IPRO 304: Process Improvement Design

Spring 2011

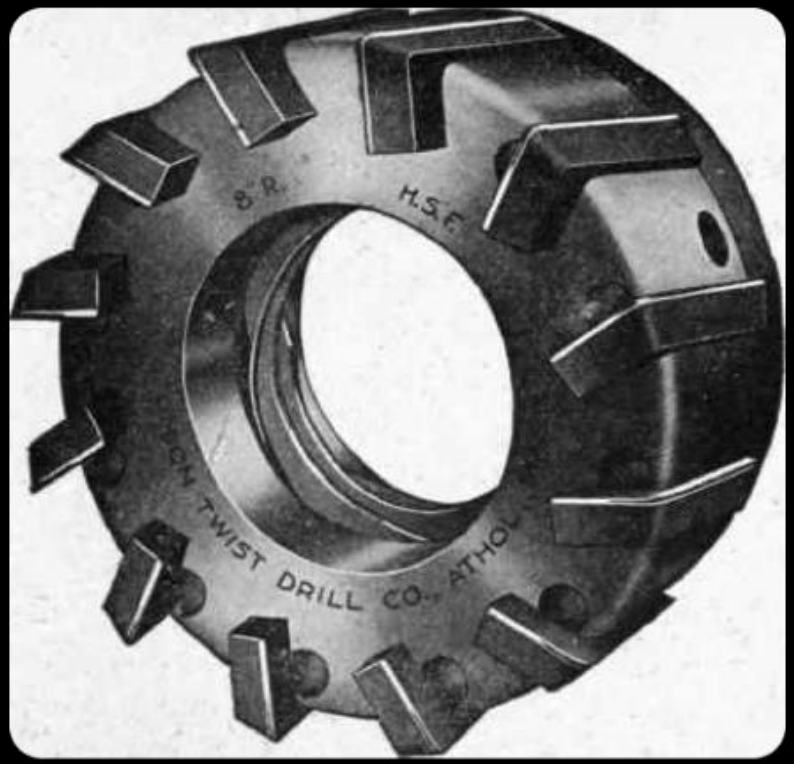
ILLINOIS INSTITUTE OF TECHNOLOGY

A. Finkl & Sons

- Manufacture all steel from scrap
- Largest consumer of electricity in Illinois
- Processes include:
  - Melting/Re-melting
  - Forging
  - Heat-treating
  - Machining

The Milling Process

The Problem



- Cutting inserts break
- Broken inserts stress those remaining

Multiple inserts are unnecessarily broken.

Workers are idle during the milling process.

