Virtual Design Review 1

Team 3: Self-Powered Wireless Sensor

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Public Use

Introduction and Roles

Jacquelyn Burnham:

Lead Controls and Programmer

Meghan Busch:

Financial Advisor and Bookkeeper

Thomas Dodamead:

Team Leader

Omar Rodriguez:

Webmaster

Caleb Stallings:

Lead CAD Designer

Project Brief

Project Brief: Background

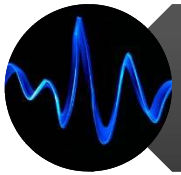
- Cummins has spent considerable funds for warranty claims on wiring harnesses
- Wiring harnesses are unprotected and exist in harsh environmental conditions
- Solution: wireless sensors
- Task: powering these sensors

Project Brief: Important Objectives

Measure parameter at a frequency no lower than 1 Hz at a distance of 5 meters

Transmit data at engine startup and remain in ready condition up to 36 hours

Has no wired connections from engine control module (ECM) or chassis power supply to the sensor



Could measure any parameter (pressure, temperature, velocity, etc.) in the engine

Project Scope

Project Scope: Description

Design, build, and demonstrate a method to power a sensor that will transmit data of a specific variable wirelessly to the Engine Control Module (ECM) in a Cummins' diesel engine.

Project Scope: Key Goals

