Bringing Legacy Small and Medium Enterprise Manufacturers into Digital Manufacturing and Towards a Distributive Manufacturing Network

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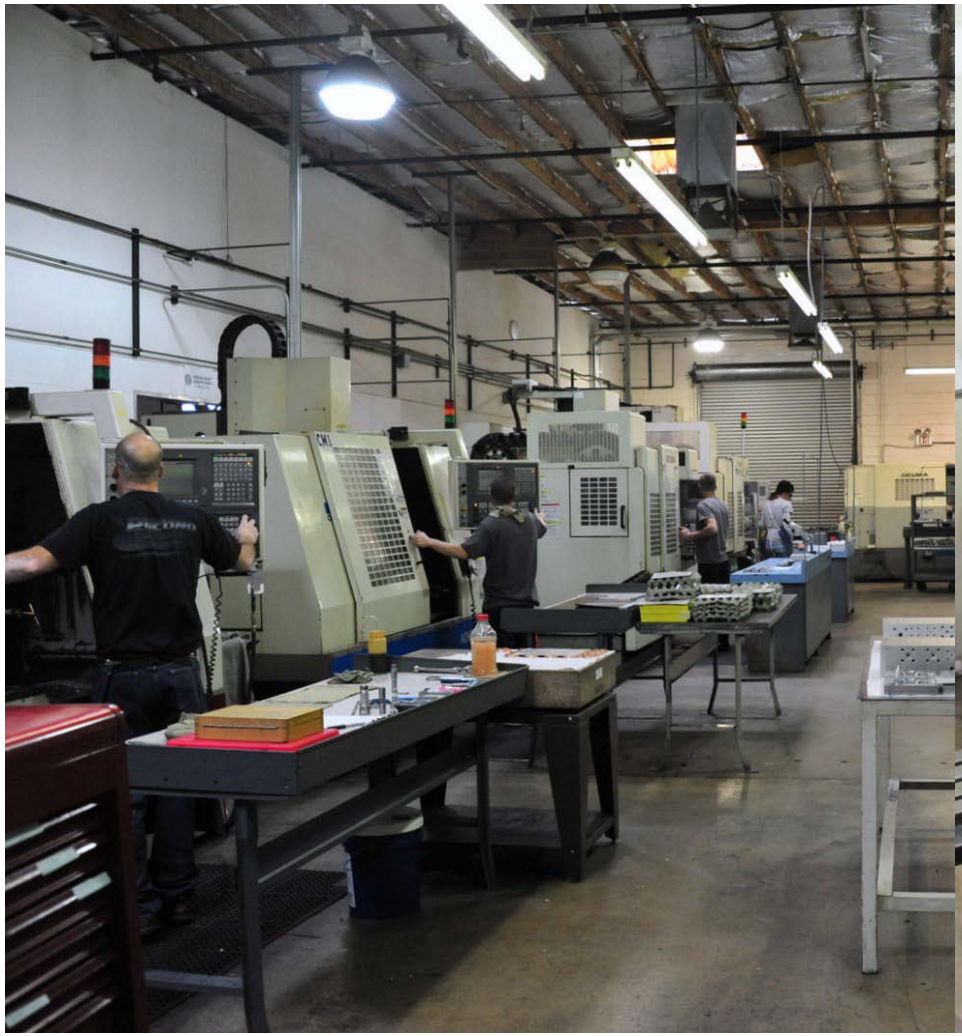
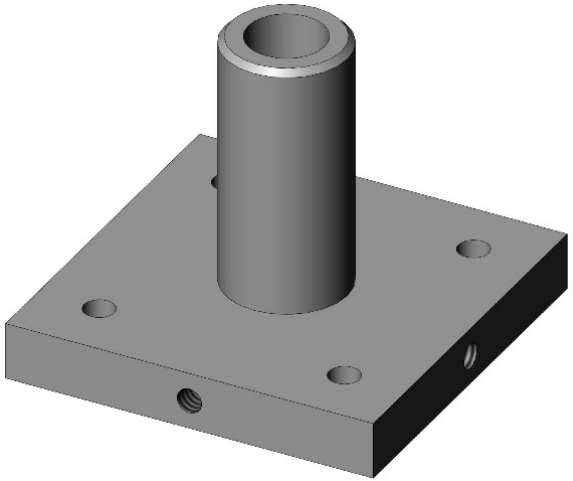
Small & Medium Manufacturing