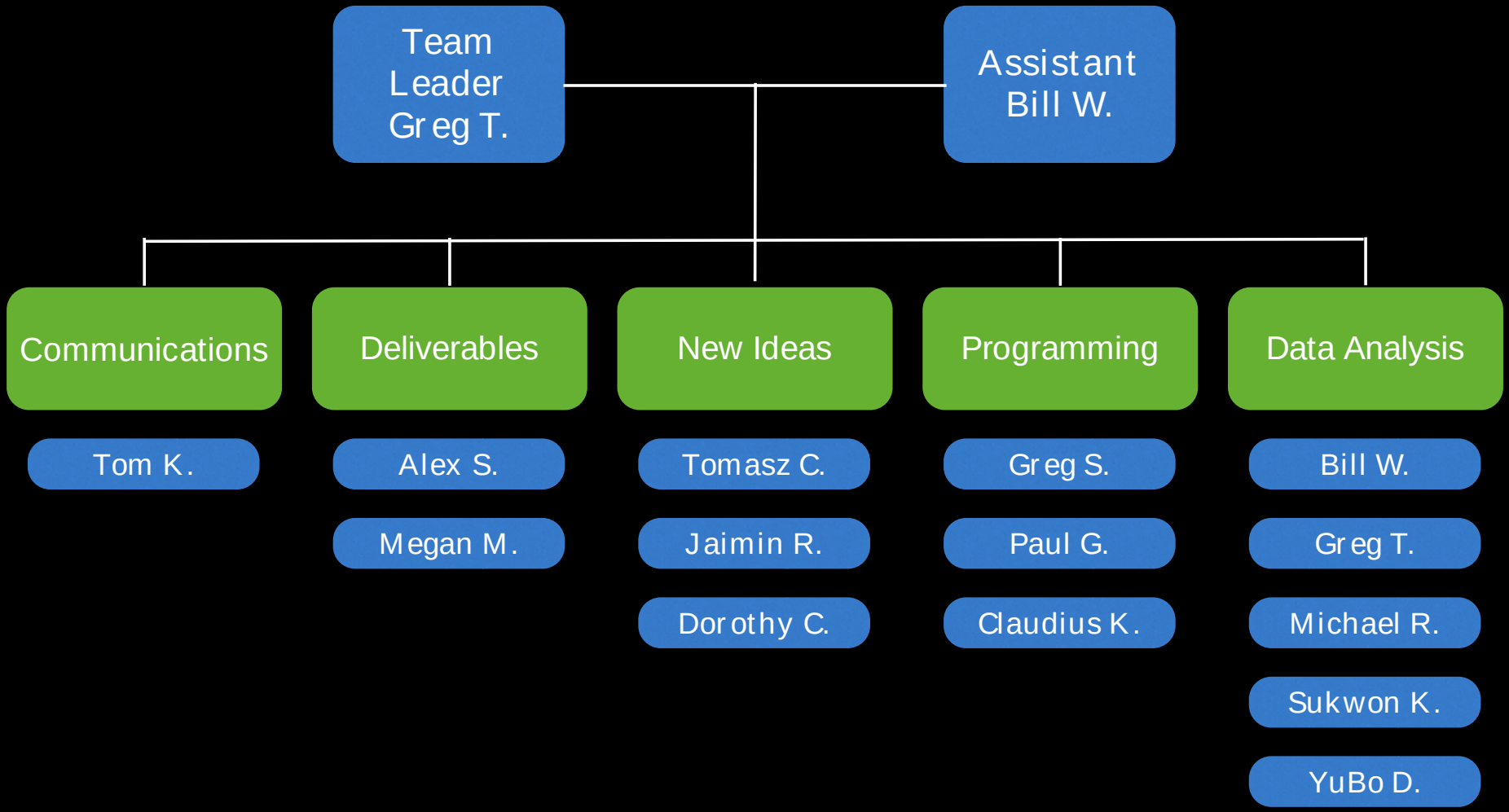
Manufacturing process can be made more efficient.

Project Goal

Detect broken inserts and alert the workers on duty.

Proposed Solution

Use a tri-axial accelerometer to detect cutting insert breaks.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Mission & Values

Challenges

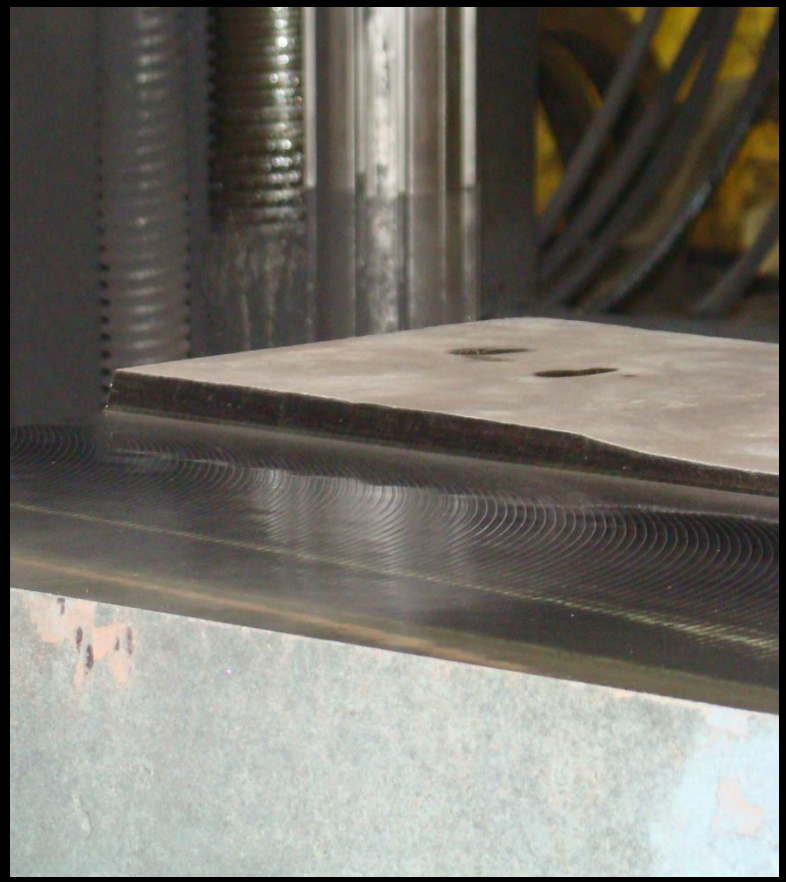
- Dealing with data consistency
- Cutting inserts not breaking when expected
- Machine malfunctions
- Material geometry consistency
- Miscommunication

