

# IoT and Lean Six Sigma – Coolant Consumption Monitoring Project

Fahad Nader  
TECH-646  
Final Draft

## Introduction

-IoT has already initiated great value in the fields of remote monitoring, smart grid management, and asset tracking. And it is a really helpful element in applying lean six sigma tools for improving manufacturing processes, and here will show the case of introducing the IoT into lean six sigma in the coolant lines and show the outcomes of this modifications.

-**The Lean Six Sigma** is a system that combined both six sigma and lean manufacturing tools. It is a collaborative methodology used to reduce variation and minimize waste to convey maximum customer value with limited resources

## Introduction

- **Six Sigma** is a set of techniques and tools used in manufacturing process to reduce variation in process by defining the problem, measure, analyze then improve and control
- **The Internet of Things (IoT)** is a system consisting of smart computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

## Introduction

- Types of sensors are used in manufacturing process :
- Temperature sensor
- Pressure sensor
- Level Sensor
- Flowmeter sensor
- Image sensor
- Optical sensor

## Introduction

The DMAIC methodology

- Step 1- DEFINE the problem and scope the work effort of the project team
- Step 2 -MEASURE the current process or performance
- Step 3 - ANALYZE the current performance to isolate the problem
- Step 4 - IMPROVE the problem by selecting a solution
- Step 5 - CONTROL the improved process or product performance to ensure the target(s) are met

## Problem Statement

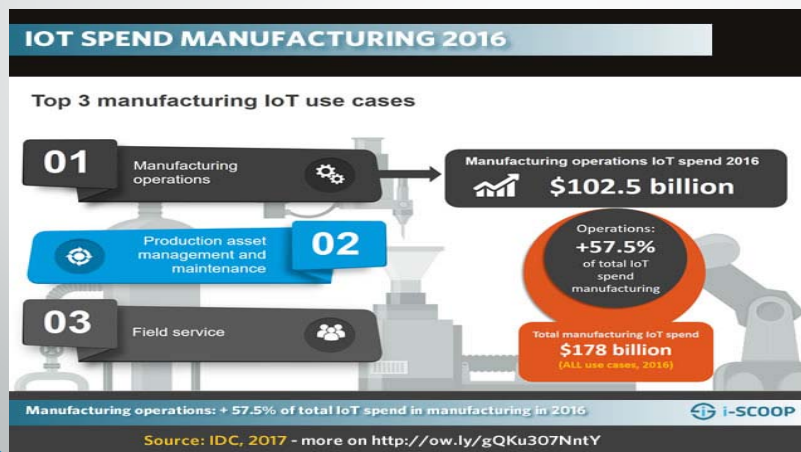
- Improving efficiency in the manufacturing process by collecting data in real time
- The manufacturing industry is facing a problems of privacy and security though interconnecting the line and its essential data online.
- The manufacturing industry has to modify the old generation manufacturing lines to introduce (IoT) to it, which can help to solve system integration problem between the two systems.
- The experienced skilled labor and the new technology produce a culture complexity among manufacturing lines human operators.

## Hypothesis

The positive direct impact of adopting the IoT in the manufacturing process that using lean six Sigma methodology could improve the waste of coolant usage in manufacturing lines.

## Research Objective

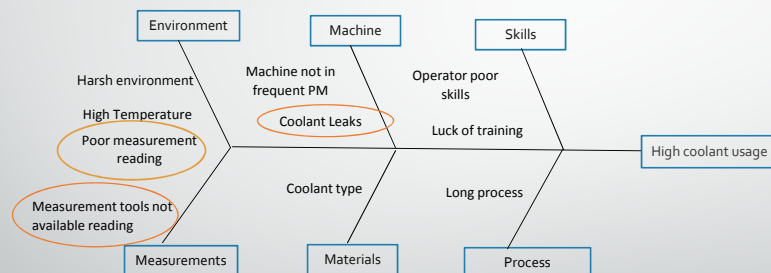
- The purpose of this research project is to discover how did the (IoT) affects the manufacturing process for the companies that adapt it, and the return of investment.