Auburn Design and Manufacturing Lab

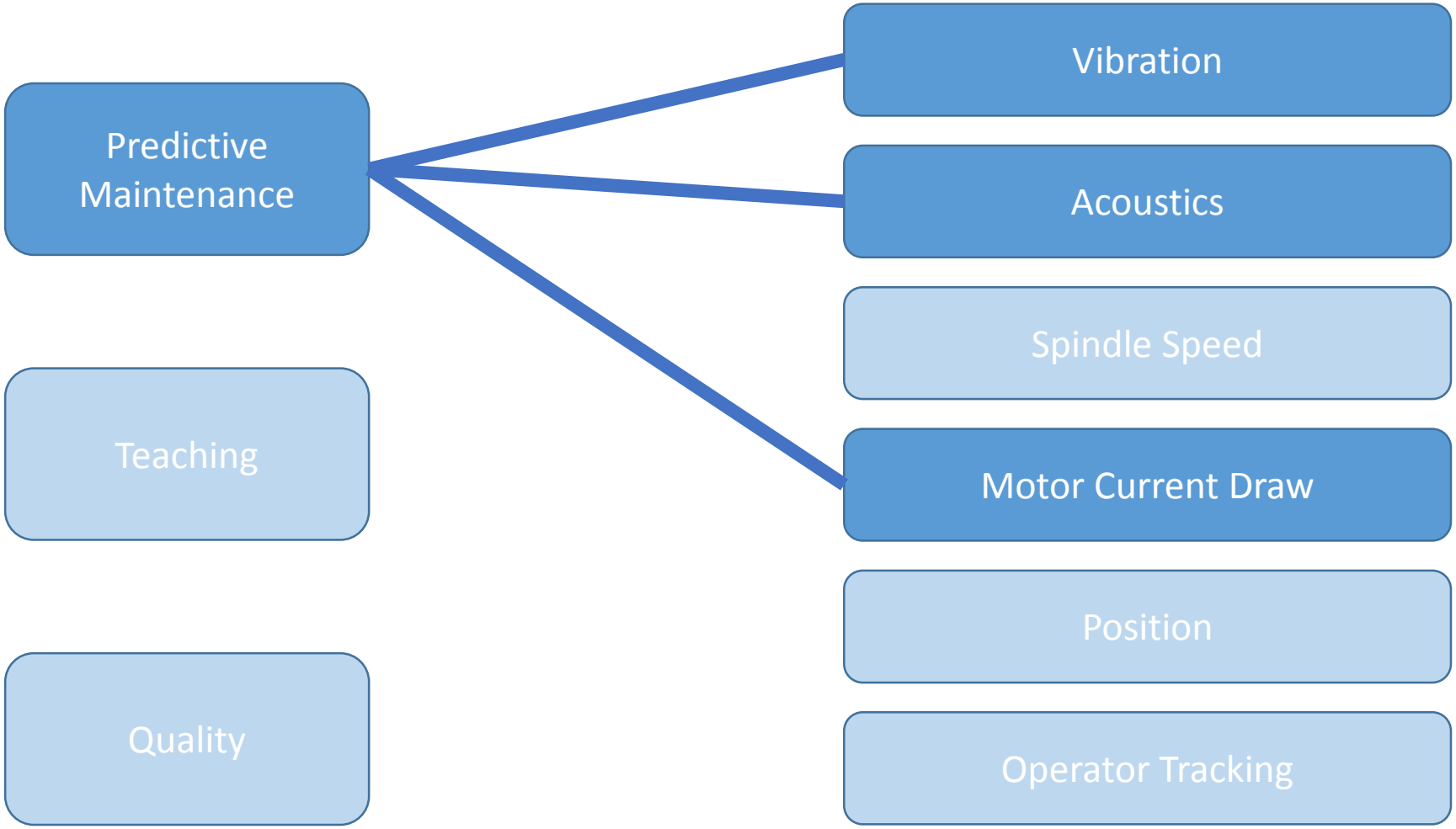
- Design and Manufacturing Lab (DML)
- Required for Mechanical Engineering students
- 300-400 students per year
- Repeat same project



