**FAMU/FSU College of Engineering**

**Department of Mechanical Engineering**

**Plans and Product Specifications**

**Team #22: Development of Functional Pedibus**

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# **Project Information**

## Need Statement

The current sponsor for the Pedibus project is Ron Goldstein, owner of the Capital City Pedicab Company here in Tallahassee. The sponsor wants to have a fully functional multi-user bike that can be rented out for events around the city. In addition to having a multi-person bike, some form of digital advertisement, mounted to the bus, is needed. The build that he received last year was near unsatisfactory. Mr. Goldstein had to reach out to a third party fabricator upon receiving the product for the build to be optimized and finalized. The team plans to deliver a fully functional, optimized product to the sponsor no later than March 14, 2015, in time for Springtime Tallahassee. In order to introduce this new business model to the city of Tallahassee, a well-functioning, and attractive pedal powered bus must be made.

## Goal Statement & Objectives

The Pedibus senior design team plans to deliver a fully-functional and optimized Pedibus to Ron Goldstein by March 14, 2015, along with shop drawings and build specifications for possible future reproduction.

* Accommodate a minimum of 10 pedaling riders
* Accommodate at least 2 extra non-pedaling riders
* Optimized design for servicing multiuse (bar, bbq, etc)
* Hitch towing ability
* Packet containing all shop drawings and fabrication specs along with components sourcing
* Detailed cost analysis for entire build
* Fully functional electric driver assist
* A clearly visible digital advertising banner
* Affordable and light-weight power source

## Constraints

The design constraints that have been placed for this build were set both by the sponsor and by law. The sponsor state early on in the design process that we wishes to utilize new, off the shelf parts as much as possible throughout the Pedibus. The sponsor also stated that the vehicle must be able to accommodate 10 pedaling passengers, at least 2 more non-pedaling passengers, as well as the driver and server. Another major design constraint that has been encountered is the ability for the Pedibus to move and perform without it having all 10 passengers pedaling. Therefore a transmission system is going to have to be implemented to ensure that the vehicle will stay fully functional with minimal passengers on board. The bus must be able to effectively climb the hills around the Tallahassee area without putting too much strain on the customers on board. Through preliminary research it has been found that digital advertising banners can be expensive depending on the size, resolution and other parameters. Mr. Goldstein wants a professional advertising banner at a reasonable cost while maximizing advertising revenue. The Pedibus can only support so much weight therefore the advertising banner should not weigh more than the frame can support. This project will operate under a dynamic budget that will be re-evaluated during acquisition in order to allow the sponsor and the team the ability to select proper componentry. The last two major constraints encountered, which are currently being investigated, are to optimize the design of the Pedibus to comply with all current towing and street laws of the state of Florida to ensure the vehicle is fully street legal and legal to tow. (iii)

## Methodology

In order to ensure that a satisfactory product is delivered to the sponsor in a timely manner, the team has put in place a rigorous sequence of checkpoints throughout the Fall 2014 semester. These will facilitate the adherence to a proper schedule for the design and build sequences. The team already has most of the initial design ideas and will be discussing them with the Mr. Goldstein during the next sponsor meeting. If everything is approved, a computer model for the Pedibus will be finalized within several weeks and the fabrication will begin as soon as possible. The two main schedule goals for the Pedibus are to have all the major fabrication (frame, drivetrain, brake system) completed by the end of the Fall 2014 semester and deliver a finalized product will all the optional upgrades and accessories by March 14, 2015.

To maximize the possibility of accomplishing our goals, the team has divided the overall project into two main parts: The main fabrication, which includes aspects such as the frame and powertrain, and then the feature addition of the vehicle. The possible features includes all of the non-necessary add-ons, such as LED screens, lights and electric assist. These two main breakdowns have been prioritized and scheduled separately and sequentially for the fall and spring semester. The more immediate priority aspect, the main fabrication and design, has been broken down even further to ensure adequate design prior to starting the build. These parts include: the structure and frame, the power and drive train, the crank and pedaling mechanism, and the seating arrangement. These different categories have been delegated to individual team members to ensure full focus in one particular aspect. These delegations were chosen based on the specialty of each team member in order to appropriately match each team member to where they could contribute the most. Since in the different aspects of the designs are being tackled individually, the team meets regularly to discuss their design and receive feedback from the rest of the group. As stated previously, the group plans to give the sponsor a finalized design concept within the upcoming weeks and get started on the fabrication as soon as possible.