Ethical & Team Dynamic Issues

- Process improvement design project
- Talk of non-disclosure agreements
- Division of work
- Trips to Finkl

Problem Solving

- Semester's work was on hypothesis testing
- Problems did arise, however
  - Cutting inserts wouldn't break when we needed them to
  - Milling machine almost broke our accelerometer
- Inaccurate hypothesis was disproven



Research

- Performed primary research at A. Finkl & Sons
- Referred to previous semester's work & professors' expertise
- New ideas team researched alternative solutions

Previous attempts & ideas

- Direct microphone
- Cameras
- Lasers
- Accelerometers
  - Wired/wireless
  - Single / Dual axis

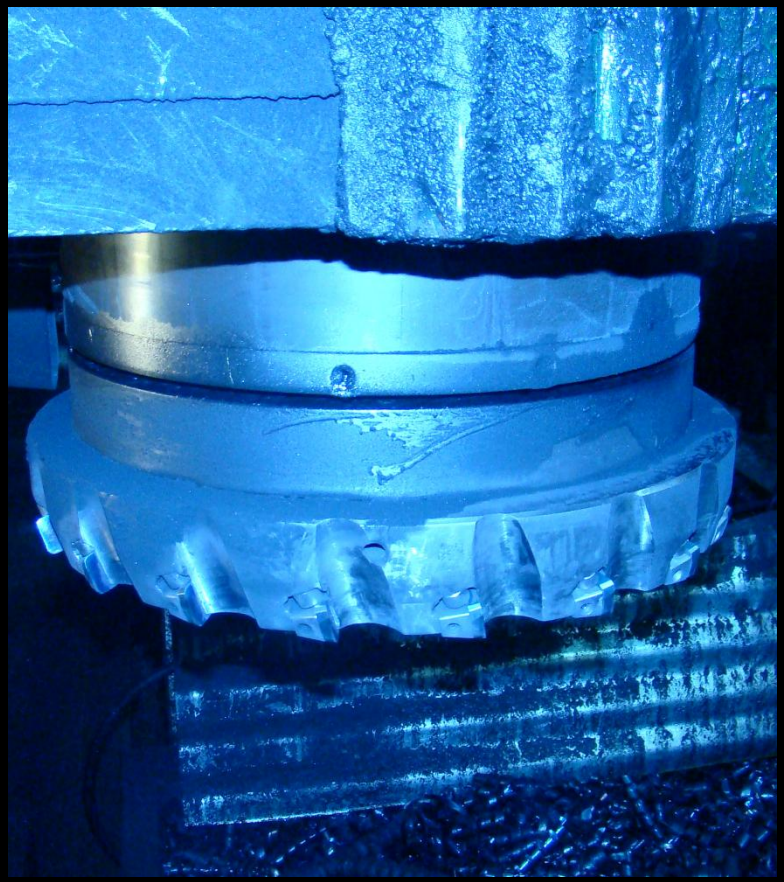
Projected & Actual Progress

- Projected progress:
  - Purchase accelerometer & write programs to collect data
  - Test hypotheses of use and placement of the tri-axial accelerometer
  - Write software that would detect broken cutting inserts
  - Implement a device that would notify employees of insert break

