
THE OHIO STATE UNIVERSITY ADVANCE ENERGY VEHICLE DESIGN PROJECT

MISSION CONCEPT REVIEW (MCR) AND DELIVERABLES



THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

TABLE OF CONTENTS

TABLE OF CONTENTS.....	1
BACKGROUND.....	2
Smart City Columbus.....	2
Funding.....	2
Projects.....	2
Urban Desert.....	2
Advanced Energy Vehicle (AEV).....	3
MISSION.....	4
Performance Constraints.....	4
Budget Constraints.....	6
Capital Costs.....	6
Energy Costs.....	6
Time Costs.....	7
Accuracy Penalty.....	7
Research and Development Costs.....	7
Safety Violations.....	7
ORGANIZATIONAL STRUCTURE.....	8
Companies and Divisions within the Company.....	8
Smart City Grant Staff.....	9
TESTING PROCEDURE.....	10
AEV Desktop-track Setup and Controller Software Confirmation.....	10
AEV Classroom-track Testing Procedure.....	10
Lab Safety Rules.....	11
Important Acronyms.....	11
INSTRUCTIONAL JUSTIFICATION.....	12
AEV - Lab Overview.....	12
Course Goals Developed during the AEV Project.....	12
LAB CALENDAR AND DELIVERABLES.....	15
TEAM MEETING MINUTES.....	16
Team Meeting Minutes - Overview.....	16
Team Meeting Minutes - Rubric.....	16
WEBSITE UPDATES.....	17
Website Update 1 - Overview.....	17
Website Update 1 - Rubric.....	18
Website Update 2 - Overview.....	19
Website Update 2 - Rubric.....	20

Website Update 3 - Overview.....	21
Website Update 3 - Rubric	22
Final Website – Overview	23
Final Website - Rubric.....	24
COMMITTEE MEETINGS.....	25
Committee Meeting 1 - Overview	25
Committee Meeting 1 - Rubric.....	26
Committee Meeting 2 - Overview	28
Committee Meeting 2 - Rubric.....	29
PROGRESS REPORTS	31
Progress Report 1 - Overview	31
Progress Report 2 - Overview	33
Format:	33
Progress Report 3 - Overview	33
Format:	33
Progress Report - Rubrics.....	34
ORAL PRESENTATIONS.....	36
Grant Proposal - Overview	36
Grant Proposal Presentation - Rubric.....	37
Research and Development Presentation - Overview	38
<u>Purpose</u>	38
<u>Constraints</u>	38
<u>Evaluation</u>	38
Research and Development Presentation - Rubric.....	39
Final Presentation – Overview	41
Final Presentation Draft	41
Final Presentation Draft - Rubric	42
Final Presentation - Rubric.....	43
PERFORMANCE TESTS	45
Performance Test 1 - Rubric	45
Performance Test 2 - Rubric	45
Final Performance Test - Rubric	46
Critical Design Review	47
Draft – Overview	47
CDR Draft – Rubric.....	49
CDR Final Report - Overview.....	52
CDR Final Report - Rubric	54
REFERENCES	57

BACKGROUND

Smart City Columbus

As Columbus looks to move forward in the 21st century, primary goals for our transportation system include improving safety, enhancing mobility, enhancing ladders of opportunity, and addressing climate change. A pilot program is being implemented through four typical urban districts: Residential Districts (Linden), Commercial District (Easton), Downtown District (Urban Core), and a Logistics District (Rickenbacker Airport).

Funding

In 2016, the City of Columbus won \$50M in grant money (\$40M from the U.S. Department of Transportation and a corresponding \$10M from Vulcan Incorporated), for the best description of a “Smart City.” Since then a total of \$417M in support has been collected to help support the original four-year grant with implementation beginning during 2017/2018.

Projects

There are many main projects that will be implemented to help achieve these four goals. One of the key efforts that unifies many of the projects is an Integrated Data Exchange. Application Programming Interfaces and Software Development Kits can bring together data from Non-Transportation Data Sources (e.g. Mid-Ohio Food Bank, Department of Health, Columbus Metropolitan Libraries, etc...), Data from Smart City (Trip and Route Planning, Kiosks, Autonomous Vehicles, Electric Vehicle Charging Stations, etc...) and Sources of Transportation Data (Ohio Department of Transportation, Central Ohio Transit Authority, The Ohio State University, etc...)

Other projects that can make use of this technology include: Mobility Assistance, Enhanced Permit Parking, Event Parking Management, Delivery Zone Availability, Truck Platooning, Oversized Vehicle Routing, and Interstate Truck Parking

Urban Desert

The residential area chosen to be the focus of Smart Columbus is Linden. Due to I-71, Linden (an area of approximately 30K citizens) is cut off from many basic services and centers of employment including healthcare, grocery stores, and banking. Bus stops (especially those with shelters) are lacking. Three of the 25 highest crash intersections are in Linden. In order to enhance ladders of opportunity there is a need to connect people from Linden to Commercial Districts for jobs and services.

Some Smart City projects focusing on these ends include creating a common payment system for a typically cash-cased and low credit clientele, improving multimodal trip planning, adding street lighting with built-in Wi-Fi, and smart mobility hub. Additionally, transportation will be addressed with collision avoidance, and connected vehicles.

Advanced Energy Vehicle (AEV)

Your task is to develop an AEV to transport people from Linden to Easton and Polaris. The AEV will be autonomous, electric-powered and travel suspended from a monorail system. You will be submitting deliverables to the Smart City Columbus Grant Staff.

MISSION

Your company will consist of three teams (divisions). Each division will develop and program a prototype AEV that must complete several tasks, fit within the required budget, and complete several deliverables during the course of the project.

Performance Constraints

The Final Performance (see rubric in Performance Tests) consists of four main tasks that must be completed successfully.

1. The AEV will begin at the designated starting dock (with the front wheel behind the starting line). The AEV will move forward and must stop at the gate between two sensors and pause for seven seconds while the gate opens (If the AEV goes too far, it will trip the second sensor and the gate will not open).*
2. The AEV then must proceed to the loading zone successfully connect to the load using a magnetic hitch without excessive recoil (the AEV may not bounce past the loading line) and pause for five seconds to verify that the cargo has safely loaded. **
3. The AEV will then return to the gate ensuring that the hitch does not disconnect during the elevation change. The AEV will once again pause between gate sensors for seven seconds.
4. The AEV will then continue to the starting dock (once again without the hitch disconnecting during elevation changes), and stop past the starting line, within the designated starting dock.

