



Overview

This project requires you to design a single-passenger trike vehicle! As ‘Part-1’ of the project you define a set of user requirements for your assumed target users. In this part, the general specifications of the vehicle and the user requirements will be identified. This will be used for generating a number of design concept candidates, and finally recommending the most appropriate concept. In ‘Part-2’, you design the detailed assembly, and parts, with particular attention to the mechanical design of the load carrying and power transmission components. A more detailed description of these two parts are provided in the following.

Part-1: For this part, each team is expected to accurately define a certain type of trike vehicle, and specify the detailed requirements as the first part of the design process. This constitutes a problem definition, leading to brain-storming solutions, and finally selection of an appropriate design concept. Questions that need to be addressed include, non-exclusively, the following:

1. Context: Which context the trike vehicle is to be used? Can you define the user persona? Can you define specifics such as age, gender, lifestyle, and their interaction with the vehicle?
2. Context constraints: What requirements does such context dictate for your design, e.g., safety standard and codes, use environment, normal and extreme usage, constrained or unconstrained passengers, tradition and cultural factors, environment concerns, frequency of use, and so on?
3. Technical constraints: Is the vehicle pedal-driven, or is it motorized, or both? What’s the normal speed of your trike? What road condition is it meant for? What are physical constraints such as clearance, size and weight of the trike, etc.? What is the budget limit? What is the desired life of use?
4. Design Objectives: What are your design objectives (e.g., cost, safety, durability, strength, aesthetics, etc.)?
5. Design Concept: Based on the above requirements and constraints, what are your plausible design concepts? How would each design rank according to the identified design objectives? Which design concept is the overall best?

At the end of the Part 1, the final design concept will be selected by ranking the design candidates in a design matrix.

Part-2: In the second part of the project the focus is on transforming the design concept to a detailed design that can be passed to manufacturing. Here each team applies and showcases their knowledge of the mechanical design and mechanics of materials and machine components



during the actual design process. The detailed design should be particularly focused on parts that are heavily loaded and could be subjected to mechanical failures (e.g. chassis, crank-spindle, shafts), as well as design of the power transmission elements (e.g. belt/chain/gear systems). Design of other complex sub-assemblies such as speed shifter, brakes, clutches, electric controllers, etc. can be simplified as rudimentary parts.

In this course, the Part-1 & Part-2 are planned to be done sequentially with separate deliverables and deadlines. The requirements of each project will be specified and given at the start of each project.



Project Part-1: Concept Generation, and Design Selection

Starting date: Oct. 16, 2019 Report due: Nov. 1, 2019

Objectives:

- To explore and learn different possible form of shapes of a single-passenger trike vehicle
- To clearly define the design project with suitable technical specifications
- To apply the basic knowledge of mechanics of materials for defining an overall design
- To explore and learn possible options for structural materials for vehicle design
- To explore and learn possible options for pedal driven or motorized vehicle and their pros and cons, and their impacts on the design objectives
- To practice information search, concept generation, and concept selection
- To apply engineering drawing or CAD tools for articulating design ideas
- To develop thorough systematic thinking in practical system design

Assumptions:

- You are open to assume any user persona and requirements. You will also assume a certain budget limit.
- Detailed electric and control system design is out of the scope of the work
- Detailed description of other complex mechanical sub-assemblies (e.g. brakes, suspension, fuel system, etc.), other than the main structure and drive elements, are out of the scope of the work.

Scope of the Work:

- Defining design problems and performing concept generation and selection
- High level description of the structure, mechanism, and accessories
- General Material and Mechanical Component selection
- Selection of Drive mechanism and evaluating their appropriateness for the design
- Necessary safety devices and measures
- High level consideration of the manufacturing processes

Relevant Background and Skills to be Gained:

- Stress analysis and design for different loadings
- Structural design
- Decision Matrix
- Information search
- PCSI CAD tool (e.g. SolidWorks) proficiency
- Engineering Graphics
- Finding off-the-shelf components and soliciting quotes (cost analysis)



Grading

A group written report (70%) and a peer evaluation report (30%) will be used as your project grade. The rubrics of the Project 1 report and peer evaluation form are attached for your reference. The peer evaluation form will be used after each project.

