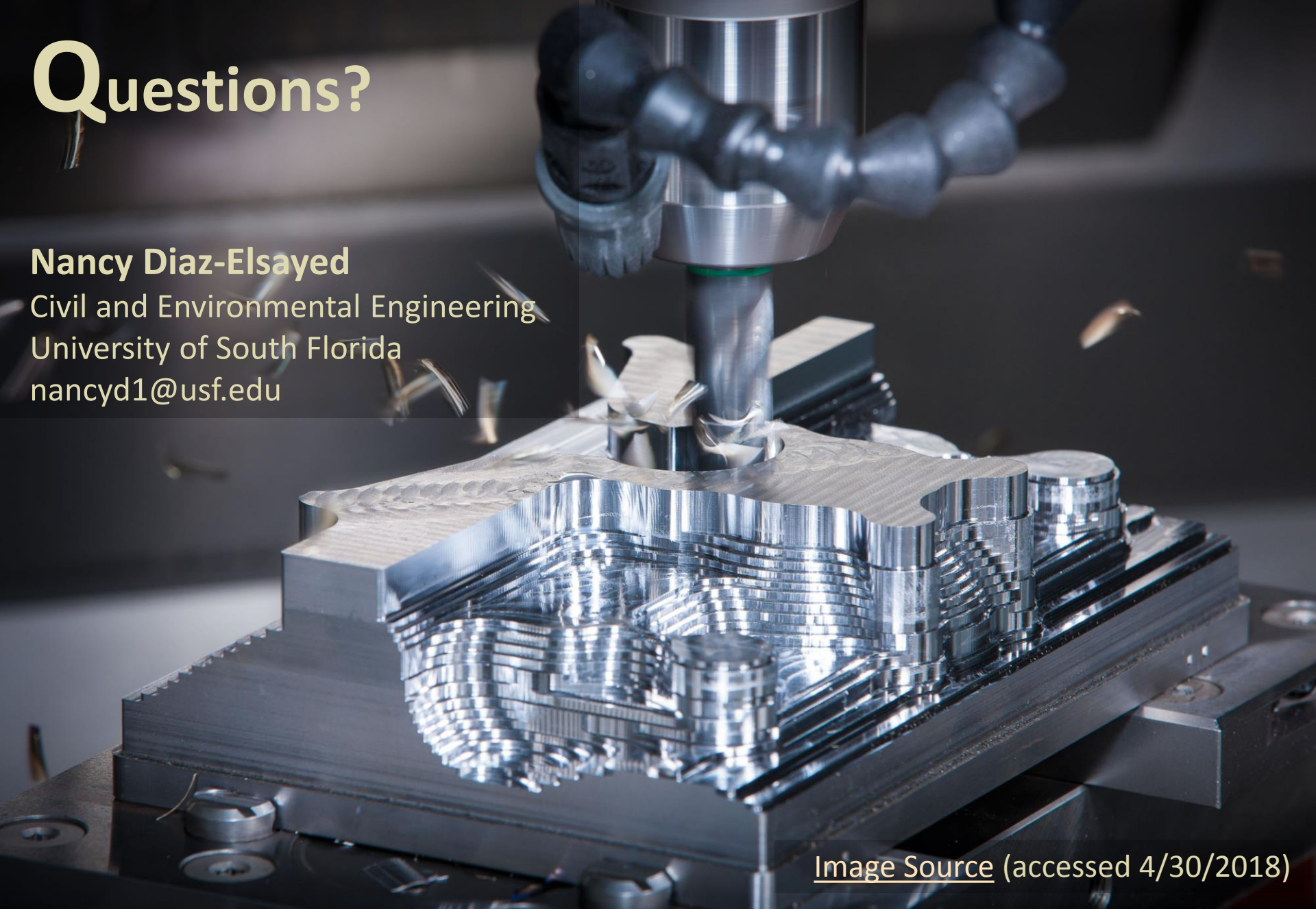

Image Source (accessed 4/30/2018)