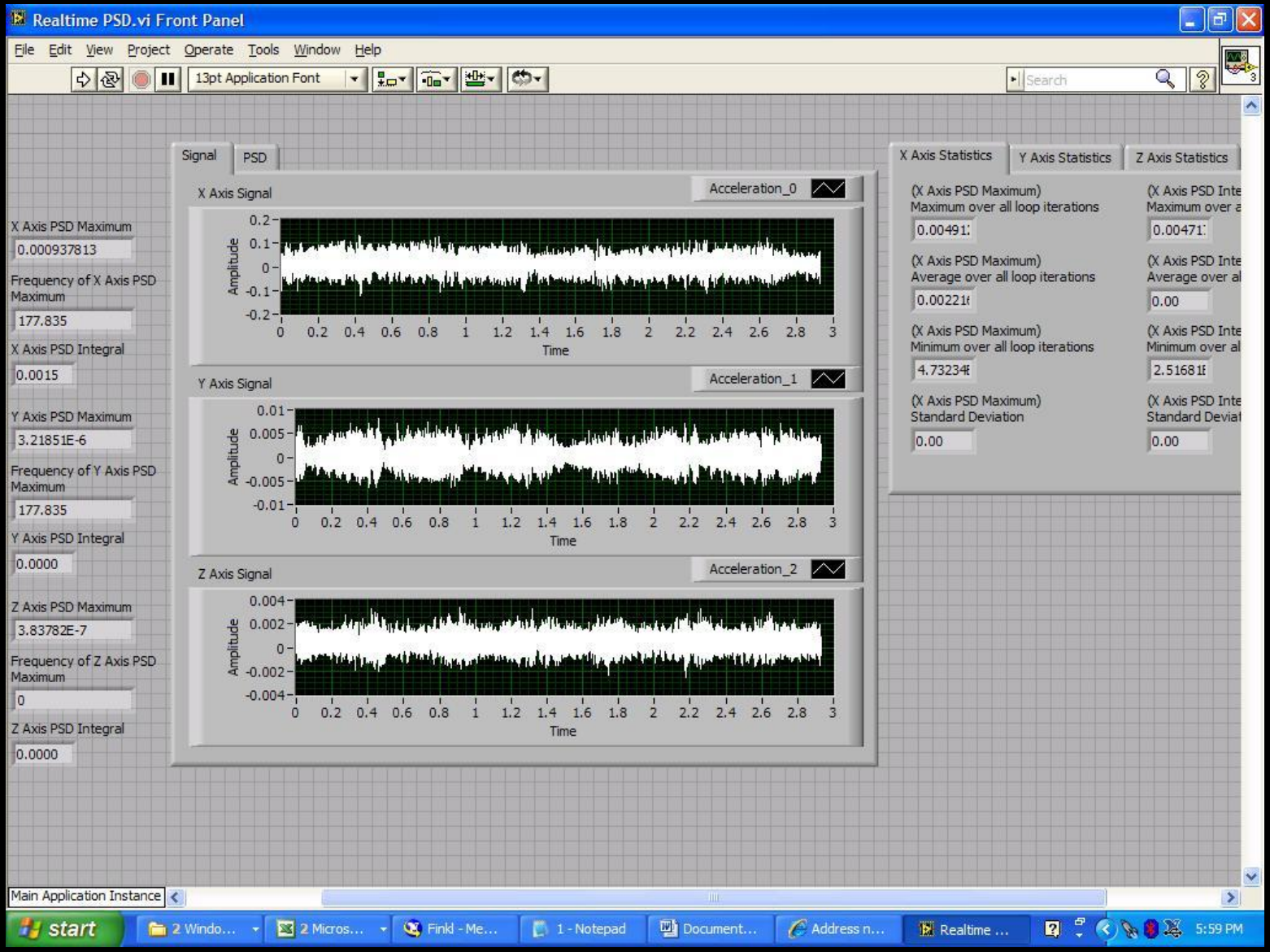
- Actual progress:
  - Accelerometer purchased & data collection and analysis programs made
  - Hypotheses tested
  - Created inserts to promote consistent tooth breaks
  - Established robust framework for following semesters to follow
  - Multiple alternative ideas developed