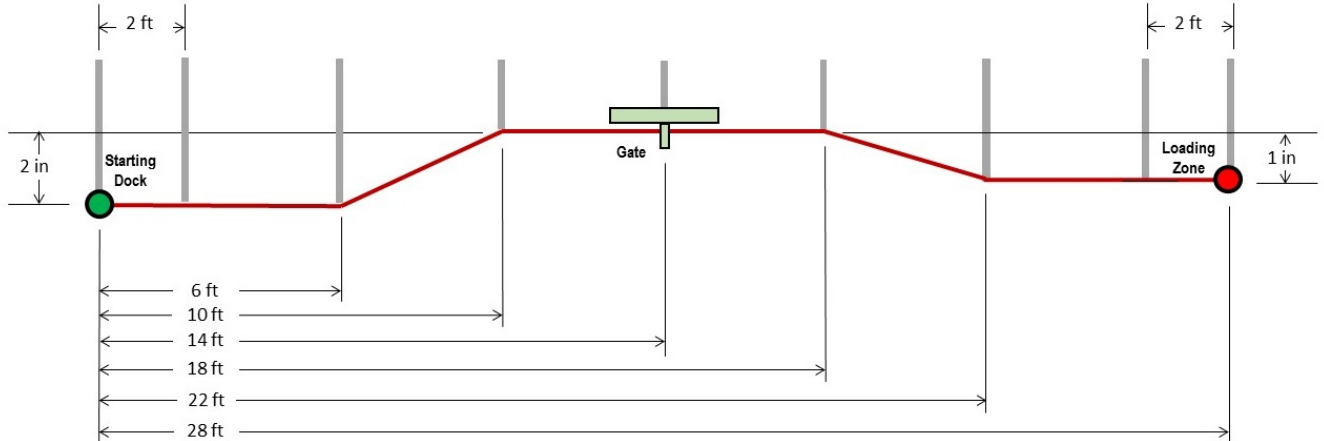


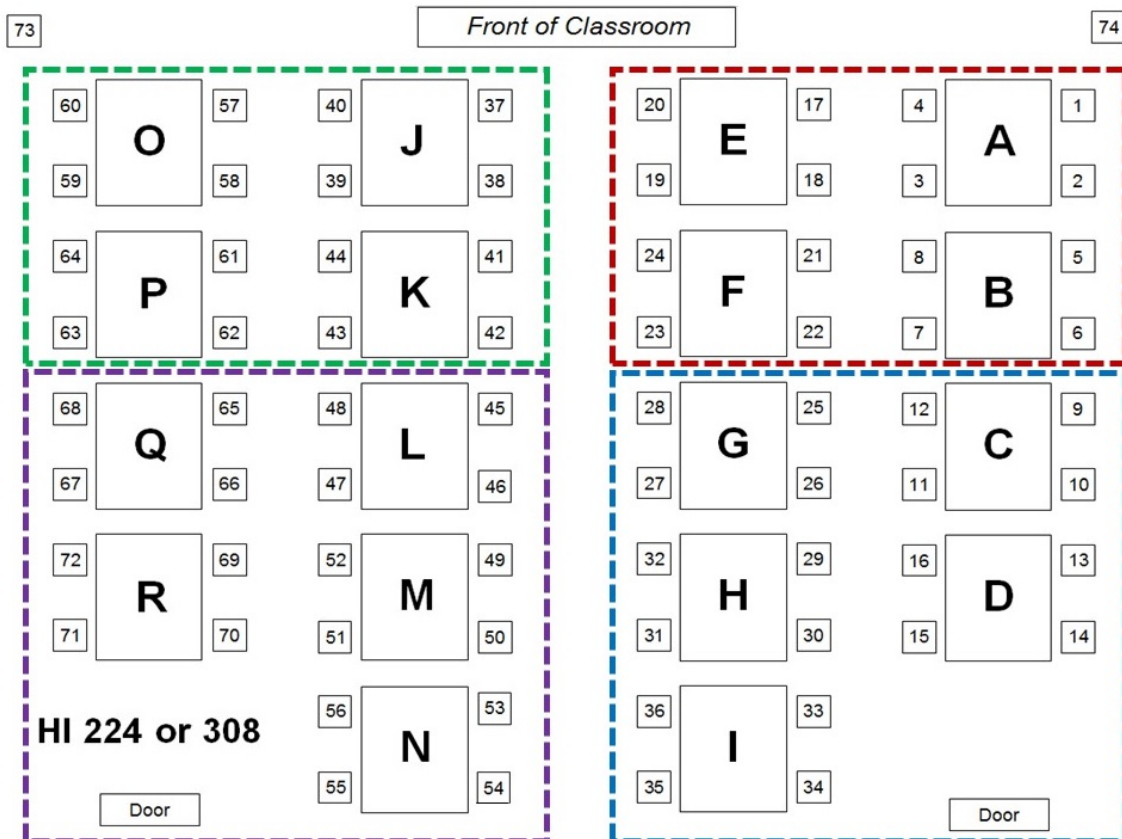
Figure 1. Elevation Changes for AEV

* Task 1 will also be assessed during Performance Test 1 (see Performance Tests)

** Tasks 1 and 2 will also be assessed during Performance Test 2

Notes:

- While 100% accuracy is expected and ideal, the AEV can still achieve its goal with minimal errors. All errors in final testing will be scored and counted against the budget.
- The scaled transport-AEV must complete the circuit within 2.5 minutes.
- The cargo is fitted with a small magnet. There needs to be a clearance of a minimum of 2 x 2 inches between the magnet and the Arduino board.
- The AEV must fit in the plastic bin that it was issued in (the plastic wheel arms can be discounted along with propellers).



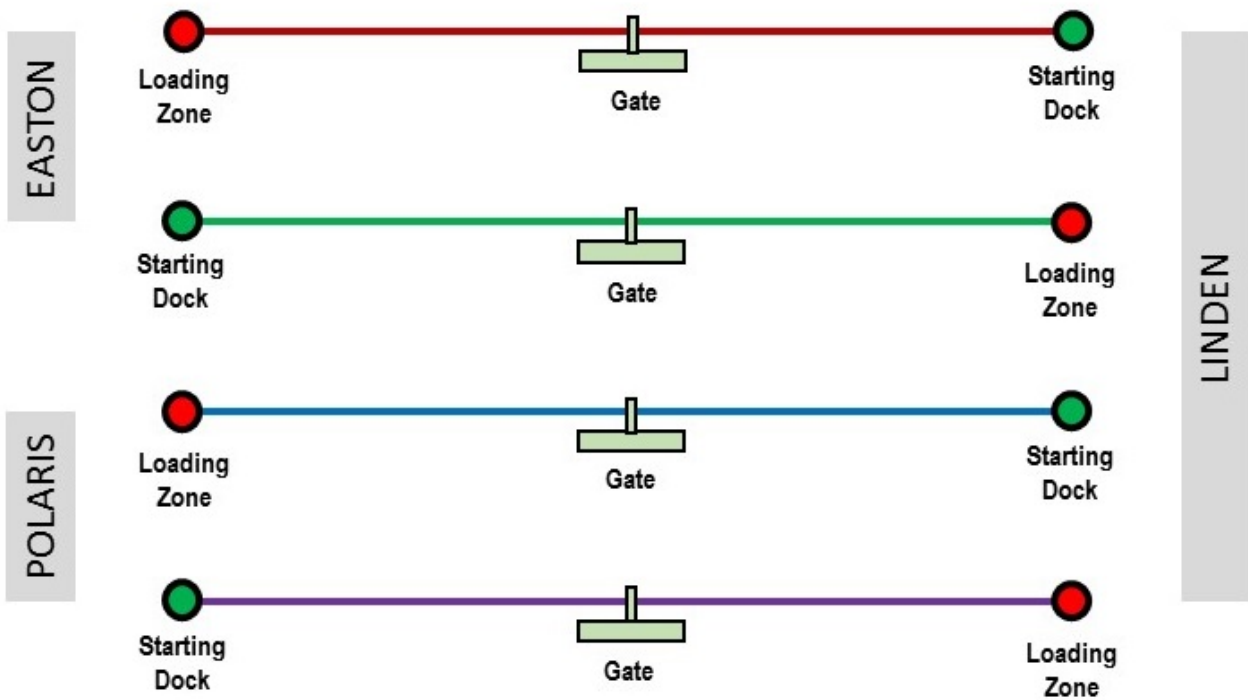


Figure 2. Group Track Assignments.

Budget Constraints

The Budget for the AEV project is \$500K. A variety of costs determines the final budget including Capital investment, Energy and Time use, Penalties for accuracy and safety as well as any additional R&D. The formula below should be used to calculate the total budget, teams may use the excel document entitled “WS_Final_Costs.”

$$\text{Total Budget (\$)} = \left(\text{Energy Costs (\$)} + \text{Time Costs (\$)} \right) * \text{Accuracy Penalty} + \text{Capital Cost (\$)} + \text{R \& D costs (\$)} + \text{Safety Violations (\$)}$$

THESE WILL BE TOTALLED FOR BEST TWO RUNS

Capital Costs

These costs are the total cost of all parts used for assembling the AEV. Prices for stock parts are found on the sheet. Prices for custom 3D-printed or laser cut parts will be determined using a pre-determined formula. Parts bought outside of class will need to be approved before purchase and costs will be determined at that point.

Energy Costs

There will be a baseline fee of \$125K for each run. Additionally, there will be a \$500 charge per Joule used during the performance test.

Time Costs

There will be a baseline fee of \$90K for each run. Additionally, there will be a \$1.5K charge per second used to complete the performance test.

Accuracy Penalty

Up to forty points can be earned for a perfect performance test. The accuracy penalty will be the inverse of the accuracy score. For instance, a score of 36/40 would have an accuracy penalty of 1.11 times the initial costs.