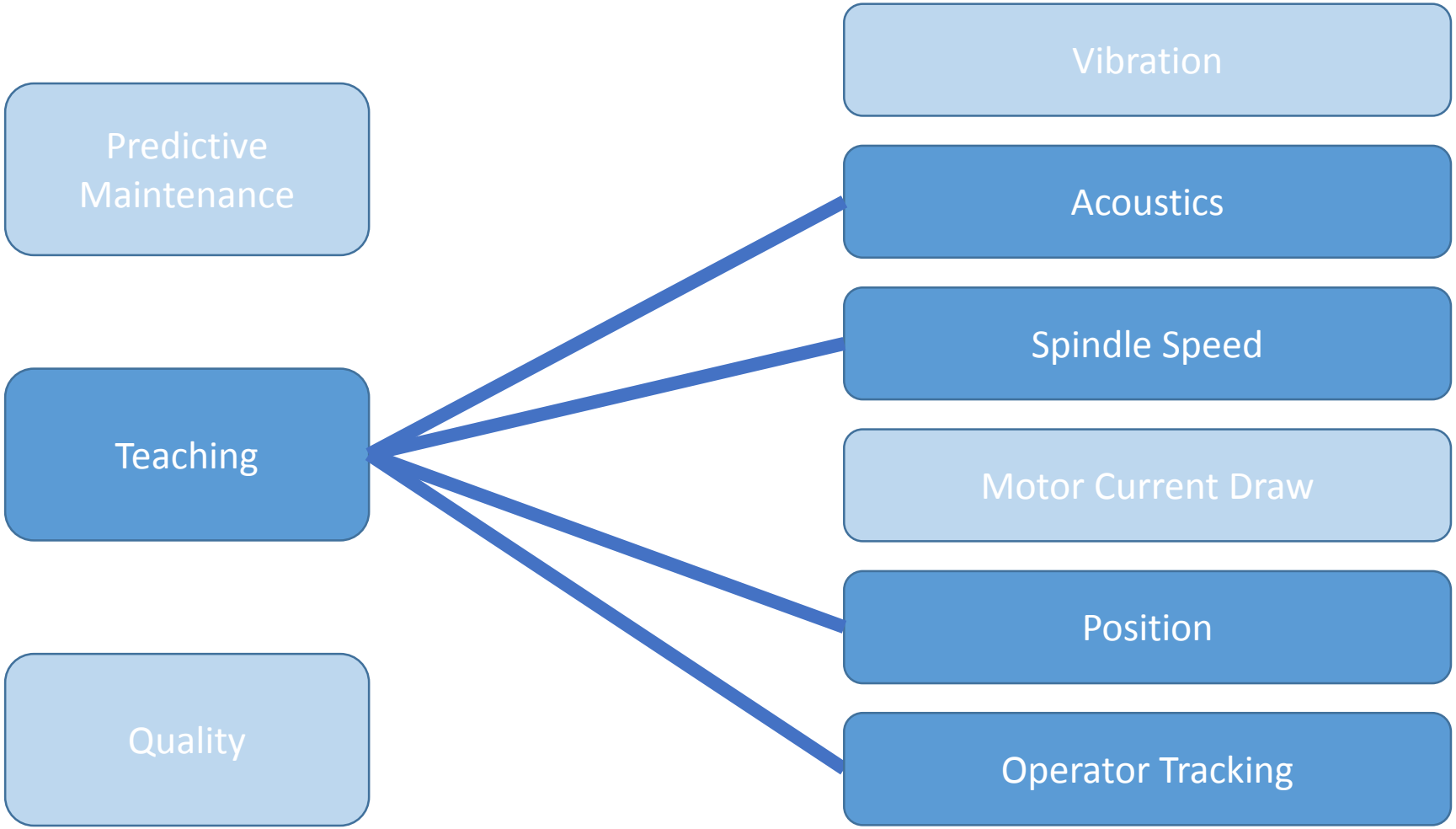
Overview Objectives

- Investigating methods to connect machines that were never intended to be connected.
- Help SMM understand benefits of a connected system.
- Provide a resource to the SMM to determine the options they have for connecting equipment.
- What data can be captured from legacy manual equipment not intended to be connected to the internet?
- How can the information from the sensors be best used?
- Evaluate configuration of sensors and collectors to determine the cost benefit relationships.
- Educational benefit of replicating the experience of a knowledgeable/seasoned expert machinist by capturing acoustic signals and connecting those to outcomes of parts.