Added Value of Achievements

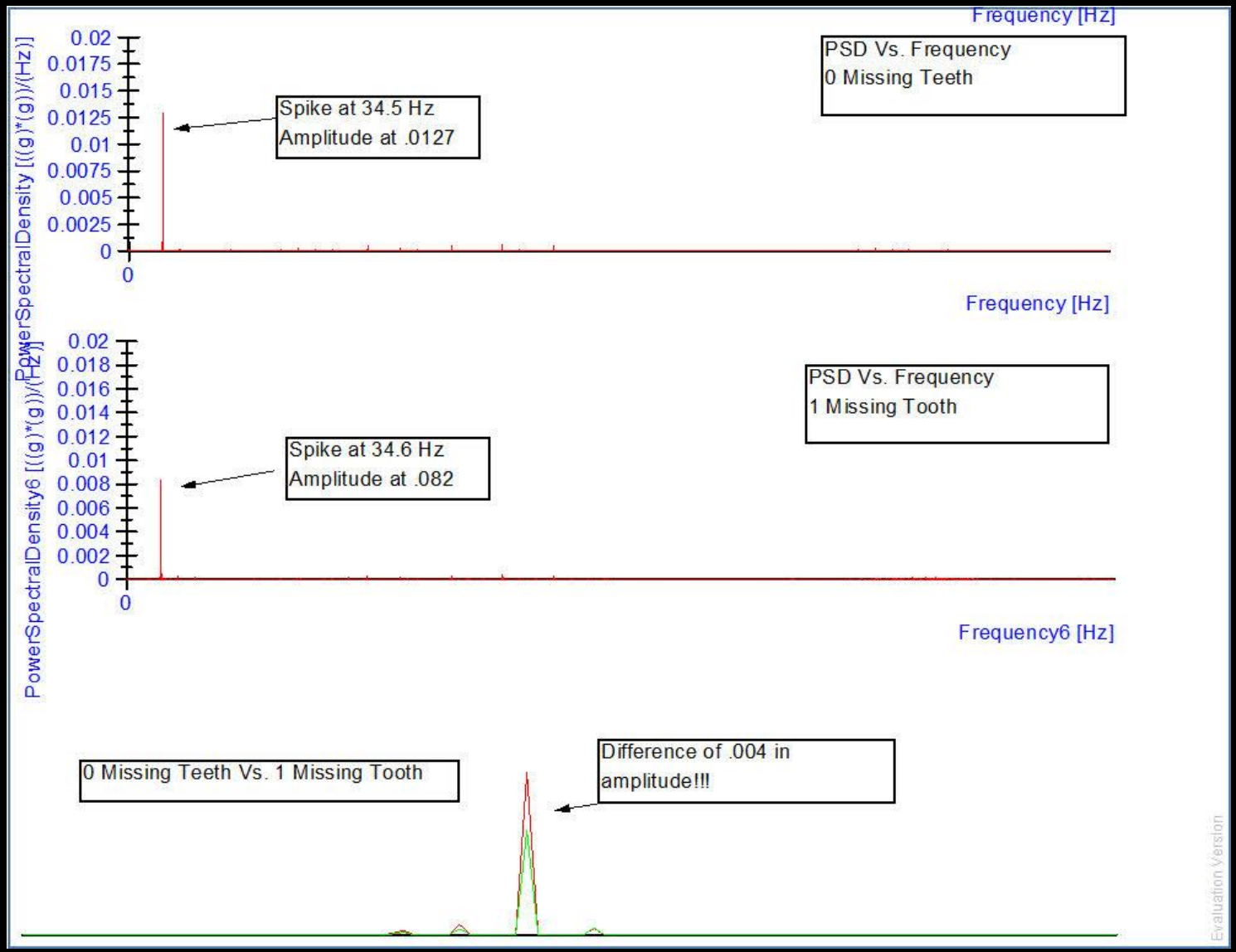
- Adds functionality to older machinery
- Allows for a consistent finish on product
- Overall efficiency of the process will increase