Research and Development Costs

Open lab may or may not be available depending on room and instructional team availability. Students will be charged \$25K for every 60-minutes of additional lab time outside of regular class lab hours.

Safety Violations

Because safety is an important issue there will be a penalty for any issues that pose a threat to the safety of the class. More severe safety violations (e.g. Fires - \$50K) will have a more severe penalty than less severe violations (e.g. unmonitored AEV falls off the track - \$15K).

ORGANIZATIONAL STRUCTURE

Companies and Divisions within the Company

The classroom will be divided into six companies. Each of the following six companies will consist of three divisions (teams) of up to four students.

- Baker International Group (Teams A, C & N)
- Bevis Devise Inc. (Teams B, D & M)
- Dreese Data Systems (Teams O, Q & I)
- Koffolt Properties (Teams P, R & H)
- P&C Scott Worldwide, and (Teams E, G & K)
- Watts Scientific (Teams F, L & J)

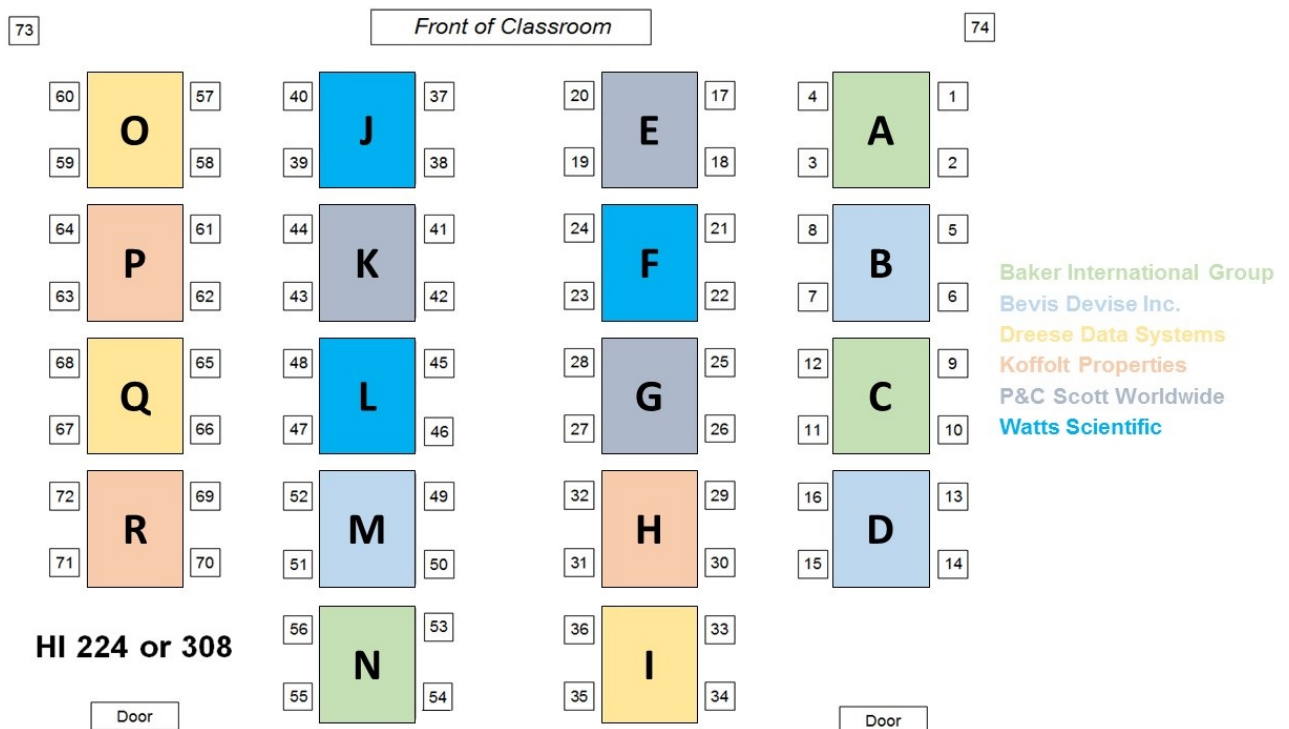


Figure 3. Assignments of Groups and Divisions within Companies

Each company will maintain a single website for promotional purposes. Divisions will be expected to cooperate and produce a cohesive company vision. Research and Development between divisions of the same company should communicate to avoid duplication of effort when possible. Each company will have committee meetings with representation from each division led by Smart City Grant Staff.

A list of deliverables and a schedule can be found in the on page 15.

Smart City Grant Staff

Questions or concerns regarding the AEV Design Project should be directed to the appropriate contact person from the instructional team in a professional e-mail.

Chief Executive Officer (Instructor)

- Bid/ Grant Oversight
- Human Resources

Director of R&D (Graduate Teaching Assistant)

- Planning
- Critical Design Review

Director of Marketing (Undergraduate Teaching Assistant)

- Public Relations
- Oral Presentations
- Websites

Chief Financial Officer (Undergraduate Teaching Assistant)

- Budget Verification
- Equipment Purchase

Director of Technical Support (Undergraduate Teaching Assistant)

- Troubleshooting

TESTING PROCEDURE

The following outlines the testing procedure for AEV operation on the track to minimize the potential of damaging the AEV, AEV components, and YOU.

AEV Desktop-track Setup and Controller Software Confirmation

- Each AEV must demonstrate proper balance on the desktop track with the AEV center-of-gravity in between and directly below the two monorail track wheels.
- The vertical support arm must be equal to or less than **6 inches** from the monorail track.
- IF major changes are made to the AEV Controller Software in between runs, confirmation of the desired programmed power control must be checked statically on the desktop track prior to testing on the classroom track.
- The AEV power must be off when transferring AEV from the desktop to the classroom track.

AEV Classroom-track Testing Procedure

1. AEV power OFF.
2. A team member must be at each station (starting dock, gate, and loading zone)
3. Team member #1 takes AEV to starting dock.
4. All other teammates must be at their designated stations and be prepared to stop the AEV if it does not pass the required operation procedure in designated location.*
5. Inform classmates (if in operational area) that AEV operation is going to start.
6. Team member #1 sets AEV on the monorail track and turns AEV power on.
7. Receive confirmation from all other Teammates that they are ready.
8. Begin AEV operation by pressing the AEV Automatic Control System start button.

*The Teammate must place their hand above the track at of the designated stopping area.

Lab Safety Rules

The guidelines that must be followed at all times in the lab are as follows:

1. ALWAYS get program verified by instructional staff prior to plugging in the power.
2. Do not stand in the propeller's plane of rotation.
3. Do not put your finger in the propeller.
4. No dangling jewelry or loose clothes.
5. No 'open' shoes. Close-toed shoes or boots only.
6. No climbing or standing on chairs or tables.
7. Be aware of sharp corners and edges, which may exist on tables or on apparatus and tools.
8. Always know the location of the phone and of the first-aid kit.
9. Report to the instructor ALL injuries occurring during lab.

Failure to follow these rules and guidelines may result in fine for Safety Violations, losing lab privilege, and/or loss in lab participation grade for the course.

Important Acronyms

Acronym	Meaning	Definition
AEV	Advance Energy Vehicle	Small, Autonomous, electric, motor-powered, propeller-driven vehicle
CDR	Critical Design Review	End of semester progress report summarizing the entire semester
LPQ	Lab Proficiency Quiz	Lab quiz to test students' knowledge on everything AEV
MCR	Mission Concept Review	It specifies the mission objectives and detailed specifics
PR	Progress Report	Small report that documents both prior learning/ outcomes, while planning and scheduling for future goals and tasks
PT	Performance Test	The labs post-LPQ in which students have one task to complete per week

INSTRUCTIONAL JUSTIFICATION

AEV - Lab Overview

The Advance Energy Vehicle (AEV) design project is a team-based project that addresses the course goals of project management, teamwork, the engineering design process (EDP), professionalism and technical communications (TechComm). AEVs are small (<500 grams), autonomous, electric motor-powered vehicles that are suspended from and maneuver along a monorail track systems hung from the laboratory ceilings; see [Figure 1](#) for an example. The AEV structure is constructed with components provided in a lab kit which includes pre-fabricated PVC sheet structure, monorail wheels, electric motor(s), propeller(s), and an in-house built AEV- Autonomous Control System with externally mounted and adaptable sensors for feed-back control. AEVs are designed based on a series of labs and performance tests that cover topics such as reflectance sensors, electric motors, system efficiency, automatic control programming, and energy management in completing the operational objectives provided.



