General Need For Product
Conventional golf bag push carts are bulky, heavy, and not compact.

Market Size
- Estimated 27 million golfers in the United States
- Average golfer spends $2,776 on golf annually
- 56% of golfers in the US walk the golf course or use a push cart

Customer Requirements
- Ease of Transport
- Ease of access to pockets
- Ability to turn swiftly
- Avoids tipping
- Device is lightweight
- Ability to turn swiftly
- Safe to attach and detach
- Ease of access to pockets
- Handle has comfortable grip

Objective

Engineering Characteristics
- Weight
- Folded volume
- Average time to attach bag
- Average time to detach bag
- Average appearance rating

Constraints
- Ground Clearance due to Rough Terrain
- Vehicle Trunk Volume Constraining Folded Dimensions
- Extended Dimensions Constraining Golf Bag Dimensions
- OSHA Exortion Regulations

Design
- The Perfect Portable Push Cart design features two separate parts, a base that permanently attaches to the golf bag without interfering with existing kickstand functionality, and a wheel assembly which the plate attaches to, that provides the structure for the wheels
- The collapsibility of the Perfect Portable Push Cart was the main focus of the design.
- The collapsibility of the Perfect Portable Push Cart was the main focus of the design.
- Folded dimensions of wheel assembly are 35” X 18” X 4.25”
- Folded dimensions of wheel assembly are 35” X 18” X 4.25”
- Track width determined based on allowing cart to be pushed on a 30 degree side slope
- Track width determined based on allowing cart to be pushed on a 30 degree side slope
- Wheel location determined such that the cart will return to a neutral position of resting on the kickstand and wheels
- Wheel location determined such that the cart will return to a neutral position of resting on the kickstand and wheels

Prototype and Testing
Base Prototype
- Constructed for first prototype
- Found that ratchet straps did not work
- Changed to ratchet snap design

Wheel Assembly Prototype
- Constructed from steel
- Has full functionality of final product
- Full scale prototype of final product

FEA Modeling
- Modelled wheel spindle and folding tube to analyze different design parameters
- Determined that aluminum tube with a solid end and internal fillet was best design
- Maximum Von Mises stress of 37.9 MPa
- Maximum Factor of Safety 1.45

Functionality Testing
- Time to Assemble and Disassemble testing
- Use stopwatch to test average time to assemble prototype and disassemble prototype
- Customer satisfaction Testing
- Use customer survey to gauge increase or decrease in customer satisfaction compared to benchmarked product
- Tilting Testing
- Maximum angle of 30°
- Pull handle off at various speeds
- Pulled into cart at various speeds
- Apply maximum loads in horizontal and vertical directions
- Course Testing
- Used for a full round of golf to test durability and functionality in the operating environment

Test Results and Future Work

PDP Summary
- Final basic volume of design is 2,889 square inches, much lower than 7,041, the average of the benchmarked products
- Final weight is 13.3 lbs and benchmarking average is 19.9 lbs
- Design addresses the problems with current technology in terms of folded volume and weight

Process Reflection
- Final product received 6.8 of 10, 10 being the highest, the Perfect Portable Pushcart received an overall score of 4.6 while the competing products received 5.5.
- Customers appreciated decrease in volume and weight but noted functionality of design needed to be improved

Test Results
- Potential customers rated our product compared to other product on the market
- Customers appreciated decrease in volume and weight but noted functionality of design needed to be improved

Recommendations for Future Design
- Improve security of bag to bag connection during operation
- Redesign kickstand to become operational
- Design bag plate to base connection as well as bag to bag plate connection
- Look into using different material for product during mass production
- Current material is 6061 Aluminum Alloy and material under consideration is hard plastic
- Reduce number of parts and simplify design
- Minimize time to assemble and disassemble

Customer Requirements
- 56% of golfers in the US walk the golf course or use a push cart
- Average golfer spends $2,776 on golf annually
- Estimated 27 million golfers in the United States
- Average golfer spends $2,776 on golf annually
- 56% of golfers in the US walk the golf course or use a push cart

General Need For Product

Prototype and Testing

Final Concept Sketch

Team Members: Andrew Foote, Joshua Gordon, Michael Kelly, Jared Levy, Corey Zamenski