Ultimate goal is to help make zero fatalities, zero injuries, and zero accidents a reality.

Passionate about creating a world with zero emissions.

Technology to allow seamless connectivity in the vehicle – it’s what consumers want, and we can make it a reality.
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SECTION 1 EXECUTIVE SUMMARY

CAPS Engineers is an engineering company focusing on the safety and progress of society. We would like to propose a project to Delphi incorporating safety and enhanced connectivity. The proposed design is composed of an automatic sensor and an air pump that works automatically. Currently in order to adjust tires that are low in pressure, one has to carefully drive the car to a gas station and then pump the tires to the right pressure themselves. This is could be dangerous and serves as a nuisance when this has to be done during the cold winter months. This automated device will make it easier to adjust low pressures of tires and safer for drivers on the road.
SECTION 2 INTRODUCTION

2.1 PROJECT OBJECTIVES.

Identify technologies and opportunities to make cars and trucks safer, greener, and more connected.

2.2 PROJECT BACKGROUND.

There are up to 50 computers buried beneath the skin of the cars and trucks that you see every day on the road. You wouldn’t know they were there. But each of them is making that vehicle safer, greener, and more connected. Many of those computers were designed and built by Delphi.

It seems every day we’re hearing in the news about “cars of the future”, ones that will park themselves, drive themselves, talk to us, use fuel more efficiently, report data to insurance companies, avoid accidents, etc. What does this mean in terms of the technologies needed, societal acceptance, and the policies and supporting systems needed to enable these safer, greener, more connected cars and trucks?

2.3 SPONSOR BACKGROUND.

Delphi Automotive is a global automotive components design and manufacturing company it is one of the world’s largest automotive parts manufacturers and provides electrical and electronic, powertrain, safety, and thermal technology solutions to the global automotive and commercial vehicle markets. Delphi operates 126 manufacturing facilities and 15 technical centers across 32 countries, utilizing a regional service model that enables it to serve its global customers. It has approximately 161,000 employees worldwide, with around 5,000+ located in the United States. Delphi operates through four segments: Delphi delivers innovation for the real world with technologies that make cars and trucks safer, more environmentally friendly, smarter, better connected, and more affordable than ever before.

Electrical / Electronic Architecture

Today’s vehicles have to be about more than transportation. They have to entertain, inform, connect, and protect their passengers. The competitive landscape is all about features and functionality. Delphi’s goal is to help auto manufacturers incorporate in demand features without substantially adding to a vehicle’s mass or cost. And it’s not easy. But they have the electrical integration experience, the systems capabilities, and the technologies to deliver unique electrical/electronic architectures for unique needs. Major products: Wiring harnesses,
electrical centers, vehicle and cell phone wireless charging, data communication cabling, hybrid vehicle charging systems

**Powertrain Systems**

Delphi’s advanced engine management systems are making an important contribution to a cleaner tomorrow by minimizing the environmental footprint of vehicles. The manufacturers of motorcycles, lawn and garden equipment, recreational products, power generators, marine engines, and other small engine products also rely on their systems-level knowledge and analysis resources. They have extensive knowledge and experience in fuel injection, electronic controls, sensors, air and fuel management, ignition systems, valve train, fuel handling, and evaporative emissions canisters. And they have a global network of engineering and manufacturing resources to respond quickly and efficiently with localized program support.


**Electronics and Safety**

Delphi is working to build safer driving experiences that have more information, entertainment and connectivity. Their safety expertise encompasses everything from crash sensing electronics to collision mitigation. And with their radar, vision, and vehicle-integration expertise, they’re enabling innovative active safety systems that help make high-performance safety features affordable in the mainstream vehicle market. These systems are designed to support their vision of a society with zero fatalities, zero injuries, and zero accidents.

Major products: Engine Control Module, Advanced reception systems, Navigation, displays, adaptive cruise control, radar and camera systems, parking guidance systems

**Thermal Systems**

Delphi meets its customers’ heating and cooling needs across a wide range of industries, with products that provide world-class comfort. In fact, they’ve been managing air, liquids, and temperature longer than any other automotive supplier in the world. They’ve virtually perfected the science, and were first to integrate electronics, sensors, and special algorithms into climate control systems to make them smarter, faster and better than ever before. This special Delphi technology creates a precise orchestration of vehicle air temperature that can be as sensitive as one-tenth of one degree. At Delphi, they call it thermal management intelligence.

Major products: Compressors, HVAC systems, powertrain cooling modules
2.4 PROJECT CATEGORIES.

Delphi has three target areas. These are safe, green, and connected.

**Safe:**
Delphi’s ultimate goal is to help make zero fatalities, zero injuries, and zero accidents a reality. The safety of the driver and passengers of a vehicle is of upmost importance. Safety features could range from airbags to sensors that detect dangerous situations. Alerts enable the driver and passengers to be aware of problems and allow them to fix them.