Figure 4: AEV Example (Night-Hawk)

Course Goals Developed during the AEV Project

Project Management and Teamwork

Project management and teamwork throughout the design process is regularly evaluated through progress reports, team meeting minutes (including schedules), and committee meetings. Each team tracks and manages the project through initial concepts, brainstorming notes, and delegation of tasks. The final AEV designs are evaluated during individual competitions and scored based on performance and design criteria. At the end of the project a final report is submitted and a PowerPoint presentation is developed to present the teams' work to the class.

The Engineering Design Process

The Engineering Design Process consists of several explicit steps: Identify project requirements/constraints, collect background information, brainstorm initial concepts, manage materials, preliminary analysis/design, systematically build/ test/ evaluate/ modify/ document progress. Teams systematic approach can be demonstrated in progress reports, committee meetings and the critical design review.

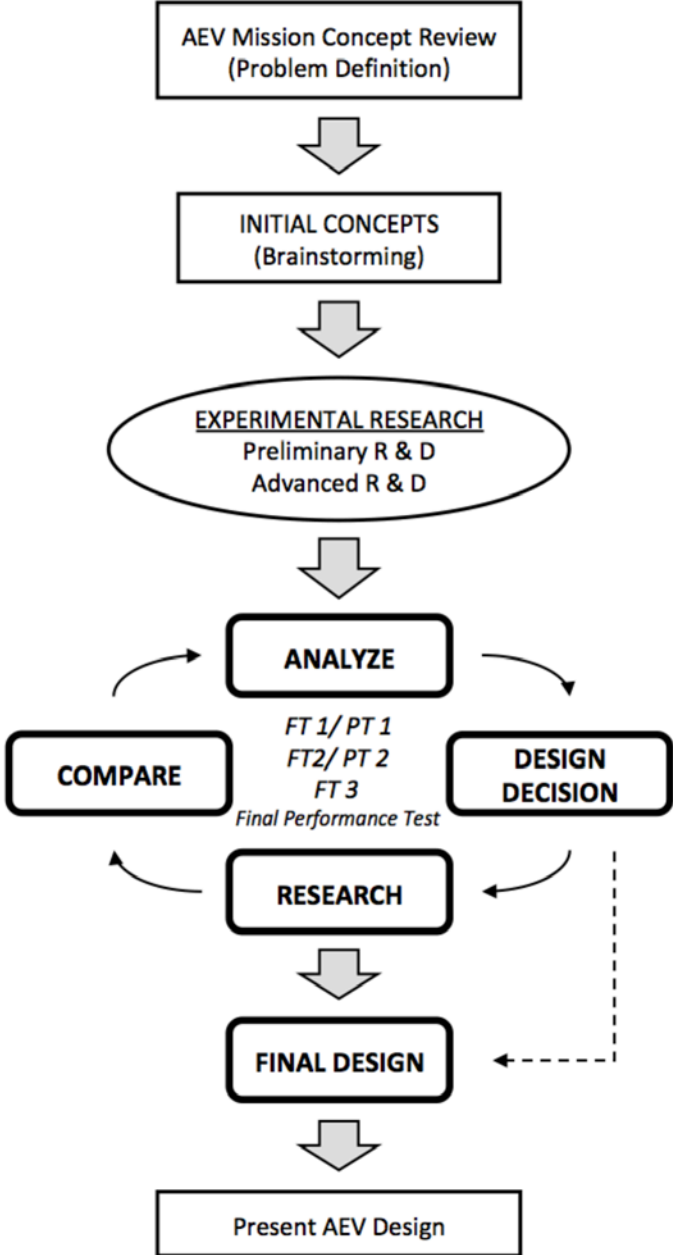


Figure 5: AEV Design Process

Professionalism and Technical Communications

There are several key forms of documentation where teams will demonstrate their ability to write clearly and professionally. The Progress Reports, Grant Application, Critical Design Review (CDR), and CDR draft will demonstrate the team's ability to communicate in a technical manner. The product website will demonstrate a team's ability to communicate electronically with multimedia. The Grant Proposal, Committee Meetings, and Oral Presentations will give team member the opportunity to communicate verbally. Lastly, e-mails to the instructional team regarding the project will model professional communications.

*In the Spring Semester, there will be an AEV Showcase where the top teams from each class can display their work and be judged for various engineering design awards.

LAB CALENDAR AND DELIVERABLES

Week	Lab Topic(s)	Deliverable(s) Due	Pts		Category
1	Introduction & Brainstorming				
2	Preliminary R&D – EX 1 - Programming Basics	pR&D Quiz 1&2	20	Ind	Proj Qz
	Preliminary R&D – EX 2 - External Sensors	Website Update 1 Team Meeting Minutes	20 10	Comp Div	Proj Docs Proj Docs
3	Preliminary R&D – EX 3 - Creative Design Thinking	pR&D Quiz 3&4	20	Ind	Proj Qz
	Preliminary R&D – EX 4 - Data Analysis Tool				
4	Preliminary R&D – EX 5 - Concept Screening and Scoring	pR&D Quiz 5	10	Ind	Proj Qz
		Website Update 2	25	Comp	Proj Docs
5	Advanced R&D 1	Progress Report 1	80	Div	Proj Docs
6	Half-way Checkpoint	LPQ	40	Ind	Proj Qz
		Grant Proposal	25	Div	Proj Docs
		Committee Meeting 1	60	Comp	Proj Docs
7	Advanced R&D 2				
8	Oral Presentations	R&D Oral Presentation	100	Div	Proj Pres
		Website Update 3	25	Comp	Proj Docs
9a	FT 1a - Design Concept Comparison	Progress Report 2	80	Div	Proj Docs
9b	FT 1b - Design Concept Comparison				
9c	FT 1c - Design Concept Comparison	Performance Test 1	20	Div/Co 80/20	Proj Perf Tests
10a	FT 2a - Operational Objectives	CDR (Draft)	100	Div	Proj Reports
10b	FT 2b - Operational Objectives				
10c	FT 2c - Operational Objectives	Performance Test 2	20	Div/Co 80/20	Proj Perf Tests
11a	FT 3a - Energy Optimization	Committee Meeting 2	60	Comp	Proj Docs
11b	FT 3b - Energy Optimization				
11c	FT 3c - Energy Optimization	Progress Report 3	80	Div	Proj Docs
12a	Final Performance Test A	Final Oral Presentation Draft	25	Div	Proj Pres
12b	Final Performance Test B				
12c	Final Performance Test C				
		Final Performance Test	100	Div/Co 80/20	Proj Perf Tests
13a	Work Day	Final Oral Presentation	100	Div	Proj Pres
13b	Oral Presentations				
13c	Oral Presentations				
		CDR	200	Div	Proj Reports
		Final Website	100	Comp	Proj Pres

TEAM MEETING MINUTES

Team Meeting Minutes - Overview

(Due Week 2)

Team meeting minutes are to be written up every team meeting (including during class lab time). The first meeting minutes will be evaluated and written feedback will be provided to the teams (as well as oral feedback during the committee meetings). After Week 2, Team Meeting Minutes will be included in Progress Reports.

More information on Team Meeting Minutes can be found in the Technical Communications Guide.

Team Meeting Minutes - Rubric

Team Meeting Notes (3.2, 3.3, 6.3 & 6.4)	4	3	2	0
Meetings since last progress report are included. Location, time, and attendees are recorded.	Meetings since last progress report are included. Location, time, and attendees are recorded.	Basic documentation is complete.	Minor lapses.	Completely missing or significantly incomplete
Topics discussed are addressed (who initiated ideas, what decisions were made, why they were made, etc...)	Topics discussed are addressed (who initiated ideas, what decisions were made, why they were made, etc...)	Minor lapses.	At least one area missing.	Completely missing or significantly incomplete
Upcoming tasks as well as who is assigned to them are listed.	Upcoming tasks as well as who is assigned to them are listed.	Tasks and assignments are complete.	Minor lapses.	Completely missing or significantly incomplete

WEBSITE UPDATES

Website Update 1 - Overview

Introduction & Brainstorming

(Due Week 2)

You will need to update your website. Please use best writing and presentation practices that are articulated in the Technical Communications Guide. You will be assessed according to the corresponding rubric.