Data collection & analysis



Data collection & analysis



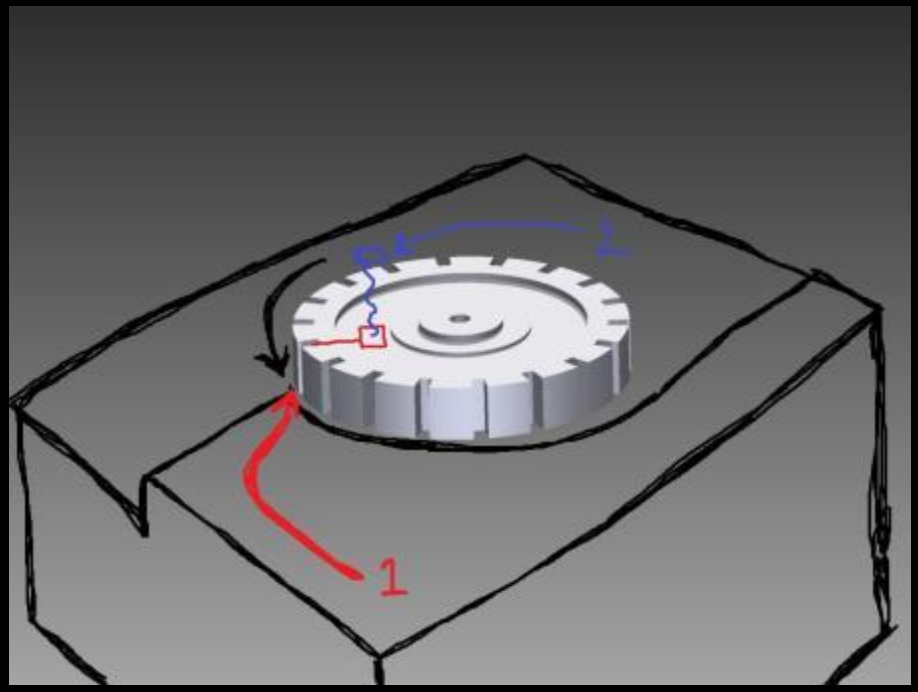
Conclusions

- Tri-axial accelerometer increased the consistency of our data and added more variables to analyze
- Data needs to be analyzed in the same pass
- Placement of the accelerometer is not critical with out method
- More data is required

Alternative Approaches

- Piezoelectric – Uses a piezoelectric to pick up force changes.
- Phosphor - Glowing phosphor paint helps detect broken inserts.
- Radioactive Dot – Uses radiation to detect a broken inserts.

Piezoelectric



- By placing a piezoelectric in such a place, an increase in the force can be read off and sent away using an infrared diode emitter receiver setup.