**Green:**
Delphi is passionate about creating a world with zero emissions. They believe that protecting the environment is crucial in developing vehicles of the future. Hybrid and electric cars are becoming a popular alternative to traditional automobiles. Delphi is aware that research on alternative fuels is being conducted, but they have also concluded that just reducing the weight of the vehicle or having products that make engines run more efficiently can improve the fuel economy of a car dramatically.

**Connected:**
Delphi has developed technology that allows for seamless connectivity in the vehicle. This is due to consumer demand and Delphi is determined to satisfy their wants. Delphi believes that the vehicle of the future should be optimally connected to maximize the driver’s and passenger experience while minimizing driver distractions. Connecting the vehicle itself and all its sensors to the outside world is essential. They state that in the future vehicles will have 100s of sensors collecting data that would allow for ease and comfort of consumers.

2.5 PROBLEM STATEMENT.

Vehicles are an efficient way to transport people all year round. However, automotive vehicles tend to work more efficiently during times of moderate temperatures. Extreme weather conditions affect the ability of a vehicle to optimize its capabilities. Tires tend to suffer severe damage during the colder months of the year. Tires have to resist damage from potholes, salt, and the dropping temperatures. As the temperatures in the colder months drop lower and lower, so does the atmospheric pressure. Tire pressures have to be checked periodically to account for these changes in temperature. Currently, vehicles have the capabilities of sensing when a tire is at a pressure that which is recommended. This ensures safety, but also forces people to constantly have to be refilling our tires. So our device will allow for seamless connectivity as well as furthering the safety of passengers in a vehicle.
3.1 PROPOSED DEVICE.
The proposed device revolves around the idea of an automatic pump and sensor. This device will be built into the rim of each of the tires. The sensor signals the pump to automatically adjust to the correct pressure based on changes in outdoor conditions. Creating an automatic pump tackles both the safety and connectivity goals that Delphi is targeting. By creating an automatic pump that is wirelessly connected to the sensor that detects when the pressure of the tire is low, drivers will be able to continue driving without worrying about their tires being low on pressure and eventually going flat. Having the pump be automatic allows for seamless use, which is exactly what Delphi’s connectivity goal entails.

3.2 RATIONALE FOR SELECTION.
During the winters and cold months of the year, tires tend to deflate due to changes in atmospheric pressure as well as poor road conditions such as potholes. Creating an automatic pump that adjusts tire pressure to the correct amount without human interaction will make adjusting tire pressure less of a nuisance to drivers. This will also ensure higher safety for the passengers of a vehicle because the pump automatically responds to abnormalities. The sensors currently alert the driver when it is time to adjust air pressure.

3.3 CUSTOMER NEEDS.
Almost anyone would be targeted by this kind of product, but some more than others.

1. **Drivers Living in areas with Low Temperatures**
   a. This product targets those who live in places where low temperatures affect the pressure of the tire. This will allow for ease of travel for all those inconvenienced by tires low in pressure.

2. **Busy Drivers**
   a. With the lives people live now it is hard to squeeze in time for anything, including adjusting tire pressure. Having this device will ensure safety for those who have little time for almost anything.

3. **Teenagers**
   a. Teenagers live busy lives, worrying about academics, sports, extracurricular activities, and being safe on the road is a lot to be running through a new drivers mind. Having the automatic pump will allow for these drivers to pay attention to the road and not worry about having to stop to adjust the pressure of the tires.
4. **Elderly Drivers**
   a. Those of older age have harder times with mobility. Having an automatic pump will not force them to get out of the car and down on their knees to adjust the pressure on their tires.

5. **Taxi/ Bus Drivers**
   a. Obviously taxi and bus drivers are constantly on the road year round. They really do not have time in the middle of the day to stop and adjust the pressure in their tires. The automatic pumps will maximize their efficiency and ensure higher safety for their passengers.

3.4 **OBJECTIVES AND GOALS.**
The objective of this design is to protect drivers and passengers against flat tires. This will be done by implementing an automatic pump and sensor in all tires. These pumps and sensors will automatically adjust the pressure of the tire to its specified amount. This will ensure higher safety for drivers and their passengers.

3.5 **CONCEPT OF OPERATION.**
The concept of this design is composed of a sensor that is wirelessly connected to the sensor that communicates that a tire is flat to the driver. This sensor will then calculated whether air must be pumped or released from the tire to bring it back to a neutral state. The sensor will then communicate this information to the pump and the air pressure in the tire will be adjusted.

3.6 **SYSTEM CONTROLS.**
The system will be connected wirelessly. A wireless sensor will be located in the rims of the tires. The sensors will communicate to each other and when one signals that the pressure of the tire is not in equilibrium, the other will signal the pump to start. Then the pump will start adjusting to the correct air pressure.
3.7 SYSTEM MODEL.

