



IPRO 304

Integration of Process Improvements

Presenters:

Alejandro Tabaoda – A.E. 4th year

Amanda Stenson – M.E. 4th year

Chaitayna Murti – E.E. 4th year



Background

▼ Sponsor Information

- ▼ A. Finkl and Sons.

- ▼ Specialty Steel

▼ Sponsor relation to the IPRO

- ▼ CEO on IIT Board of Trustees

- ▼ IIT Alumni Employed at A. Finkl and Sons.



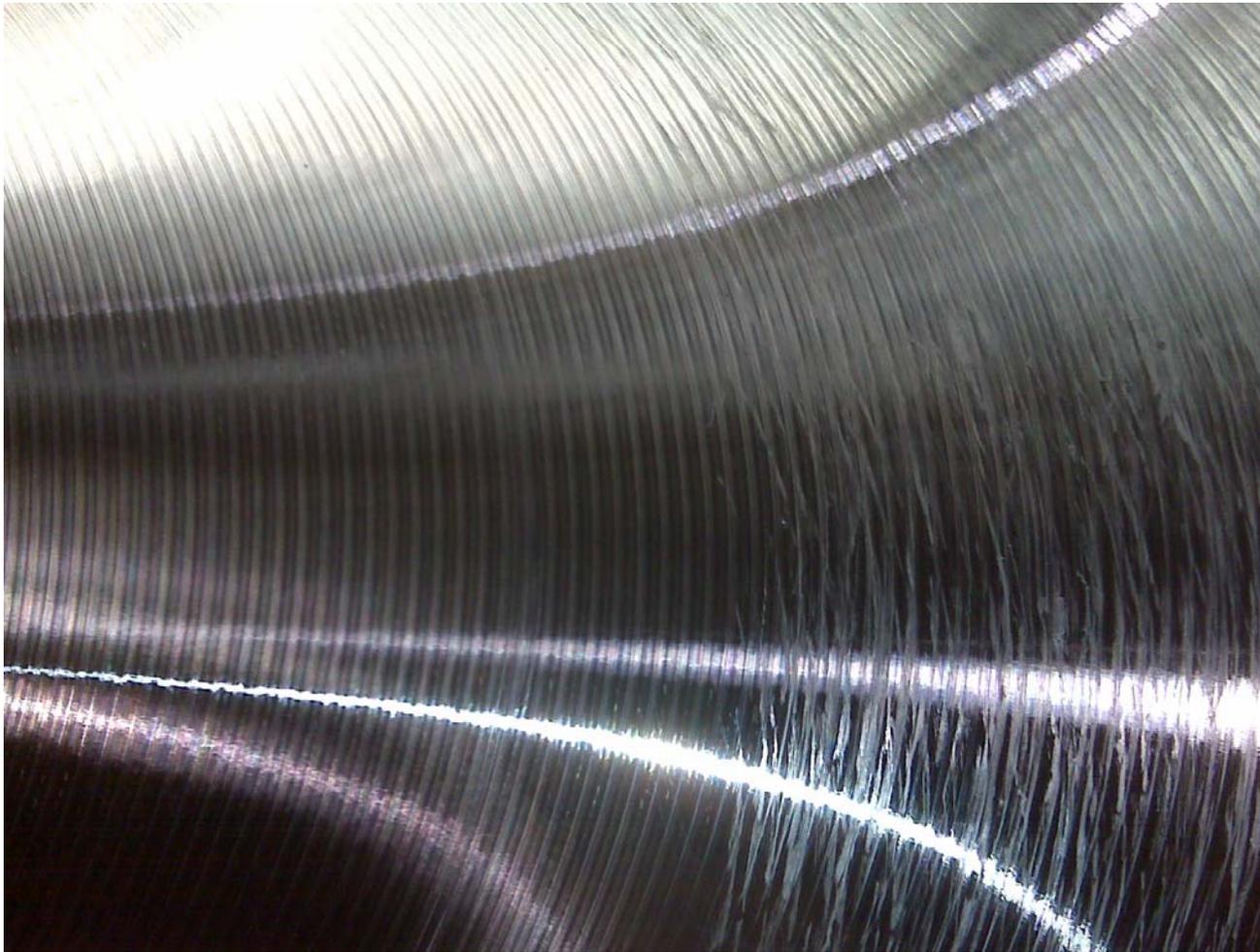
Problem Statement

Broken carbide inserts from the machining operation incur significant economic and productivity losses in the company.