# **Work Breakdown and Assignments**

## Work Breakdown

The project plans require that the following tasks be completed roughly within the timeline given in the Gantt chart (Section 2.2)

* Design Communication with Sponsor
  1. Initial Meeting (Concluded Sept. 18)
  2. Meeting to discuss preliminary designs (Concluded Sept. 30)
* Design and Solid Model Completion
  1. Frame Model Draft
     1. Subsystem Creation
        1. Drivetrain draft
           1. Gearing and Torque Calculations
           2. Component Selection
        2. Ergonomics draft
           1. Component Selection
        3. EE Component draft
           1. Component Selection
        4. Steering Draft
           1. Geometry Calculations
           2. Component Selection
* Shop Drawing Creation
  1. Finalize Frame
     1. Finalize Drivetrain
     2. Finalize Ergonomics
     3. Finalize EE Componentry
     4. Finalize Steering
  2. Create Assembly
     1. Make Drawing Packet
* Part Source and Vendor Selection
  1. Metal Source
  2. Steering Source
  3. Drivetrain Source
  4. EE Componentry Source
  5. Ergonomics Source
* Fabrication
  1. Meet with sponsor to discuss budget after component selection and source
  2. Finish any necessary design changes required by sponsor
  3. Order necessary components
  4. Begin fabrication
  5. Finish stage 1 fabrication (The Pig)
  6. Begin Stage 2 fabrication (The Lipstick)
  7. Finish Stage 2 fabrication by March 14, 2015
* Mechanical Testing
  1. Initial team mechanical testing
  2. Fix any design problems found
  3. Allow sponsor and other interested parties to test
  4. Consider design recommendations
  5. Make final changes before Springtime Tallahassee

## Schedule

Figure . Tentative schedule for major events in the development of Pedibus project

## Work Assignments

-Kyle Anderson (Team Leader): is head of basic frame and steering design. Due to the frame being central to all of the other subsystems, this part of the project will need to be completed within the first 2 weeks of shop drawing.

-Stephen Avery (Lead ME): is in charge of the drivetrain and subsystem integration. This task requires component selection, user integration, and sourcing of componentry. Subsystem integration requires the design of brackets and solid model assembly in order to attach all subsystem components to the frame.

-Alejandro San Segundo (ECE Liaison): is head of ergonomics, seating, and ECE component integration. This requires research into proper cycling ergonomics, seating position and angle, user direct component selection and sourcing, and ECE component integration.   
  
-Brett Willenbacher (Financial Advisor): is in charge of maintaining a budget and source compilation. This requires maintaining communications directly with the sponsor and recording any purchases and or purchase requests.   
  
-Mitch Robinson (Lead ECE, Webmaster): is in charge of designing the electrical componentry and maintaining the project website. This task requires constant communication with the sponsor and the ME team members regarding project advancements. Additionally, this requires sourcing and integrating the electrical components needed.   
  
-Mitch Stratton (ECE Team Member): is going to cover the miscellaneous operations required by the team. These will be determined as the project continues but may include maintaining documentation and sourcing secondary componentry as necessary.

# **Specifications**

Required Product Specifications include the most basic requirements for the design:

* Space for 10 peddlers, 1 driver, 1 server, and amenities.
* Minimum additional capacity of 2 riders.
* Modular design allowing for additional features added afterward.
* Easily Transportable.
* Uses mostly off the shelf and or modular componentry.
* Some form of digital advertisement.
* Forward, Neutral, and Reverse drive gears.

## Design Specifications

Design Specifications include measurable design objectives to consider prior to final designs are made:

* Engineering Design Drawing Packet must be included.
* Wheel Base and track width similar to road vehicle of same size.
* 16” wheels to accommodate full size disc brakes.
* Less than 25” Outer Diameter Tires.
* Primarily Steel Construction.
* Must meet all State of Florida requirements to be titled as a trailer.
  1. GVWR <1499 lbs
  2. Highway Rated Tires
  3. Towing Lights

## Performance Specifications

Performance Specifications include requirements set by the sponsor that regard how well the machine needs to operate:

* Must operate with a 4200 lb payload.
* Must not exceed 30 mph while not being towed.
* Turning radius of less than 25 feet.
* Must have theft deterrent steering and or drivetrain.
* Able to be operated without all cranks being operated.
* Must not back drive peddlers feet.
* Able to maintain 10 mph at 4% gradient.
* Able to move from a stop at 4% gradient.