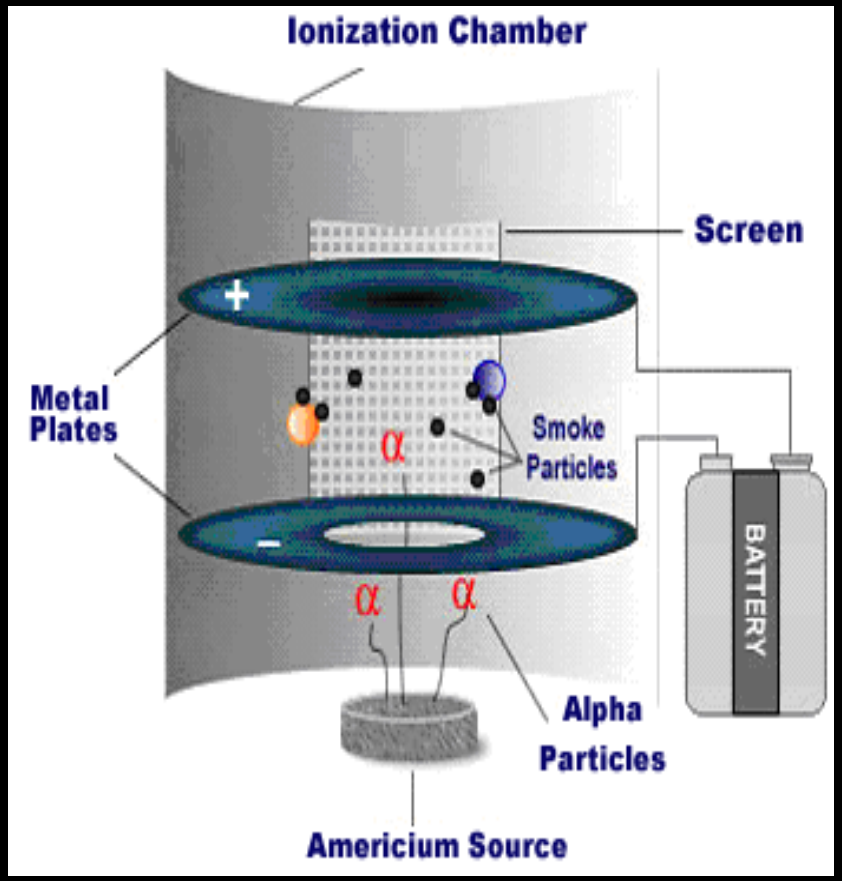
Piezo Positives

- False readings could be eliminated
- No need for complex data analysis
  - Relatively simple to implement

Negatives

- A thorough force study would have to be done
- Powering the circuit will involve ingenuity and probably require an inductive setup
- Initial installation maybe troublesome

Radiation Detection



- The insert would carry a small amount of radioactive material (the source).
- When the insert passes through or near the two detector plates it would trigger the system.

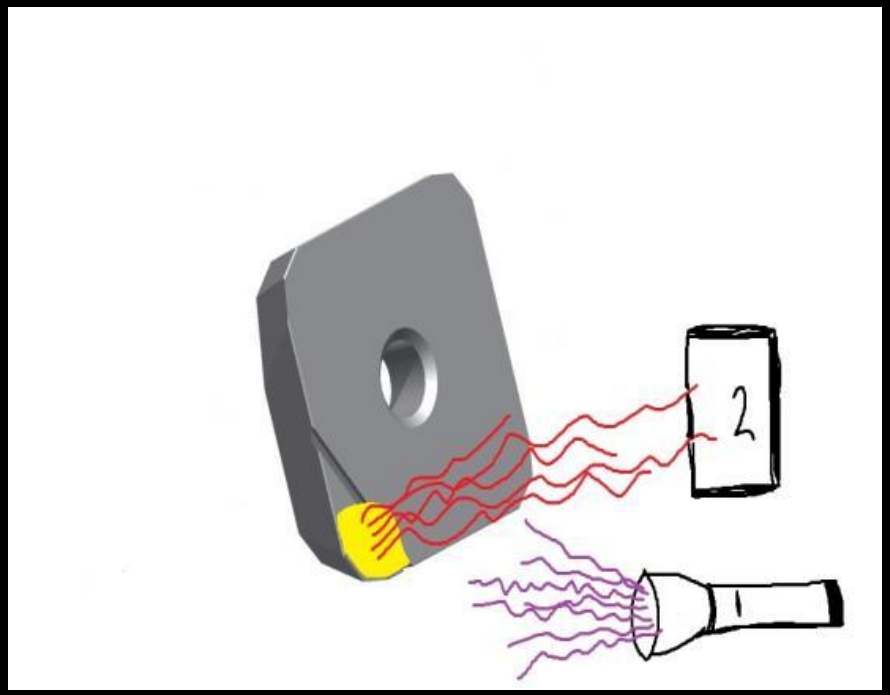
Radiation Method Positives

- No need for complex data analysis
- Quick System response
- Versatility with where data can be taken from

Radiation Negatives

- Circuit tends to act up and not work properly currently
- Positioning of detector plates may be a challenge
- Fitting inserts with radio active dots is required (i.e. electroplating)

Phosphor Method



- In this setup, a UV source shines onto a phosphor paint which then glows and sends off light towards a detector.
- If the insert breaks the detector will not see the glow.

Phosphor Positives

- No need for complex data analysis
  - Quick System response
  - Allows for easy yes/no output

Negatives

- Challenging to place detector and emitter in the right location
  - Paint wear issues
  - Fitting inserts with paint

Future Work

- Discuss future with A. Finkl & Sons
- Continue developing detection methods
- Gather additional data to test software programs
- Experiment with new ideas

Achievements

- Fully tested our hypothesis
- Wrote software for collecting and analyzing data
- Collected & analyzed data
- Developed new ideas for future semesters
- Developed framework for next semester to follow

Questions?