For this update, you will need to:

- Set up drop down menus.
- Set up the Company-landing page.
- Set up Division (team) pages within the Company Page
- Division page should show approach to MCR.
- Create team pages with student information (contact information, pictures, roles, etc...)

Be sure to see the Website Update grading rubric.

Website Update 1 - Rubric

	CATEGORY	POINT DISTRIBUTION		
NAVIGATION	Link Function (7.0)	2	1	0
	Links work. If still a work in progress, are labeled as such.	All links work	Occasional lapses	Few or no links work
	Link Labels (7.0)	2	1	0
	Links are clearly labeled or easily identifiable.	All links are clearly labeled (either directly or with hyperlink format)	Occasional lapses	Few or no links properly labeled
	Website Organization (7.0)	2	1	0
Website is well organized and intuitive. Drop down menus easy to follow. Good landing page.	All links and organization are intuitive (users will not get lost)	Occasional lapses	Few links are intuitive, easy to get lost	
LAYOUT	Colors/ Fonts (7.0)	2	1	0
	Pleasing color palette, fonts easily readable.	Good use of fonts (sans serif, appropriate color/ size/ style)	Some issues	Major issues
	Webpage Organization (7.0)	2	1	0
	Webpage is well organized. Page is easy to follow and space is not distracting.	Space is used effectively (alignment, white space, etc...)	Issues on many pages.	Major issues
	Consistency (7.0)	2	1	0
Website is consistent/uniform and appears to have been completed by one person.	Pages are consistent/ uniform	Occasional lapses	Major issues	
MULTIMEDIA	Multimedia (7.0)	2	1	0
	Images are properly cropped; tables are readable; audio is audible; High quality images/ audio/ video (no background noise)	Appropriate techniques are used for chosen multimedia.	Frequent lapses in multimedia	Major issues
CONTENT	Approach (4.1)	4	2	0
	Division (Team) approach to MCR (e.g. priorities) are explained.	Division (Team) approach to AEV clearly articulated and justified.	Well-articulated, but not justified.	Absent
	Contact Information (5.3 & 7.0)	2	1	0
Division (Team) contact information contains pictures, names, student roles, etc...	Division (Team) contact information complete and easily navigable	Major issues	Absent	
TOTAL		20		

Website Update 2 - Overview

Preliminary Research & Development
(Due Week 4)

You will need to update your website. Please use best writing and presentation practices that are articulated in the Technical Communications Guide. You will be assessed according to the corresponding rubric.

For this update, you will need to:

- Update any changes from Website Update 1
- Create an evolution of design section that features
 - Update (and comment) various codes used.
 - Update (and comment) various designs examined.
 - Update research that supports your AEV decisions.
- Complete any other tasks from the Preliminary R & D Lab Guides (below).

Programming Basics

- Upload Arduino code used for Scenario 1. This should be done for codes used in all future labs.

Reflectance Sensors

- Upload a picture of your sensors secured to the AEV correctly.
- Describe the function of the reflectance sensors and their importance in completing the MCR.

Creative Design Thinking

- Upload all individual concept sketches as well as the team concept sketch.
- Include explanations behind sketches. Explain why that idea would be successful in completing the scenario.

Data Analysis Tool

- Upload both the Energy vs. Time and Energy vs. Distance plots
- Upload code associated with these plots
- Explain the figures by describing what the AEV is doing for each section of the plot

Concept Screening and Scoring

- Upload both Concept Screening and Concept Scoring spreadsheets along with descriptions of the criteria.
- Include the pros and cons of each design (should be placed near the drawings of each design).
- Make it clear which two AEV concepts will be carried forward in the design cycle.

Be sure to see the Website Update grading rubric.

Website Update 2 - Rubric

	CATEGORY	POINT DISTRIBUTION		
NAVIGATION	Link Function (7.0)	1	0.5	0
	Links work. If still a work in progress, are labeled as such.	All links work	Occasional lapses	Few or no links work
	Link Labels (7.0)	1	0.5	0
	Links are clearly labeled or easily identifiable.	All links are clearly labeled (either directly or with hyperlink format)	Occasional lapses	Few or no links properly labeled
	Website Organization (7.0)	2	1	0
Website is well organized and intuitive. Drop down menus easy to follow. Good landing page.	All links and organization are intuitive (users will not get lost)	Occasional lapses	Few links are intuitive, easy to get lost	
LAYOUT	Colors/ Fonts (7.0)	1	0	
	Pleasing color palette, fonts easily readable.	Good use of fonts (sans serif, appropriate color/ size/ style)	Major issues	
	Webpage Organization (7.0)	2	1	0
	Webpage is well organized. Page is easy to follow and space is not distracting.	Space is used effectively (alignment, white space, etc...)	Issues on many pages.	Major issues
	Consistency (7.0)	1	0	
Website is consistent/uniform and appears to have been completed by one person.	Pages are consistent/ uniform	Major issues		
MULTIMEDIA	Multimedia (7.0)	2	1	0
	Images are properly cropped; tables are readable; audio is audible; High quality images/ audio/ video (no background noise)	Appropriate techniques are used for chosen multimedia.	Frequent lapses in multimedia	Major issues
	Citations (7.3)	1	0.5	0
Non-original information is properly cited. (These are required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations	
CONTENT	Approach (4.1)	2	1	0
	Division (Team) approach to MCR (e.g. priorities) are explained.	Division (Team) approach to AEV clearly articulated and justified.	Well-articulated, but not justified.	Absent
	Contact Information (5.3 & 7.0)	1	0.5	0
	Division (Team) contact information contains pictures, names, student roles, etc...	Division (Team) contact information complete and easily navigable	Major issues	Absent
	Key Areas Identified (2.5 & 4.1)	2	1	0
	Division (Team) identifies and justifies priorities for AEV, which AEV plans will be carried forward.	Two to Four key areas clearly identified. Choices are reasonable for a consumer	Major issues	Absent
	Key Areas Supported (2.2 & 2.3)	3	2	0
Current AEV findings supported by research (how did you get there; how are things getting better, what data was used during the screening process)	Data used to support success of AEV in selected Key Areas	Data and evidence to support research lacking.	Absent	
EVOLUTION	Evolution of Design	2	1	0
	Easily located, clear and graphically friendly.	Section is easily located, clear and friendly.	Multiple criterion significantly lacking or missing.	Absent
	Previous Codes (2.4)	2	1	0
	Previous codes since last Progress Report are included	Codes are <u>organized</u> , <u>well comment</u> , and <u>changes are tracked</u> .	One criterion significantly lacking or missing.	Absent
	Previous Designs (2.4)	2	1	0
A variety of designs from the very first prototype to final prototpes are described and displayed as well as reflectance sensors.	Various prototypes are shown as well as justification for revisions.	Justifications or intermediary protypes lacking.	Absent	
TOTAL		25		

Website Update 3 - Overview

Advanced Research & Development

(Due Week 8)

You will need to update your website. Please use best writing and presentation practices that are articulated in the Technical Communications Guide. You will be assessed according to the corresponding rubric.

For this update, you will need to:

- Update any changes from Website Update 2
- Create an evolution of design section that features
 - Update (and comment) various codes used.
 - Update (and comment) various designs examined.
 - Update research that supports your AEV decisions.
- Complete any other tasks from the Preliminary R & D Lab Guides (below).

Data Analysis Tool

- Upload both the Energy vs. Time and Energy vs. Distance plots
- Upload code associated with these plots
- Explain the figures by describing what the AEV is doing for each section of the plot

Concept Screening and Scoring

- Upload both Concept Screening and Concept Scoring spreadsheets along with descriptions of the criteria.
- Include the pros and cons of each design (should be placed near the drawings of each design).
- Make it clear which two AEV concepts will be carried forward in the design cycle.

Advanced Research and Development

- What are your current AEV findings?
- How does the research support these findings?
- How does/will this make your AEV more marketable?