Visual of Problem





Project History

- ▼ IPRO Created Four Semesters Ago
- ▼ Previous Approaches
 - ▼ Laser
 - ▼ Wireless Accelerometers
 - ▼ Microphones
- ▼ Promising Solution
 - ▼ Accelerometers



Semester Objectives

- ▼ Create Methodology to Detect Broken Inserts
- ▼ Use Controlled Environment for Experimentation.
- ▼ Devise New Methods of Detection and Control.



Mission and Ethics

▼ Mission

- ▼ Create Detection Procedure
 - ▼ Cutting Insert Breaks
 - ▼ Cutting Insert Chips

▼ Ethics

- ▼ Non-Disclosure Agreement.
- ▼ Reduction in Human Error
- ▼ Cost Implications

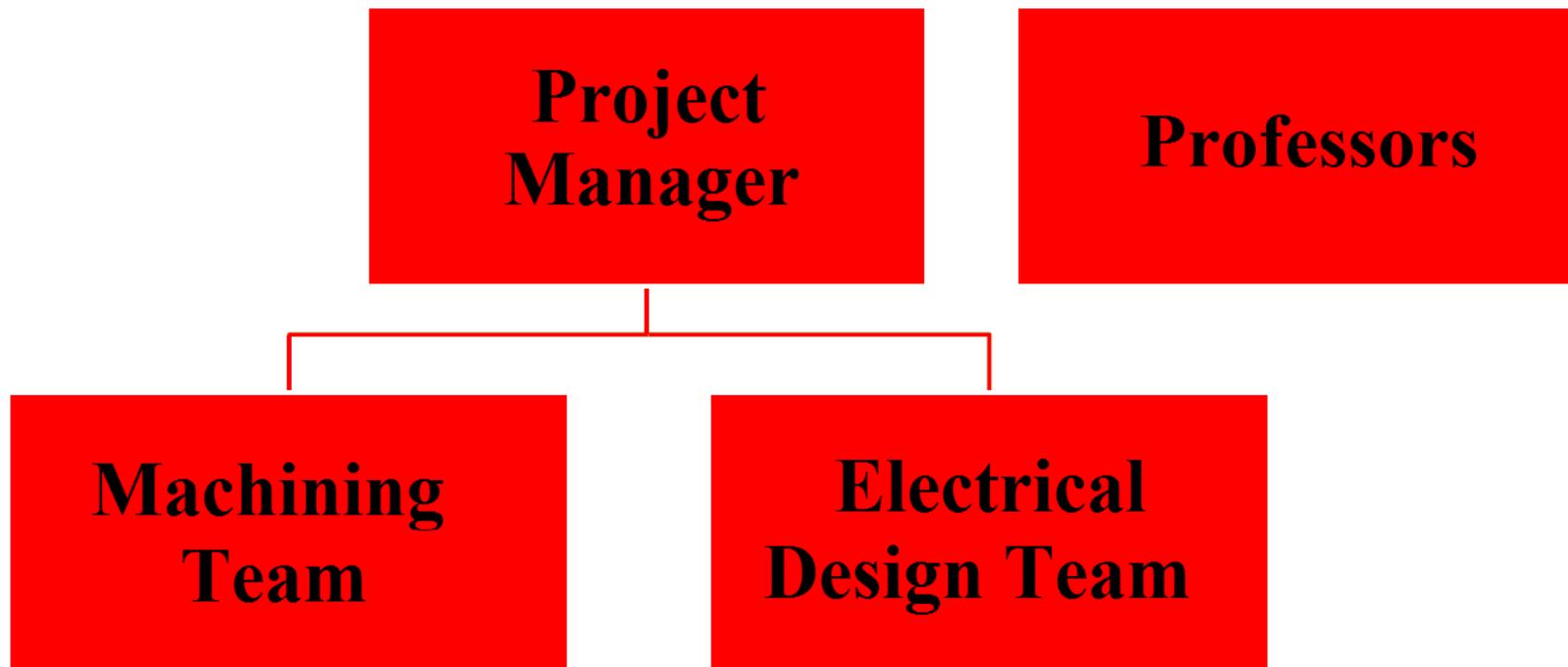


Group Organization

Name	Year	Major	Team
Jessie Bauer	4th year	Electrical and Computer Engineering	Electrical Design
Tony Bergeron	4 th Year	Computer Science	Electrical Design/Team Leader
Matt Campen	4th year	Computer Engineering	Electrical Design
Erik Gruchalski	3rd year	Mechanical Engineering	Machining/Team Leader
Tae Ki Choi	5th year	Architecture	Machining
Ryan Marx	4th year	Computer Science and Computer Engineering	Electrical Design
Chaitanya Murti	4 th year	Electrical Engineering	Electrical Design
Brian Robbins	4th year	Mechanical Engineering	Machining
Atinder Pal Sohal	4th year	Electrical Engineering	Electrical Design
Amanda Stenson	4th year	Mechanical Engineering	Project Manager/Machining
Alejandro Taboada	4th year	Aerospace Engineering	Machining
Bingjian Zhang	4th year	Electrical Engineering	Electrical Design