Data Needs


Predictive Maintenance
Teaching
Quality
Vibration
Acoustics
Spindle Speed
Motor Current Draw
Position
Operator Tracking

Data Needs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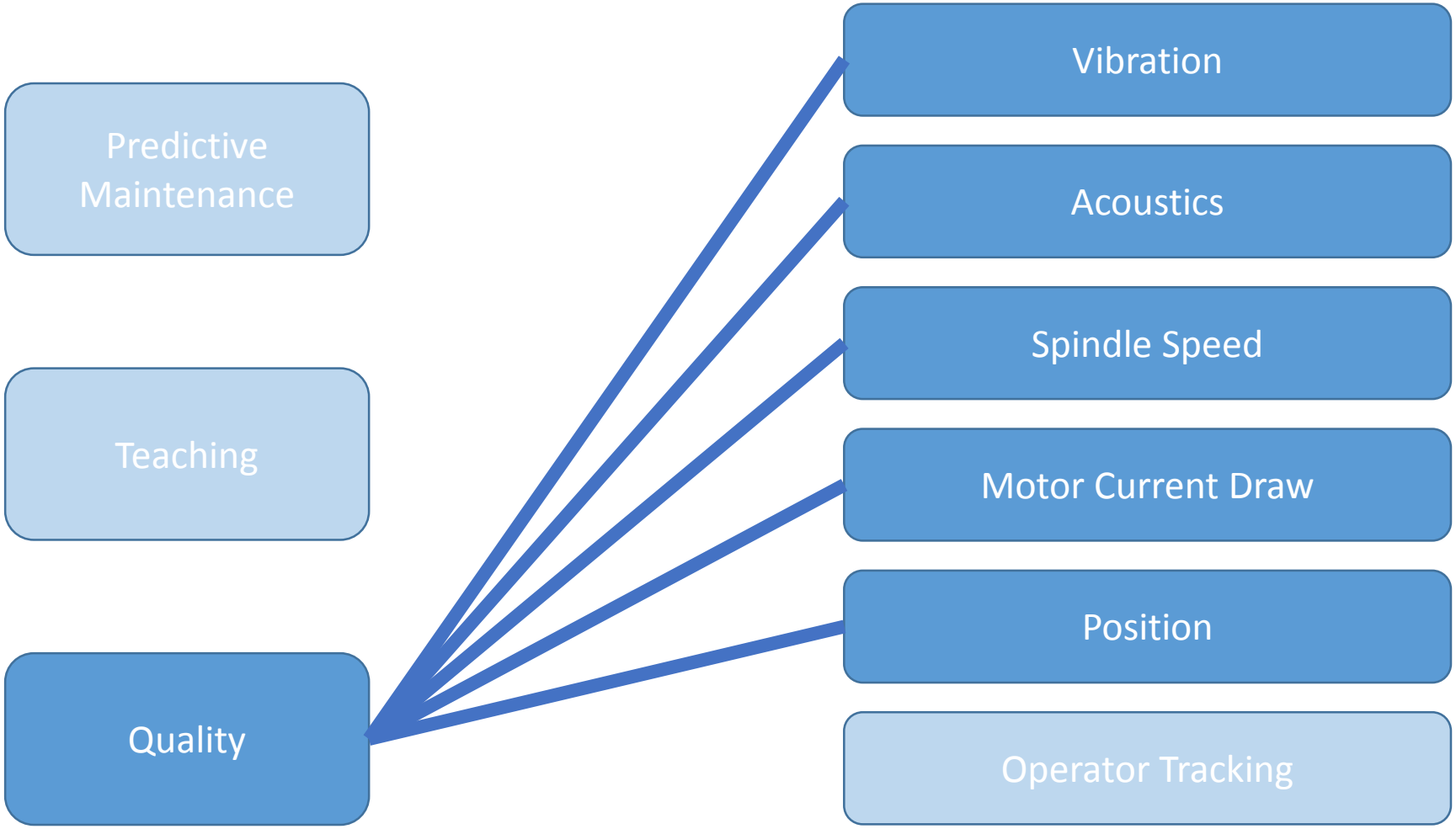
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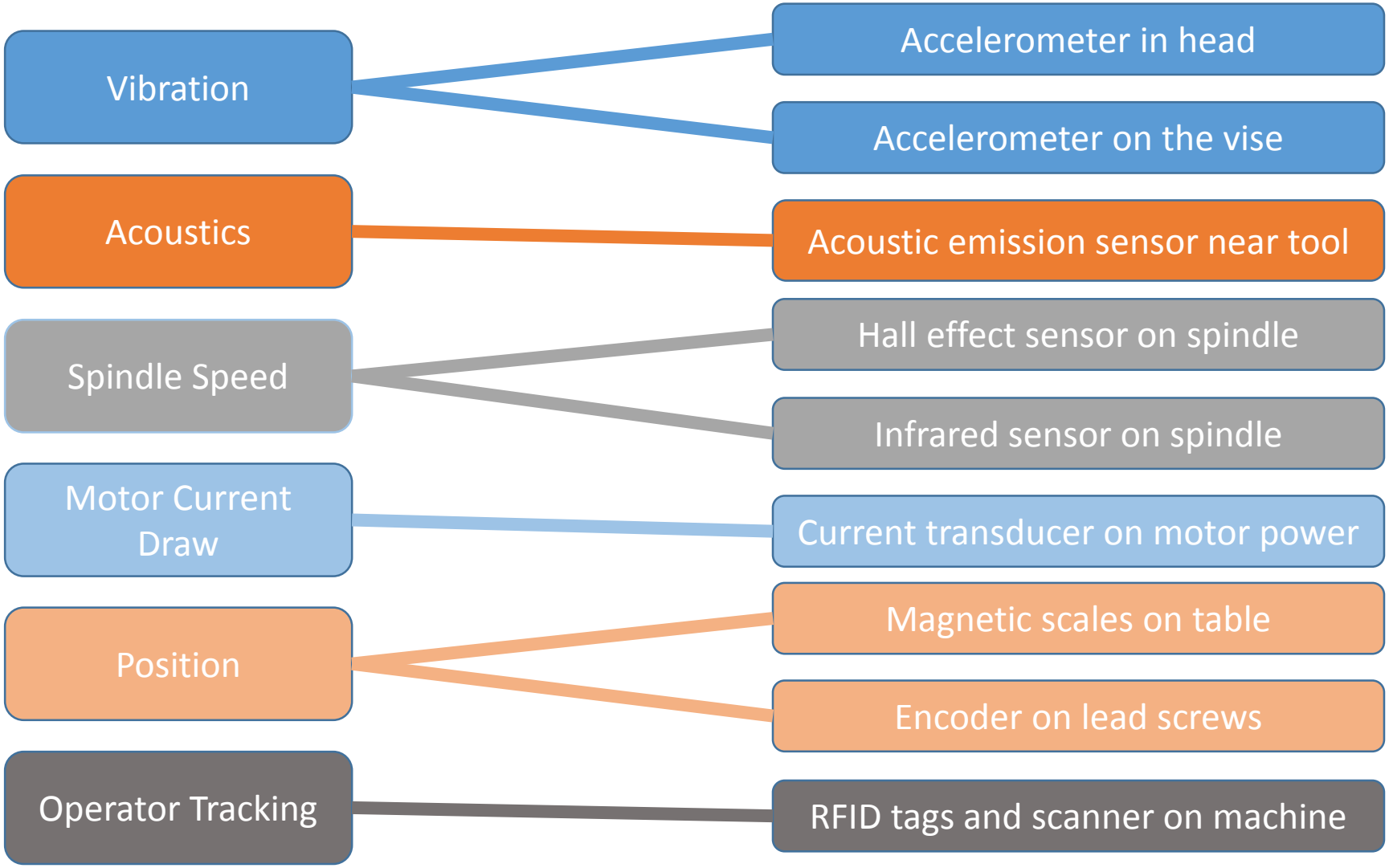
Sensor Selection