Both Figure 1 and Figure 2 are virtual models of the automatic pump and sensor. The model will fit on the inside of the tire. The tube on the left side of Figure 1 is the tube through which the air pressure will be adjusted within the tire. The actual body of the device will have the sensor located within it and this will connect wirelessly to the vehicle’s sensor that detects low pressure in tires. In Figure 3, the inside components of a tire are labeled. The device will be implemented into the inner lining of the tire. Through a wireless component the sensor that signal a driver that a tire is low in pressure will signal the automatic pump to begin adjusting tire pressure while the car is still and in park.
3.8 DAY-IN-THE-LIFE.
On a cold morning in State College, Pennsylvania Professor Berezniak gets up and starts his car. Yesterday he attended his grandson's birthday party and he slept late. He grabbed his coffee and turned on his car. Before leaving, Professor Berezniak noticed that the signal for low tires on his car was lit. Fortunately, he had tires with the newly developed Delphi Automatic Pump and Sensor. Instead of worrying about going out of his way in order to pump his tires, his car notified him that his tires were low on pressure, and this signaled the automatic pumps to adjust his tires. In a matter of just minutes, the tires had been fully adjusted, and he is ready to get on the road to teach a full day of classes. The Delphi Automatic Pump and Sensor made traveling easier, safer, and more efficient for Professor Berezniak.

3.9 LIFE CYCLE ASSESSMENT (LCA).
Each device will come built into new tires. The device’s lifespan will be equal to that of standard tires. If the tire ever pops due to accidents or disturbances in the road, a brand new tire that has the pumping/pressure sensing unit built in must be purchased.

3.10 ECONOMIC ASSESSMENT.
Class 5 Cost Estimate:
Class 5 assessments are usually prepared based on a very miniscule amount of information; therefore, they have wide accuracy ranges. Class 5 estimates may be prepared within a very limited amount of time and with little effort expended.

- **Maturity Level of Project Definition and Deliverables:**
  - Our project has a very low maturity level; it only being a Class 5 product means that there is only about 0% to 2% of full project definition. This means that the project scope description and plant location are said to be general locations. This also assumes both plant production/facility capacity as well as the contracting strategy. This also assumes that the block flow diagrams used as engineering deliverables have begun and work on this deliverable is advanced.

- **End Usage:**
  - Class 5 estimates are prepared for any number of strategic business planning purposes. The project location studies are taking place at the Pennsylvania State University Main Campus. The project is sponsored by Delphi. Budgeting estimates range depending on sources used.

- **Estimating Methodology:**
  - In order to estimate the cost we are comparing prices of components of the device. In order to minimize cost of production our plants and factories will be located internationally as opposed to domestic locations.
• **Expected Accuracy Range**
  - A portable air pump costs about $13 and implementing wireless Bluetooth technology will bump the price up $27. Just the parts are going to cost $40 a piece. Then assembling will cost manual labor. In 2009 the average hourly rate for people working in manufacturing in China was just under $1.80. This will save us money in the production process. We plan on partnering with tire companies such as Goodyear and Bridgestone in order to sell more products and spread awareness of the device and its advantages. This being a Class 5 assessment makes the typical accuracy ranges -20% to -50% on the low side and +30% to +100% on the high side. These depend on the technological complexity of the project and appropriate reference information.

• **Demands and Constraints:**
  - The demand will probably go up during the winter months. This will cause a hike in the prices because it will be hard for production to keep up with the higher demand for the device.

3.11 **PRODUCT DEVELOPMENT AND MARKETING.**

In order to keep the product cost efficient, its production will be outsourced. The production components are very basic. Computer chips, sensor and other body parts can be either provided by the firm or can be easily found in the country of production itself.

**Beta Testing:** To estimate the faults of the product, the product is tested inside tires of the testing cars. The feedback will help to develop improvements in the product.

**Market Testing:** To estimate the market outcome every product must be beta tested. A suggestive beta testing of this product is with a small car company. By targeting small car companies and even dealerships, the response to the product will be efficiently recorded. The data will help to bring about the subsequent changes in the product.

**Launching of Product:** The product will be launched by being implemented in many of the newest car designs from companies like Honda, Toyota, and Ford. Additionally, the product will be pushed at car dealerships and other smaller car companies, in hopes that they will offer installations of the product to customers.

**Advertising:** The best way to market the product would be achieved by partnering with car companies. Companies such as Honda, Toyota, Ford, and others have done extensive market research, and will have the funds and resources to effectively advertise the product being implemented in new cars. These car companies will be able to tailor commercials for the target audience, and achieve maximum sales.
SUMMARY

Benefits of implementing the design of this automated air pressure adjusting device will give consumers advantages in safety, spending, and time. The goal of the new product was to prevent safety issues associated with incorrect air pressure in tires, however other benefits exist. For example, time is saved as owners no longer have to check tire pressure or readjust inflation. This also gives an economic advantage as correct tire pressure plays a big role in preventing flats or tire blow-outs. Shortcomings include not all cars on the road having this new safety feature, as only new cars will have the device. It is a very feasible option and can be easily adopted by requiring all new cars to have the device. Other applications could include anything that has tires. For example, it could also be beneficial to airplanes, tractors, or any device that is inflated and the pressure sensor can fit inside.
REFERENCES

Works Cited