Design Report Guide

The general format and guideline refers to <http://writing.colostate.edu/guides/documents/ce-trpt/index.cfm>. An article titled “A guide to technical report writing” is also posted in Canvas for your reference.

For this project, in specific, following items will be checked.

1. The title page includes
 - a. Project Title:
 - b. Team No:
 - c. Team Name (optional)
 - d. Team Members with signatures
2. Executive Summary
3. Introduction (an overview of the background, requirements and your design goals)
4. A brief description of information search results
 - Standards and codes that apply to the product
 - Patents and literature search results
 - Competitors' products and their specifications, if applicable
 - Others (discussion with experts, users, etc.)
5. Description of concept alternatives
 - Design factors that differentiates each concept
 - Pros and cons of each concept
 - Ranking of each concept on the design objectives
6. Concept analysis and selection
 - Simplified technical and cost analyses
 - Screening matrix, scoring matrix, and sensitivity analysis results
 - Concept integration/fusion
 - Recommendation of one (or two) concept(s) for further development
7. Final Recommendations and Conclusions
8. References
9. Appendices

Note:

1. As a general guide, the length of the report (excluding Title page, Table of contents, List of Figures/Tables, Executive Summary, Appendix, and References) should be between 10-15 pages (1.5 line space, minimum 12 pt font size for the body text).



2. Your audience is other professionals who do not know your specific project (think about your fellow classmates.)
3. Concept description with clearly labeled figures or diagrams is encouraged.



RUBRIC for PROJECT PART-1 REPORT

Team #:

Elements (% of marks)	Marks	Comments
Preliminary (2%) <ul style="list-style-type: none"> Cover Page - including: Project Title, Team # [required] & team Name [optional], names of team members with <i>signatures</i> 		
Executive Summary (5%)		
Introduction (8%)		
Search Results (10%) <ul style="list-style-type: none"> Standards & Codes that apply to the product Patents & Literature Search Results Competitors' Products & Their Specifications [if applicable] Others 		
Description of Concept Alternatives (30%) <ul style="list-style-type: none"> Choices of Material & Components & Sub-systems Impacts on Design Objectives 		
Concept Analysis & Selection (30%) <ul style="list-style-type: none"> Simplified Technical & Cost Analysis Concept Selection, Integration/Fusion Design Matrix 		
Recommendations (3%)		
References and Appendices (2%)		
Overall technical writing quality (5%)		
Originality (5%)		
Total Mark		



Peer Evaluation Form (confidential)

Team No. _____

Please give your assessment of the performance of each team member **(including yourself)** in the design project. For each of the stated attributes, assess the performance according to the following scale, and total each column. If you have any comments or suggestions for any colleague(s), write them overleaf.

Unacceptable (0-5, reasons to be given)

Poor 5

Fair 7.5

Good 10

Names of team members Attributes					
Respect team goal and pursues it wholeheartedly					
Attends all meetings punctually					
Participates openly in team discussion and planning					
Accepts critical comments objectively					
Shows respect for other team members					
Accepts a fair share of the required work					
Carries out assigned tasks promptly					
Shows interests in the work of other team members					
Has a positive and motivating effect on team morale					
Overall (out of 10)					
Comments					

Your name (print): _____

Signature _____

Date: _____



Agreement of Team Members

Team No: _____ **Team Name** _____

Team Manager: Name _____, Tel: _____ Email _____

Secretary: Name _____, Tel: _____ Email _____

Other members:

Name _____, Tel: _____ Email _____

Name _____, Tel: _____ Email _____

Name _____, Tel: _____ Email _____

Name _____, Tel: _____ Email _____

For the teamwork in the course MSE 320, I shall act in good faith for the wellbeing of the team as a whole, in order to achieve team goals and satisfy course requirements. In addition, I agree to be bided by the following rules with the understanding that I shall be held accountable for breach of such an agreement.