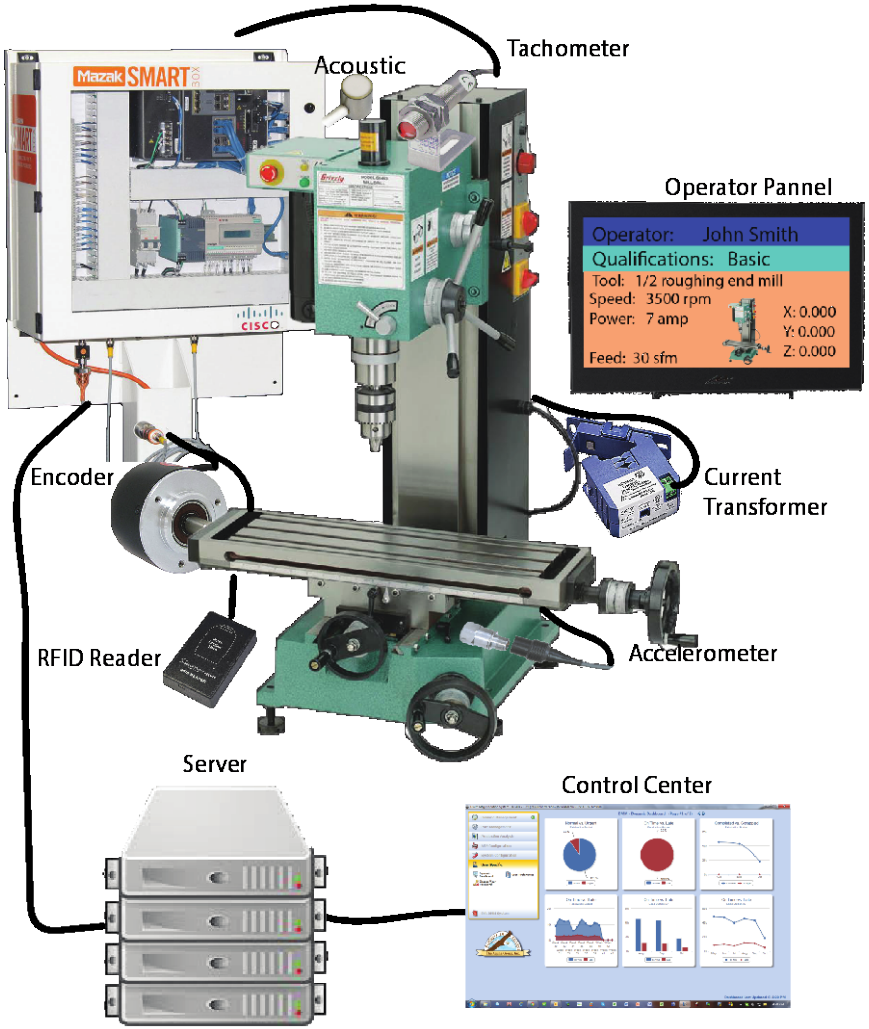
Possible Sensor Array

Multiple price point sensor arrays

Data	Price Range: $250	Price Range: $2500	Price Range: $7500
Vibration	Arduino	PCB Piezotronics	Kistler
Acoustics	Seeed Studio	Physical Acoustics	Physical Acoustics
Spindle Speed	Eagle Tree	Honeywell	Monarch
Motor Current	Gravity	Loulensy	Johnson Control
Position	iGaging	DRO PROs	Mitutoyo
Data Acquisition	Raspberry Pi	DATAQ	Mazak

Prototype Lab

- Initial Focus
  - Mills
- Two different models
  - Shop Fox
  - Grizzly



Lab Wide Implementation

RFID Tracking

- Track operator usage of machines
  - Log which operator is using the machine
  - Log progress through project
- Track tools used in lab
  - Track total service time of tool
  - Track abnormal use
- Align outcomes with operator actions
  - Before sensor installment feature quality
  - After sensor installment feature quality

Plan Forward

- Data Analytics
  - Large volume of non-IP manufacturing data
- Campus Dashboard
  - Centrally located display with:
    - Machine status
    - Machine statistics
- Initial Node of Distributed Manufacturing
  - Connected machines
  - Trained operators
  - Project monitoring process
  - Machine statistics