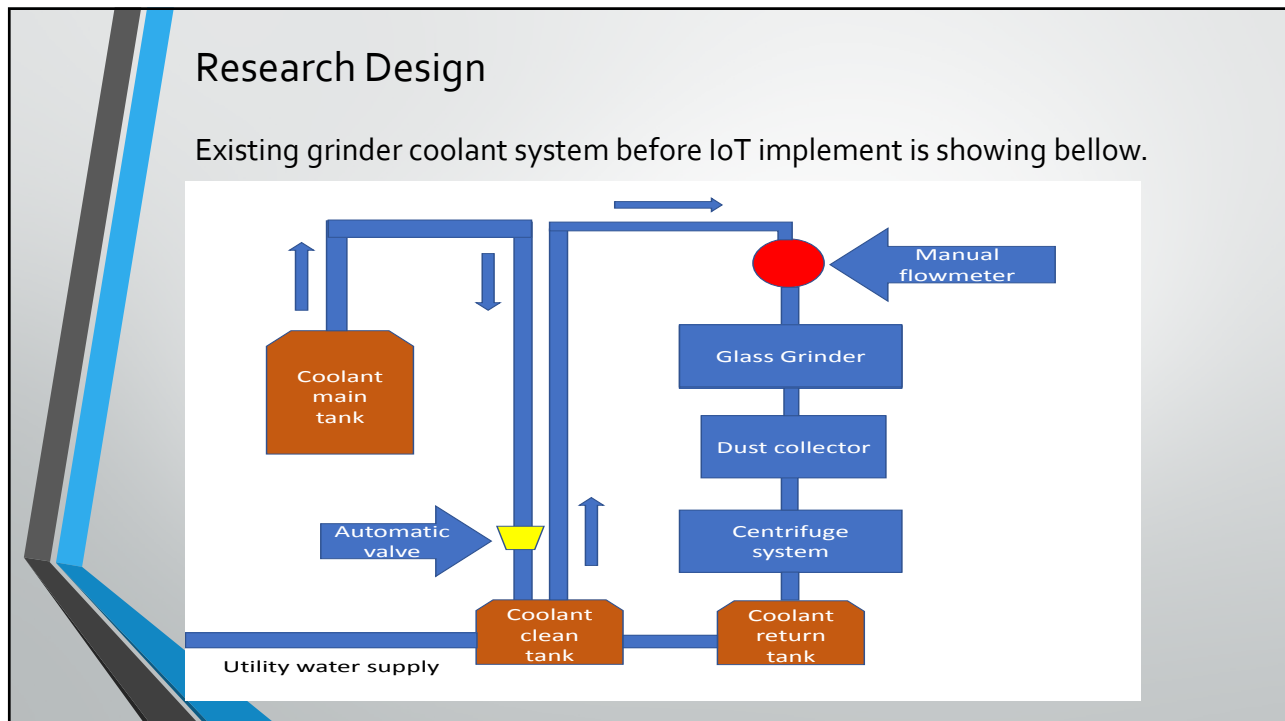
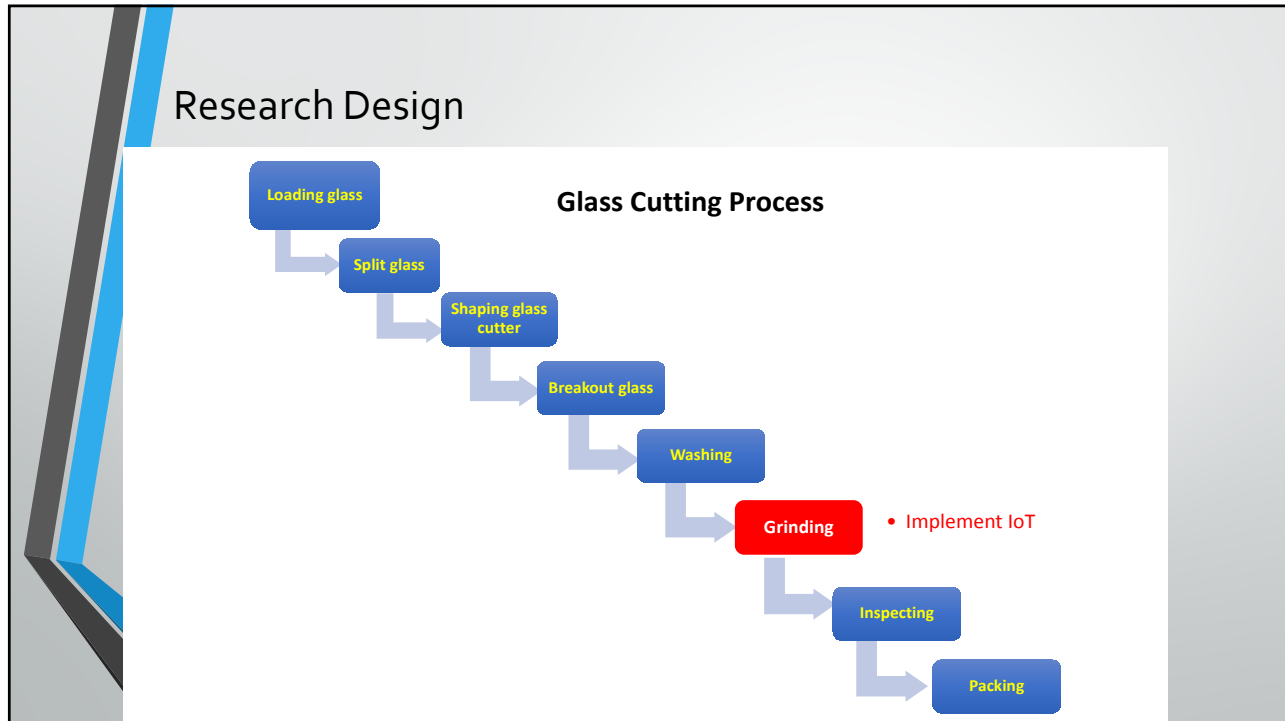