Group Organization





Project Plan





Our Plan

- ▼ Research Methodologies to Use
- ▼ Use Accelerometers for Data Collection
- ▼ Use Bridgeport and Haas CNC Machine at IIT
 - ▼ Collect Data
 - ▼ Analyze Data
- ▼ Use Milling Machine at A. Finkl and Sons
 - ▼ Collect Data
 - ▼ Analyze Data
- ▼ Present Data to A. Finkl and Sons



Analysis

- ▼ Two Accelerometers
- ▼ NI LabView SignalExpress
- ▼ Analysis
 - ▼ Time Domain
 - ▼ Frequency Domain



Variables

▼ **RPM**

▼ Material Hardness

▼ **Depth of Cut**

▼ Heat

▼ Feed Rate

▼ Machine Vibration

▼ **Number of Broken Inserts**

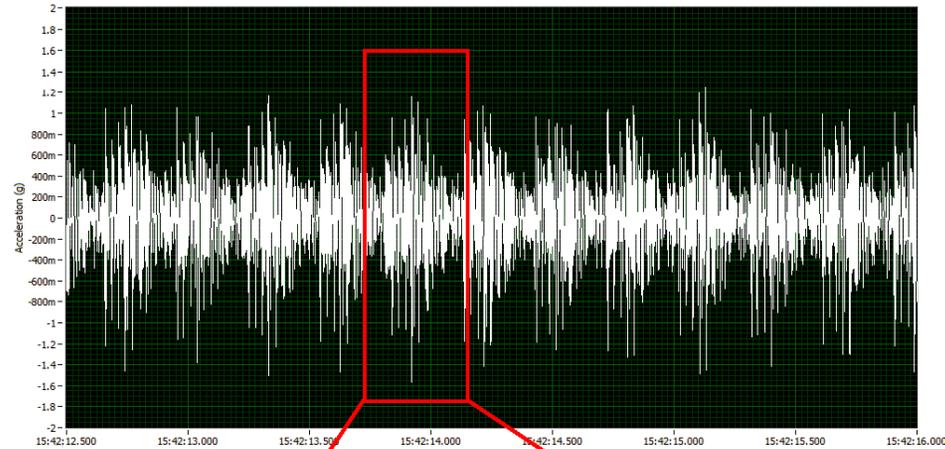
▼ Surface Finish

▼ External Noise

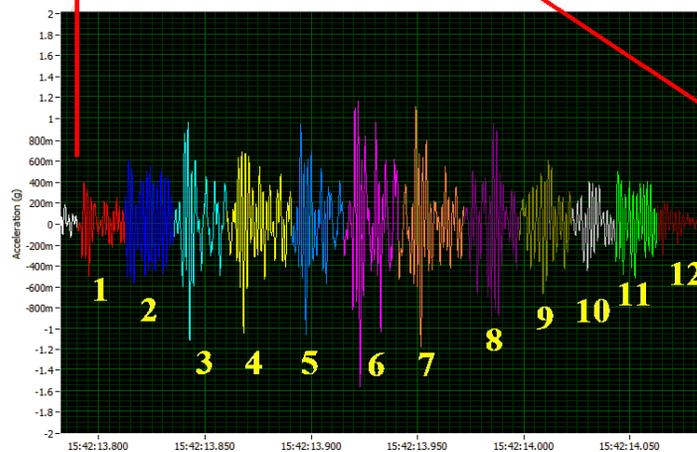
▼ Insert Wear



Time Domain Reading: 0 Broken



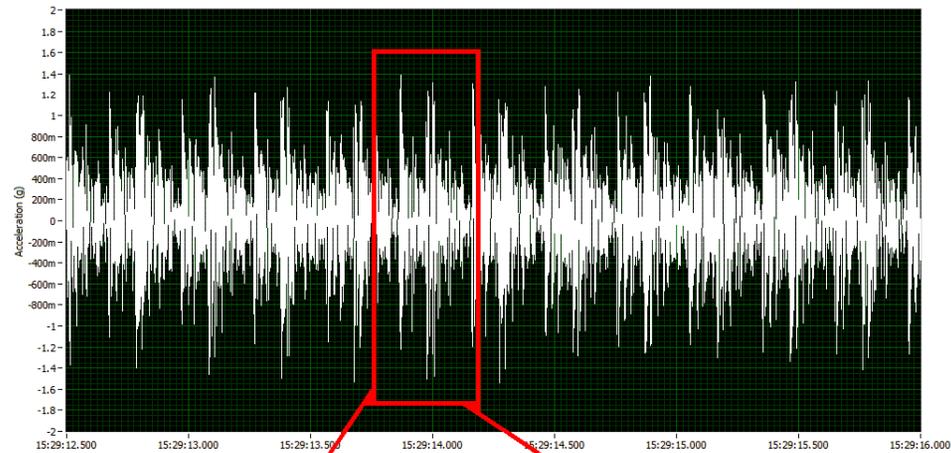
Above: View From 1 Run



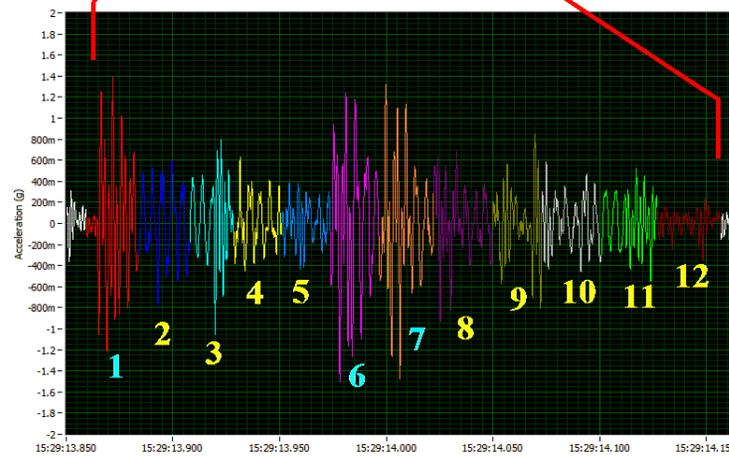
Above: View Showing Each Tooth During 1 Rotation
CNC Machine - 0 Broken Inserts



Time Domain Reading: 3 Broken



Above: View From 1 Run



Above: View Showing Each Tooth During 1 Rotation
CNC Machine - 3 Broken Inserts



Progress

- ▼ Measuring Contact of Each Cutting Insert
- ▼ Testing at A. Finkl and Sons. Facility
- ▼ Analyzing Data Using LabView



Obstacles

- ▼ Replicating A. Finkl and Sons. Milling Machine
- ▼ Obtaining Useful Data
- ▼ Timing Constraints
- ▼ Obtaining Instruments, Devices, etc.