Be sure to see the Website Update grading rubric.

Website Update 3 - Rubric

	CATEGORY	POINT DISTRIBUTION		
NAVIGATION	Link Function (7.0)	1	0.5	0
	Links work. If still a work in progress, are labeled as such.	All links work	Occasional lapses	Few or no links work
	Link Labels (7.0)	1	0.5	0
	Links are clearly labeled or easily identifiable.	All links are clearly labeled (either directly or with hyperlink format)	Occasional lapses	Few or no links properly labeled
LAYOUT	Website Organization (7.0)	2	1	0
	Website is well organized and intuitive. Drop down menus easy to follow. Good landing page.	All links and organization are intuitive (users will not get lost)	Occasional lapses	Few links are intuitive, easy to get lost
	Colors/ Fonts (7.0)	1	0	
	Pleasing color palette, fonts easily readable.	Good use of fonts (sans serif, appropriate color/ size/ style)	Major issues	
LAYOUT	Webpage Organization (7.0)	2	1	0
	Webpage is well organized. Page is easy to follow and space is not distracting.	Space is used effectively (alignment, white space, etc...)	Issues on many pages.	Major issues
	Consistency (7.0)	1	0	
Website is consistent/uniform and appears to have been completed by one person.	Pages are consistent/ uniform	Major issues		
MULTIMEDIA	Multimedia (7.0)	2	1	0
	Images are properly cropped; tables are readable; audio is audible; High quality images/ audio/ video (no background noise)	Appropriate techniques are used for chosen multimedia.	Frequent lapses in multimedia	Major issues
	Citations (7.3)	1	0.5	0
Non-original information is properly cited. (These are required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations	
CONTENT	Approach (4.1)	1	0.5	0
	Division (Team) approach to MCR (e.g. priorities) are explained.	Division (Team) approach to AEV clearly articulated and justified.	Well-articulated, but not justified.	Absent
	Contact Information (5.3 & 7.0)	1	0.5	0
	Division (Team) contact information contains pictures, names, student roles, etc...	Division (Team) contact information complete and easily navigable	Major issues	Absent
	Key Priorities Identified (2.5 & 4.1)	2	1	0
	Division (Team) identifies and justifies priorities for AEV, which AEV plans will be carried forward.	Four to Six key priorities clearly identified. Choices are reasonable for a consumer	Major issues	Absent
	Key Areas Supported (2.2 & 2.3)	4	2	0
Current AEV findings supported by research (how did you get there; how are things getting better, what data was used during the screening process)	Data used to support success of AEV in several of the selected Key Areas	Minimal Support	Absent	
EVOLUTION	Evolution of Design	2	1	0
	Easily located, clear and graphically friendly.	Section is easily located, clear and friendly.	Multiple criterion significantly lacking or missing.	Absent
	Previous Codes (2.4)	2	1	0
	Previous codes since last Progress Report are included	Codes are organized, well comment, and changes are tracked.	Two criteria significantly lacking or missing.	Absent
	Previous Designs (2.4)	2	1	0
A variety of designs from the very first prototype to final prototypes are described and displayed as well as reflectance sensors.	Various prototypes are shown as well as justification for revisions.	Both areas seriously lacking.	Absent	
TOTAL		25		

Final Website – Overview

(Due Week 13)

You will need to update your website. Please use best writing and presentation practices that are articulated in the Technical Communications Guide. You will be assessed according to the corresponding rubric.

For this update, you will need to:

- Update any changes from Website Update 3
- Create an evolution of design section that features
 - Update (and comment) various codes used.
 - Update (and comment) various designs examined.
 - Update research that supports your AEV decisions.
- Final “sales pitch” for your AEV
 - Include any final data and justifications to help “sell” your AEV to website viewers.

Be sure to see the Website Update grading rubric.

Final Website - Rubric

		CATEGORY	POINT DISTRIBUTION		
NAVIGATION	Link Function (7.0)		4	3	0
	Links work. If still a work in progress, are labeled as such.	All links work	Occasional lapses	Few or no links work	
	Link Labels (7.0)		4	3	0
	Links are clearly labeled or easily identifiable.	All links are clearly labeled (either directly or with hyperlink format)	Occasional lapses	Few or no links properly labeled	
LAYOUT	Website Organization (7.0)		8	6	0
	Website is well organized and intuitive. Drop down menus easy to follow. Good landing page.	All links and organization are intuitive (users will not get lost)	Occasional lapses	Few links are intuitive, easy to get lost	
	Colors/ Fonts (7.0)		4	3	0
	Pleasing color palette, fonts easily readable.	Good use of fonts (sans serif, appropriate color/ size/ style)	Some issues	Major issues	
MULTIMEDIA	Webpage Organization (7.0)		6	5	4
	Webpage is well organized. Page is easy to follow and space is not distracting.	Space is used effectively (alignment, white space, etc...)	Some issues	Issues on many pages.	
	Consistency (7.0)		4	2	0
	Website is consistent/uniform and appears to have been completed by one person.	Pages are consistent/ uniform	Occasional lapses	Occasional lapses	
CONTENT	Images (7.0)		8	6	4
	Images are properly cropped; tables are readable, High quality images.	Appropriate techniques are used for chosen images.	Occasional lapses in images	Frequent lapses in images	
	Multimedia (7.0)		10	8	6
	Audio is audible; High quality audio/ video/ animations (no background noise/ no skipping)	Several animations, GIFs or videos throughout. High quality and does not "skip"	Several multimedia throughout. Quality may be lacking or may skip.	Several multimedia throughout. Quality lacking and skips.	
CONTENT	Citations (7.3)		4	2	0
	Non-original information is properly cited. (These are required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations	
	Approach (4.1)		8	6	4
	Division (Team) approach to MCR (e.g. priorities) are explained.	Division (Team) approach to AEV clearly articulated and justified.	Minimal lapses	Well-articulated, but not justified.	
	Contact Information (5.3 & 7.0)		6	4	2
	Division (Team) contact information contains pictures, names, student roles, etc...	Division (Team) contact information complete and easily navigable	Minimal lapses	Major issues	
	Sales Pitch Focus Identified (2.5 & 4.1)		8	6	4
	Division (Team) identifies and justifies strengths of AEV	Four to Six key areas clearly identified. Choices are reasonable for a consumer	Minimal lapses	Major issues	
	Focus Areas Supported (2.2 & 2.3)		16	12	8
	AEV claims supported by research (how did you get there; how are you better than previous versions)	Data used to support success of AEV in selected Key Areas	Data/ evidence to support research lacking.	Minimal Support	
			4	2	0
	Easily located, clear and graphically friendly.	Section is easily located, clear and friendly.	Multiple criterion significantly lacking or missing.	Absent	
Previous Codes (2.4)		3	3	1	
Previous codes since last Progress Report are included	Codes are <u>organized</u> , <u>well comment</u> , and changes are <u>tracked</u> .	One criterion significantly lacking or missing.	Two areas significantly lacking or missing.		
Previous Designs (2.4)		3	2	1	
A variety of designs from the very first prototype to final prototypes are described and displayed.	Various prototypes are shown as well as justification for revisions.	Justifications or intermediary prototypes lacking.	Both areas seriously lacking.		
TOTAL			100		

COMMITTEE MEETINGS

Committee Meeting 1 - Overview

(Week 6)

During week 6 there will not be a written update (progress report, website update, etc...), but rather an oral check-in. The main focus will be on progress through the preliminary research and design.

Each of your teammates will be a representative on one of three committees (so one committee will have two representatives). The committees are:

1. Human Resources - Be prepared to discuss how your team is getting along. You will want to bring your team meeting minutes*, schedule*, and team working* agreement. The Chief Executive Officer will lead these meetings.
2. Research and Development – Be prepared to discuss the progress of your AEV. You will want to bring your team meeting minutes*, and your first progress report. The Director of R&D will lead these meetings.
3. Public Relations – Be prepared to discuss documentation (especially the website) or your project. You will want to bring your first two website updates (these can be on the computer). The Director of Marketing will lead these meetings.

The purpose of these meetings is for the Smart City Grant Staff to see how your projects are coming along and offer some advice. It is important that all claims be backed with data/evidence.

