

IPRO 304: Process Improvement Design

Spring 2011



ILLINOIS INSTITUTE OF TECHNOLOGY



- 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.







+ Mission & Values

All members are to come to class on time and prepared

All members must report progress to ensure proper work division

All members are to be respectful of each other's strengths/weaknesses

All members must be dedicated to solving A. Finkl & Sons problem



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+ 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





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+ 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







- 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

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Data collection & analysis



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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





Challenging to place detector and emitter in the right location

Paint wear issues

Fitting inserts with paint





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







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