## Importance and benefits

- The importance of this research is to show the benefits of collaboration between (IoT) and lean six sigma in manufacturing process improvement. Both IoT and lean six sigma claim the similar goals of improving the manufacturing process, equipment reliability and increase customer satisfaction.

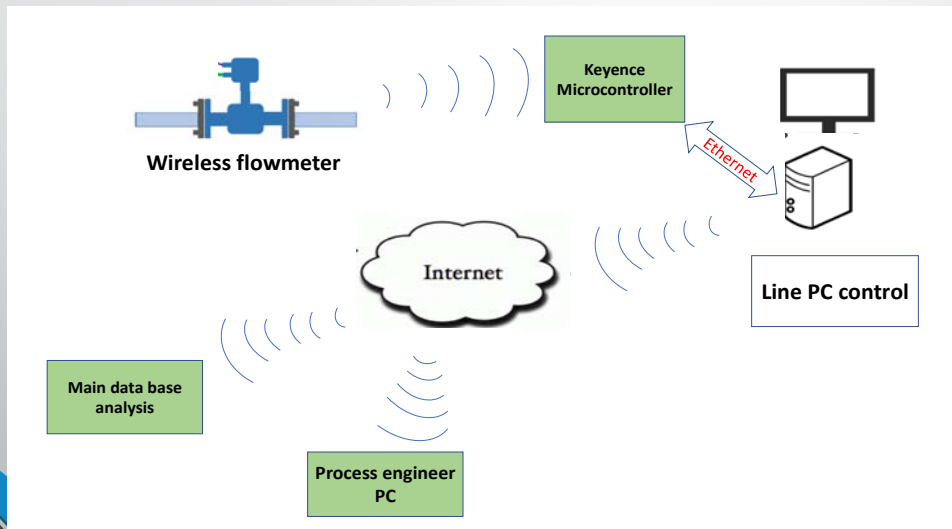
## Process analysis –Cause & Effect



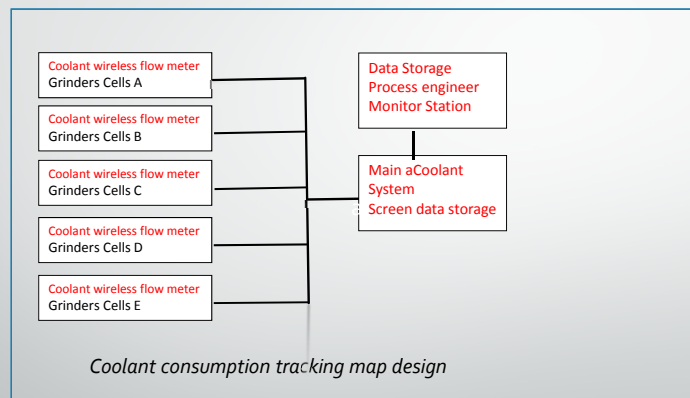


## Research Design

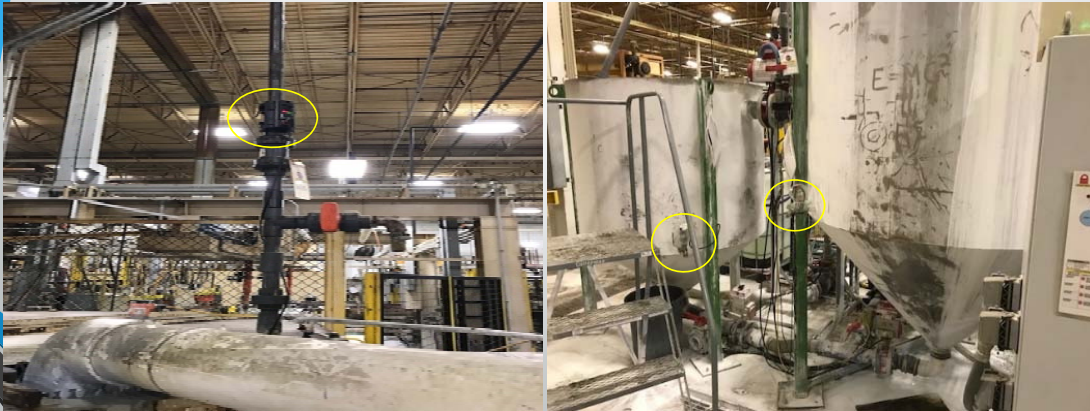
### Grinding system with IoT



## Research design



## System Implementation

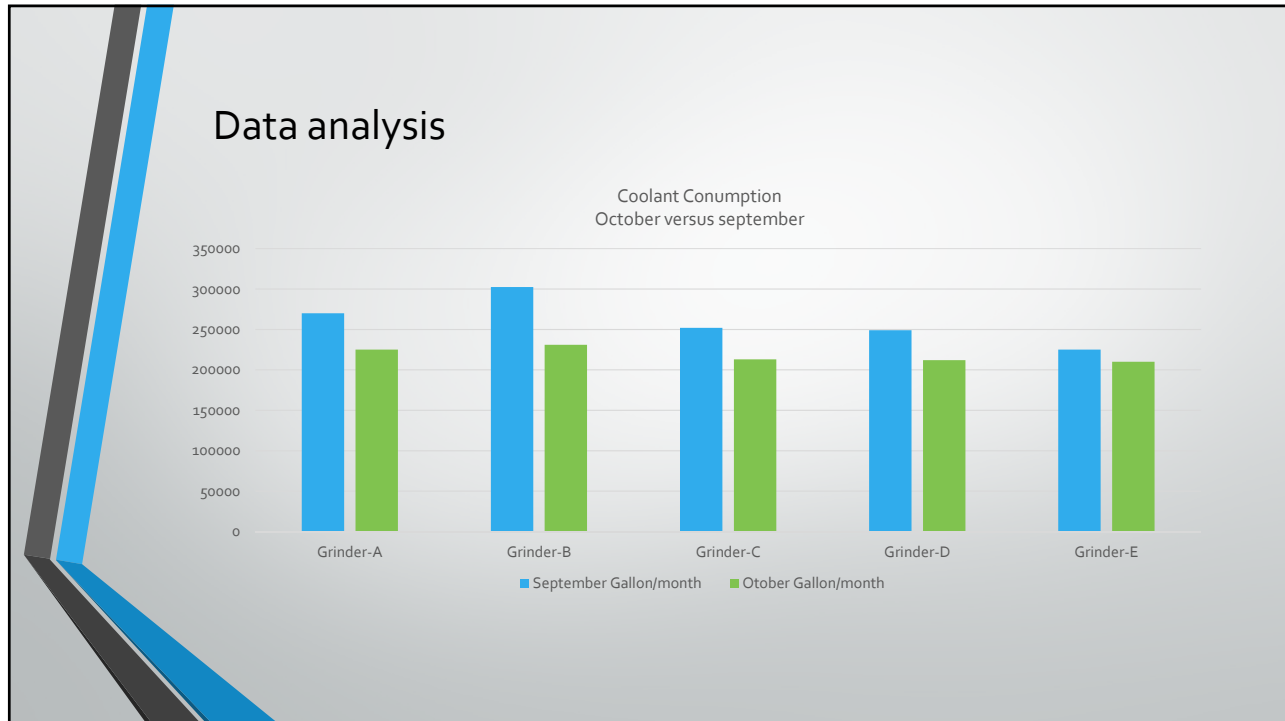


### Data analysis

- Data collection of this project started once the IoT monitoring system was implemented on the coolant lines at the beginning of October 2017. The data analyzed was conducted for the month of October. The comparison of Sept and October data is shown in the table below.

Lines	September Gallon/month	October Gallon /month	Saving Gallons	Percentage Saving
Grinder-A	270000	225000	45000	16.7%
Grinder-B	302400	231000	71400	23.6%
Grinder-C	252000	213000	39000	15.5%
Grinder-D	249000	234000	15000	6%
Grinder-E	225000	222000	3000	1.3%





### Results: Deliverable

The data analysis results as shown in the table & chart above shows the saving per-grinder coolant line and the total monthly saving for only one month gives the sum of (173400 gallons) and that equal to around \$40000 saving.

## Risks

The IoT is considered new technology with well known security risk on data, communication network areas. Since this research is working within the facility network and does not have the remote access capability, therefore network security issue is minimized.

## Budget Summary

- Before adopting IoT to the glass grinding lines, the averaged daily coolant consumption was about 8656 gallons which means 360 G/hr.. After introducing this new technology the daily average usage per line improved to become (7500 gallons) which means 312G/hr. It makes the saving of 48G/hr that equals \$120 per-hour saving which can be considered a big improvement in manufacturing waste reduction.

## Conclusion

- The importance of this project is clearly showed in the data above that proves the important of improvement and updating the manufacturing lines, which results of more efficient manufacturing process that leads to higher savings. It opens the doors for future projects to be proposed to the company management and approved for next year plan. This project also include installing wireless meter in the high voltage substations to monitor wattage power.

## References

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