*Please upload these documents or a link to a Buckeye Box file on Carmen.

Committee Meeting 1 - Rubric

Human Resources

Planning (3.2 & 3.3)	5	4	3	0
Teams have a clear plan. Time estimates have been made (with some accuracy). Adjustments have been made where necessary.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Team Roles (6.3 & 6.4)	5	4	3	0
Teams have a clear, comprehensive division of labor (this may be by role or task). Team members are dependable and contribute in a positive manner.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Team Interaction (6.2)	5	4	3	0
Teams interact in a respectful manner. Students provide encouragement and help. Actions not people are the target of any criticism. Conflicts are being resolved effectively.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

Research and Development

Problem Definition (1.2)	5	4	3	0
Team has identified a problem (or several problems) and these problems are based on evidence.	Problems clearly stated and supported by evidence.	Problem not clearly stated OR evidence unclear.	Problem not clearly stated AND evidence unclear.	Problem not stated or no evidence.
Planning (1.3)	5	4	3	0
Teams has a plan to solve the problem. Plan is directly related to problem and collects corresponding data.	Plan clearly stated, relates to problem, and will use appropriate data.	1 criteria missing.	2 criteria missing.	Extremely lacking.
EDP (2.3, 2.4, & 2.5)	5	4	3	0
Teams have a plan to evaluate their processes and prototypes. It is clear that there is not a single stopping point.	Plan to evaluate relates to processes AND prototypes with appropriate data for collection.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support criteria.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

Public Relations

Audience Identified (4.1 & 4.2)	5	4	3	0
Team identifies audience (potential customers), determines their needs and has a plan to meet there needs.	All three criteria addressed and supported with some data.	All three criteria addressed.	Missing one or two criteria.	Extremely lacking.
Style (7.2)	5	4	3	0
Teams have a well-developed writing style. Writing is brief, concise, clearly labeled, etc...	All three criteria addressed.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Iterations (2.3, 2.4, & 2.5)	5	4	3	0
Visuals (pictures, data, graphs, etc...) presented well. Format choices are justified. Navigation is easy.	All three criteria addressed.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support criteria.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

Committee Meeting 2 - Overview

(Week 11a)

During week 11a there will not be a written update (progress report, website update, etc...), but rather an oral check-in. The main focus will be on progress from the Advanced Research and Design as well as the initial Performance Tests.

Each of your teammates will be a representative on one of three committees (so one committee will have to representatives). The committees are:

1. Human Resources - Be prepared to discuss how your team is getting along. You will want to bring your team meeting minutes*, team working agreement*, and schedule. The Chief Executive Officer will lead these meetings.
2. Research and Development – Be prepared to discuss the progress of your AEV. You will want to bring your second progress report. The Director of R&D will lead these meetings.
3. Public Relations – Be prepared to discuss documentation (especially the website) or your project. You will want to bring your third website update (these can be on the computer). The Director of Marketing will lead these meetings.

The purpose of these meetings is for the Smart City Grant Staff to see how your projects are coming along and offer some advice. It is important that all claims be backed with data/evidence.

*Please upload these documents or a link to a Buckeye Box file on Carmen.

Committee Meeting 2 - Rubric

Human Resources

Planning (3.2 & 3.3)	5	4	3	0
Teams have a clear plan. Time estimates have been made (with some accuracy). Adjustments have been made were necessary.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Team Roles (6.3 & 6.4)	5	4	3	0
Teams have a clear, comprehensive division of labor (this may be by role or task). Team members are dependable and contribute in a positive manner.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Team Interaction (6.2)	5	4	3	0
Teams interact in a respectful manner. Students provide encouragement and help. Actions not people are the target of any criticism. Conflicts are being resolved effectively.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support goals.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

Research and Development

Problem Definition (1.2)	5	4	3	0
Team has identified a problem (or several problems) and these problems are based on evidence.	Problems clearly stated and supported be evidence.	Problem not clearly stated OR evidence unclear.	Problem not clearly stated AND evidence unclear.	Problem not stated or no evidence.
Planning (1.3)	5	4	3	0
Teams has a plan to solve the problem. Plan is directly related to problem and collects corresponding data.	Plan clearly stated, relates to problem, and will use appropriate data.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Iterations (2.3, 2.4, & 2.5)	5	4	3	0
Teams have a plan to evaluate their processes and prototypes. It is clear that there is not a single stopping point.	Plan to evaluate relates to processes AND prototypes with appropriate data for collection.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support criteria.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

Public Relations

Audience Identified (4.1 & 4.2)	5	4	3	0
Team identifies audience (potential customers), determines their needs and has a plan to meet there needs.	All three criteria addressed and supported with some data.	All three criteria addressed.	Missing one or two criteria.	Extremely lacking.
Style (7.2)	5	4	3	0
Teams have a well-developed writing style. Writing is brief, concise, clearly labeled, etc...	All three criteria addressed.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Iterations (2.3, 2.4, & 2.5)	5	4	3	0
Visuals (pictures, data, graphs, etc...) presented well. Format choices are justified. Navigation is easy.	All three criteria addressed.	1 criteria missing.	2 criteria missing.	Extremely lacking.
Professionalism (5.3)	5	4	3	0
Students are dressed appropriately for the meeting. Students communicate in a polite and professional manner. Students appear receptive to feedback.	Explicit evidence to support criteria.	Evidence unclear, but appears to be achieving goals.	Appears to be achieving some goals.	Evidence extremely lacking.

PROGRESS REPORTS

Progress Report 1 - Overview

Preliminary Research & Development

(Due Week 5)

Write a Progress Report with formatting and content highlighted in the Technical Communications Guide under 'Progress Report' for specifics.

In addition to the requirements listed in the Technical Communications Guide, briefly address the questions from the Preliminary R & D Lab Guides within the summary and do not to use numbers or bullets.

Programming Basics

- Comment on the performance of the electric motors
- (i.e., in scenario 1 line 1, did the propeller begin to rotate at the start of the program or was there resistance observed in the motor to rotate the propeller at low speeds?).
- Discuss how the commands used in this lab may limit the success of the AEV in its completion of the scenario. Hint: by applying the "brake(m);" command, will an AEV stop right away?
- Discuss any potential errors made and how these were resolved during the lab.
- Refer to question 2 above. Did the team need more guidance on any of the lab material or are there recommendations to make the lab a better experience?

Reflectance Sensors

- Discuss how the commands used in this lab may limit the success of the AEV in its completion of the scenario Hint: by applying the brake command, will an AEV stop right away?
- Discuss any potential errors made and how these were resolved during the lab. Was the team able to complete the scenario?
- Did the team need more guidance on any of lab material or are there recommendations to make the lab a better experience?

Creative Design Thinking

- Provide descriptions of the main features and motivations of each individual design. Describe how the designs differ for the team and how that change will improve or hinder the AEV's ability to complete the scenario. Are there any specific design features that will aid in any component of completing the MCR? Were there any specific techniques used for the brainstorming session of the lab?
- Provide each individual concept sketch. Each sketch needs to be hand-drawn in the 3 primary orthographic views with overall dimensions, scale, estimated weight, and an estimated Bill of Materials with the estimated cost of each part used (refer to the AEV kit checklist for AEV parts cost). Do not forget to fill out the title block. Orthographic paper is located in the [Appendix](#).
- Provide the descriptions of the main materials used in each individual design. Discuss how this will determine the characteristics of the final design. Will there

be parts that will need to be fabricated or bought (3D printed, laser cut, and store bought materials)?

- Use the individual concept sketches and the discussion and create a team concept sketch (with 3 primary orthographic views with overall dimensions, scale, estimated weight, and an estimated Bill of Materials with the estimated cost of each part used).

Data Analysis Tool

- Provide the figures and tables for Energy vs. Time and Energy vs. Distance.
- Provide an explanation for the figures and what they are representing (Hint: refer to the Arduino Code appended to the data).