Reduce Warranty Claims and Maintenance Costs

Simplify Sensor and Power Supply Assembly

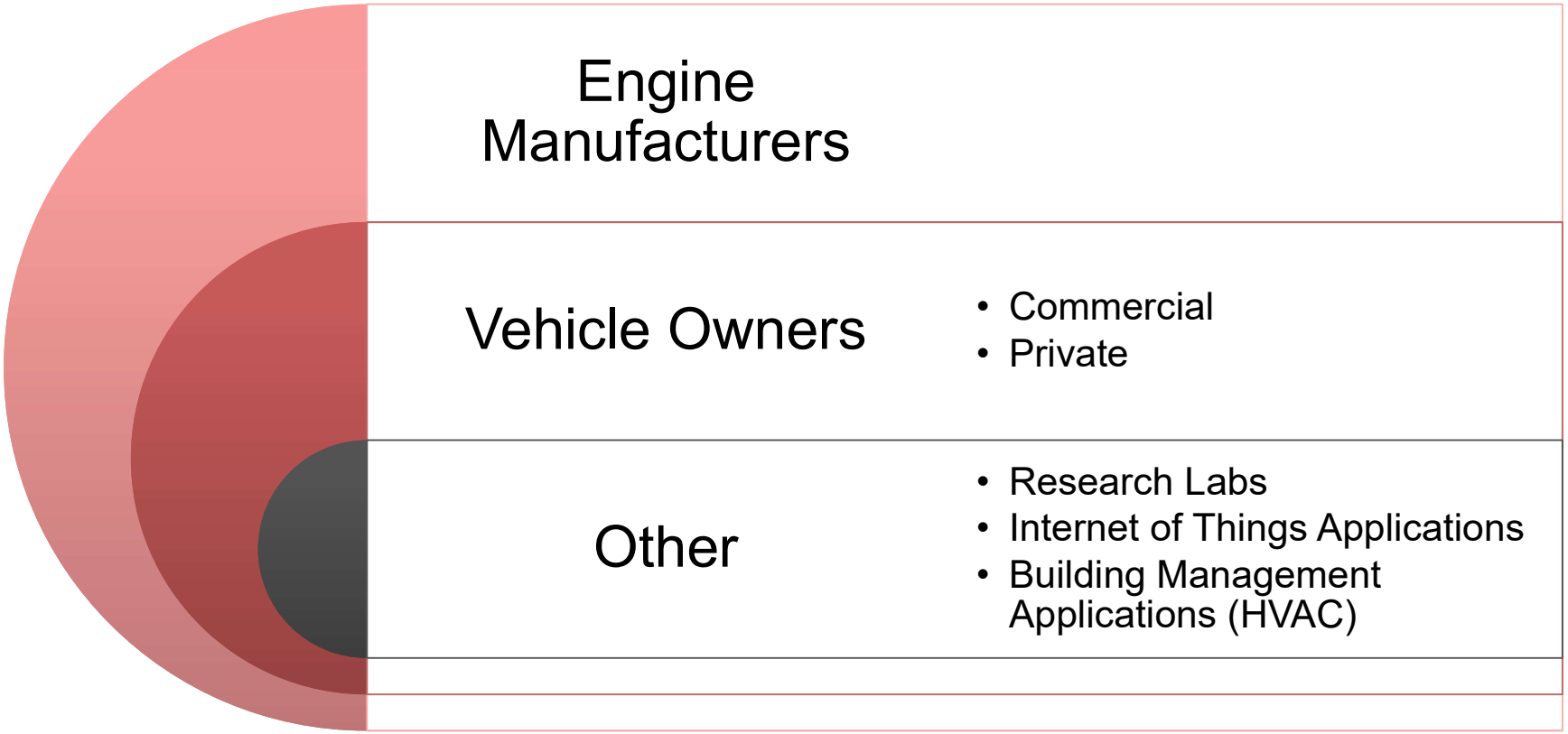
Improve Wireless Sensing Technologies

Investigate Methods of Producing Power from Surroundings

Increase Robustness and Lifespan of Sensor Design

Communicate Important Engine Data with ECM

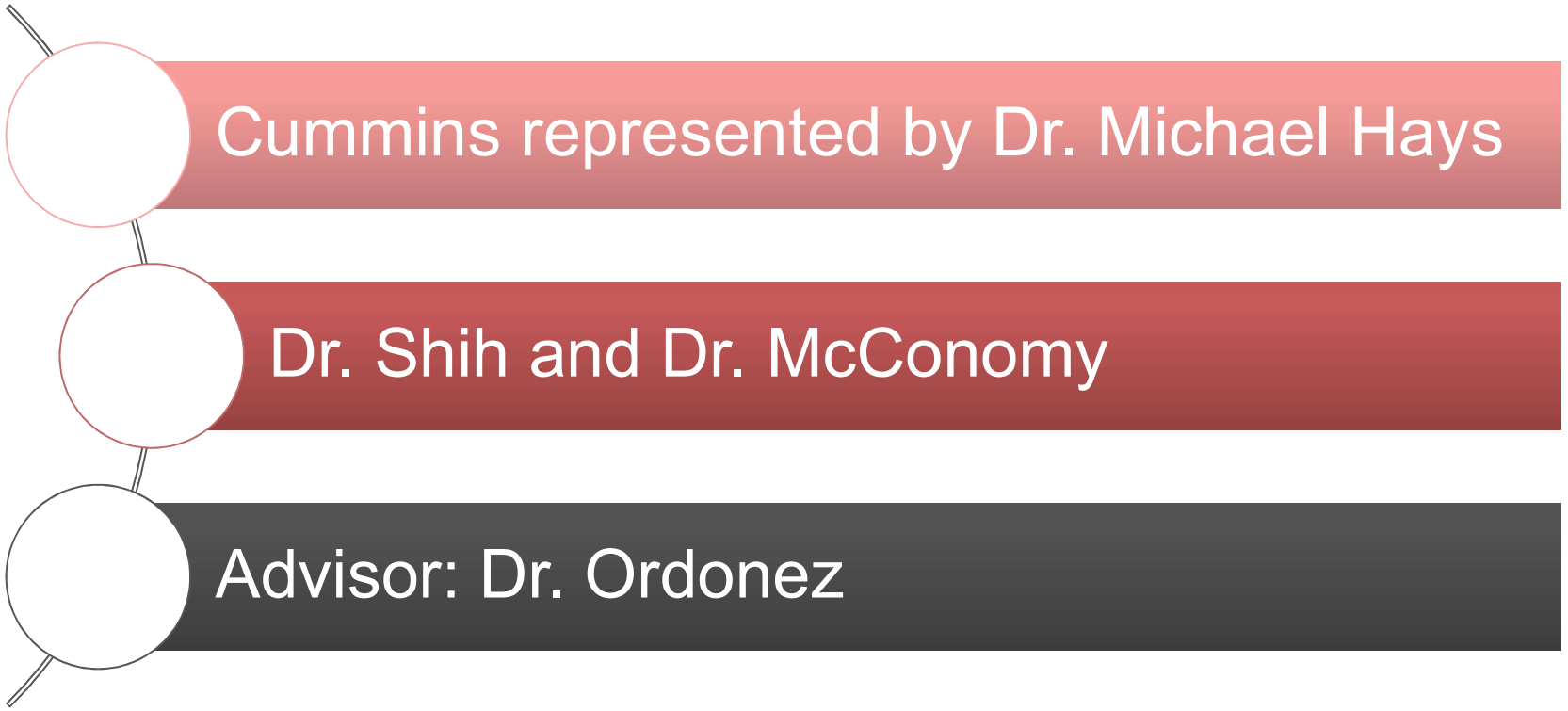
Project Scope: Market



Project Scope: Assumptions

- Purchased sensor will perform to the manufacturer's specifications.
- ECM is compatible with wireless communication method.
- Focus on only one parameter for the sensor.
- It has highway applications only.
- The attachment method of the sensor will not be designed.
- Sensor can be utilized anywhere in the engine.

Project Scope: Stakeholders



Customer Needs

Customer Needs: Meeting with Sponsor

Question	Customer Statement	Interpreted Need
Which current wired sensors are your priority to make wireless?	Any sensor within the engine can be used: thermal sensor, speed sensor, pressures sensor, etc.	The variable to be measured will be up to the design team to decide.
What type of wireless communication do those wireless sensors use?	Any communication type can be implemented into the ECM.	The wireless communication can be adapted to the ECM.