 - ▼ Accelerometers - New versus Old



Scope of the Problem





Accomplishments and Results

- ▼ Created a Working Process
- ▼ Analyzed Data Successfully
- ▼ Identified Variables and Constraints
- ▼ Identified Differences Between One and Three Broken Inserts
- ▼ Developed Prototype Software for Tooth Isolation



Conclusions

Using accelerometers, it is possible to tell the differences between when broken inserts are present and when broken inserts are not present.

Differences Currently Only Observed When:

- ▼ Finishing Cuts
- ▼ Low to Intermediate Depth of Cut
- ▼ Controlled RPM



Next Semester

- ▼ Continue Working With Accelerometers
- ▼ Streamline Testing Procedure
- ▼ Streamline Analysis Methodology
- ▼ Continue Experimentation at A. Finkl and Sons.
- ▼ Continue Development of Tooth Isolation Technique



Summary



Acknowledgements

▼ A. Finkl & Sons

- ▼ Guy Brada – Chief Metallurgist
- ▼ Liz Bilitz – Liaison to IIT students

▼ PCB Piezotronics

- ▼ Keith Crawford – Field Application Engineer

▼ University of Texas

▼ Illinois Institute of Technology

- ▼ Dr. Ray DeBoth – Professor Emeritus
- ▼ Professor Thomas Wong – ECE Department
- ▼ Craig Johnson – Machine Shop Supervisor
- ▼ Russ Janota – Director of Operations Mechanical Behavior

▼ National Instruments

- ▼ Bill Ornt – Software Engineer



Questions?