Customer Needs: Ranking Matrix

Customer Needs

Important Objectives	Sensor must be self-powered	Needs to have a sampling frequency no lower than 1 Hz	Can use any signal communication between ECM and sensor	Communicate to the ECM wirelessly	Design has a volume less than 6 in^3	The wireless sensor can be used in engines ranging from 2.8 L to 120 L.	Decide on a variable for the sensor to measure	No specific safety or fire ratings need to be met	Power supply last 36 hours after engine shut off	Operate at a distance of 5 m
Wireless Hardness	O	O	O	X					O	X
Highway vehicle applications	O				O	X	X			O
Resist harsh environmental					O	O	O	O	O	
Monitor the engine during startup	O	O	O						X	
Demonstrate wireless communication	O	O		X						X
No wired connections to battery	X								X	
Rank of Importance	33	18	12	18	12	11	11	6	30	24

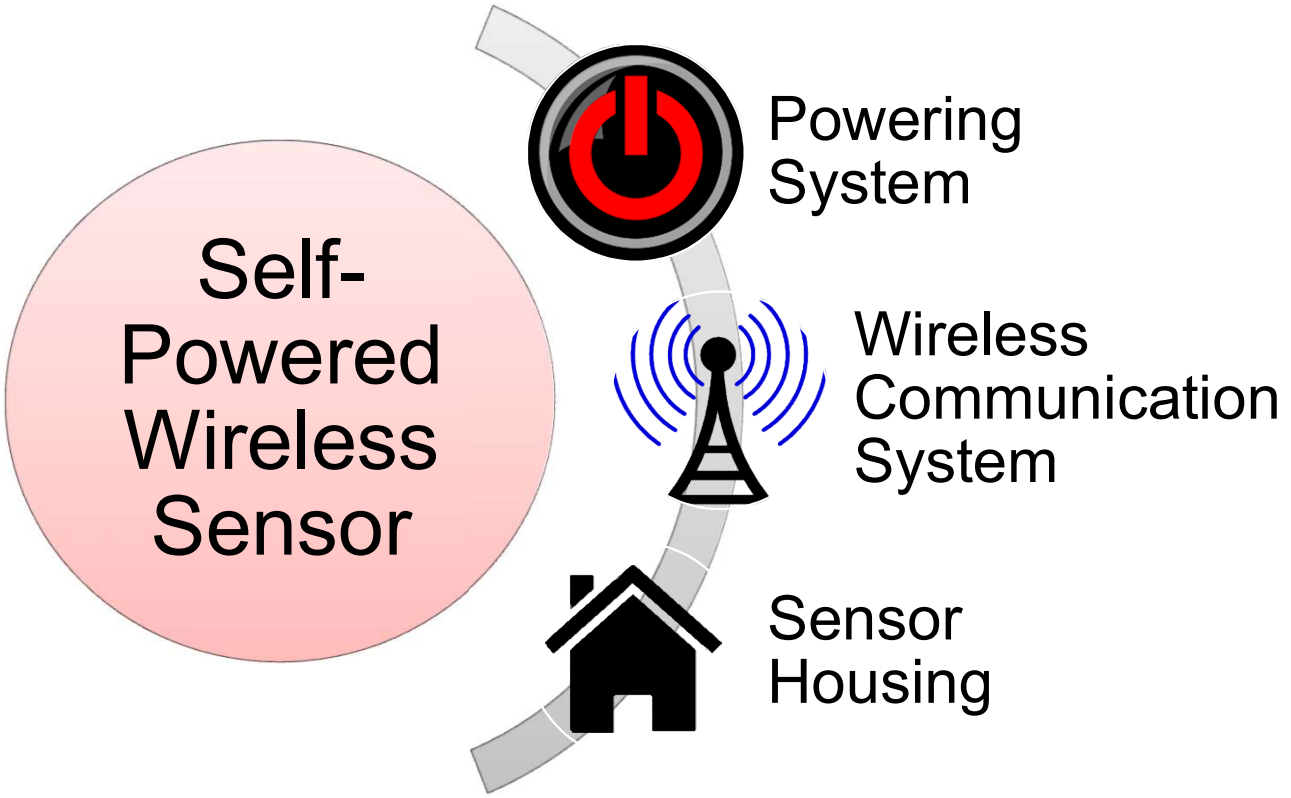
Legend	
X	9
O	6

Customer Needs: Summary

Interpreted Customer Needs	
1. Sensor must be self-powered.	6. Design has a volume less than 6 in^3.
2. Power supply last 36 hours after engine shut off.	7. Can use any signal communication method between ECM and sensor.
3. Transmits signal at least 5 meters.	8. Decide on a variable for the sensor to measure.
4. Communicate to the ECM wirelessly.	9. Can be used in engines ranging from 2.8 L to 120 L.
5. Sampling frequency no lower than 1 Hz.	10. No specific safety or fire ratings need to be met.

Functional Decomposition

Functional Decomposition



Functional Decomposition

Powering

- Store energy
- Produce energy

Communication

- Condition signal
- Receive signal
- Transmits signal

Housing

- Manage heat
- Limits electrical interference
- Protects from debris

Conclusion

- Project Description: Design, build, and demonstrate a method to power a sensor that will transmit data of a specific variable wirelessly to the Engine Control Module (ECM) in a Cummins' diesel engine.
- Design within the customer needs.
- Next Steps:
  - Decide on a variable to sense.
  - Decide on type of sensor.
  - Generate concepts on how to power the sensor.

Questions?