Concept Screening and Scoring

- Describe how the AEV ran on the test track with the scenario code (Things to keep in consideration: how was the balance of the AEV, was it leaning to one side, did the AEV move right away when the code was activated, etc).
- Provide a completed copy of the Concept Screening **and** Scoring spreadsheets (with descriptions of the criteria choices and what the spreadsheets are representing).
- Discuss the pros and cons of each design as compared to the Reference AEV using the Concept Screening and Scoring spreadsheets to help for justification. Use these matrices to define which two AEV concepts will be carried forward in the design cycle.

Look ahead to the upcoming lab(s) and provide a concise overview of the upcoming situation, your team's goals for the week, and the weekly schedule to accomplish the desired outcomes.

In the appendices, provide a copy (or copies) of the Arduino Code using the format laid out in the Technical Communications Guide, as well as all Team Meeting Notes specific to this progress report.

Be sure to see the Progress Report grading rubric.

Progress Report 2 - Overview

Advanced Research & Development
(Due Week 10)

Format:

Write a Progress Report with formatting and content highlighted in the Technical Communications Guide under 'Progress Report' for specifics. Be sure to address these requirements listed in the Technical Communications Guide.

Content:

Teams should address the findings from their two-weeks of Advanced Research and Development. Findings should be justified with data and data analysis. Errors, limitations, and delimitations should be addressed. Teams should outline their plan for the Performance Tests, and articulate the connection between their findings and their plans.

Be sure to see the Progress Report grading rubric.

Progress Report 3 - Overview

Performance Tests
(Due Week 11)

Format:

Write a Progress Report with formatting and content highlighted in the Technical Communications Guide under 'Progress Report' for specifics. Be sure to address these requirements listed in the Technical Communications Guide.

Content:

Teams should address the findings from the first half of their performance tests. Findings should be justified with data and data analysis. Errors, limitations, and delimitations should be addressed. Teams should outline their plan for the final Performance Tests, and articulate the connection between their findings and their plans.

Be sure to see the Progress Report grading rubric.

Progress Report - Rubrics

		CATEGORY	POINT DISTRIBUTION					
BACKWARD LOOKING SUMMARY	Situation (1.4)	6	5	4	3	2	1	0
	Address what was recently completed. Why was it completed? How was it completed?	What, why, and how are fully addressed.	What, why, and how addressed, but one lacks detail.	Two of 3 criteria are fully covered.	Incomplete analysis of two criteria.	One of three criteria fully addressed.	Incomplete analysis of all three criteria.	Missing.
	Results and Analysis (1.4 & 1.5)	8	7	6	4	2	1	0
	Results and analysis are objective, supported with data/ observations, and comprehensive.	Results are objective, supported by data, and comprehensive.	Minor errors, or minor loose ends.	Results/analysis are objective, and supported by data.	Results lack some objectivity, or are not fully supported.	Results lack data and are not comprehensive.	Minimal analysis.	Missing.
	Tables & Figures (1.4 & 7.5)	8	7	6	4	2	1	0
	Relevant data/ information summarized in a clear and concise manner to support summary.	Data/information is relevant and supports summary. Summary is clear, concise.	Minor errors, or minor loose ends.	Data supports summary. Lacks either clarity, relevance or is not concise.	Data/ information supports summary, but there are several weaknesses.	Data/ information supports summary.	Minimal data/ information.	Missing.
FORWARD LOOKING SUMMARY	Takeaways (2.2, 2.3, & 2.4)	6	5	4	3	2	1	0
	Takeaways identified for both AEV and Engineering Design Process (EDP).	Relevant takeaways are identified for both AEV and EDP.	Minor errors, or minor loose ends.	Relevant takeaways are identified for AEV or EDP, but not both.	Takeaways lack relevance.	Major takeaways overlooked.	Minimal data/ information.	Missing.
	Situation (1.3 & 3.1)	6	5	4	3	2	1	0
	Address what will be completed next. Why it will be completed? How it will be completed?	What, why and how fully addressed.	Minor errors, or minor loose ends.	Two of 3 criteria are fully covered.	Incomplete analysis of two criteria.	One of three criteria fully addressed.	Incomplete analysis of all three criteria.	Missing.
	Upcoming Goals (1.2 & 2.5)	6	5	4	3	0	*May be in Team Meeting Minutes	
	Clear team goals are articulated and explained.	Goals are <u>complete</u> , <u>measurable</u> , <u>specific</u> and <u>reasonable</u> .	Minor errors, or minor loose ends.	One criterion significantly lacking or	Two criteria significantly lacking or missing.	Missing		
Upcoming Schedule* (3.2 & 6.4)	8	7	6	4	0			
A comprehensive plan is articulated for all team members. Tasks, subtasks, materials, and time needs are all clear.	Plan is <u>comprehensive</u> (enough subtasks), <u>organized</u> and <u>feasible</u> .	Minor errors, or minor loose ends.	One criterion significantly lacking or	Two criteria significantly lacking or missing.	Missing			
APPENDIX	Team Meetings (3.2, 3.3, 6.3 & 6.4)	6	5	4	3	0	*May be in Team Meeting Minutes	
	Meetings since last progress report are included. Location, time, and attendees are recorded as well as what was discussed (who initiated ideas, why decisions were made, and who is assigned what tasks/subtasks)	Minutes are <u>complete</u> , <u>comprehensive</u> , <u>organized</u> and <u>relevant</u> .	Minor errors, or minor loose ends.	One criterion significantly lacking or	Two criteria significantly lacking or missing.	Missing		
	Arduino Code (2.4 & 5.4)	6	5	4	3	0		
Previous codes since last Progress Report are included	Codes are <u>organized</u> , <u>well commented</u> , and changes are <u>tracked</u> .	Minor errors, or minor loose ends.	One criterion significantly lacking or	Two criteria significantly lacking or missing.	Missing			

		8	7	6	4	2	0
TECHNICAL COMMUNICATIONS	Structure (7.2)						
	Writing is brief, clear, and flows naturally.	Writing is brief, clear, and flows naturally.	Writing is brief, clear, and flows naturally with minimal lapses.	Writing is lacking brevity, clarity or a natural flow.	Writing is lacking brevity, clarity or a natural flow and contains lapses in other areas.	Writing is brief, clear, or flows naturally, but quite lacking in general.	Exceedingly poor.
	Professionalism (7.2)	4	3	2	0		
	Writing is professional.	There is no slang, unprofessional jargon. Emotional statements are avoided.	Minor lapses in professionalism (not distracting).	Lack of professionalism distracts from overall message.	Exceedingly poor.		
	Tense/ Person (7.2)	4	3	2	0		
	Writing uses preferred tense and person.	Writing is in third person. Writing is in past tense. Writing typically uses passive voice.	Some inconsistencies in tense/person (not distracting)	Inconsistencies are distracting from overall message.	Exceedingly poor.		
Spelling/ Grammar/ Punctuation (7.2)	4	3	2	0			
Writing mechanics are skillful	Solid writing mechanics	Minor lapses in writing mechanics (not distracting)	Writing mechanics distract from overall message.	Exceedingly poor.			
TOTAL		80					

ORAL PRESENTATIONS

Grant Proposal - Overview

(Week 6)

Purpose

To aid your rapid prototype development, the Smart City Team will be awarding three grants to help cover the cost of custom parts. Each team will submit one entry for the proposal.

Constraints

Grant proposals will consist of a 60 – 90 second pitch with a visual. The pitch should address what the part is, how it works and how it will help the AEV. The pitch may be presented by any (or all) members of the group; however, the entire group will be assessed on the delivery of the presenters.

The visual will consist of one PowerPoint slide with the following information:

- Team Letter/Name
- SolidWorks Drawing (or video/gif) of part
- Bullet points to address important issues

*Visuals must be submitted to Carmen no later than midnight before the presentation

Selection

Students and the Instructional Team will vote for their top three choices, with a first place vote receiving three points, second place two points and third place one point. The two teams that receive the highest point totals from the students and instructional team will each be awarded 100% funding for the part. The next two highest point totals will receive 75% and 50% funding respectively.

Grant Proposal Presentation - Rubric

CATEGORY	POINT DISTRIBUTION					
	5	4	3	2	1	0
Description of Part (2.1)	5	4	3	2	1	0
Part is described in detail (both form and function) as well as how it will improve the AEV,	Part is <u>described</u> in detail (both form and function) as well as how it will <u>improve</u> the AEV.	Minor lapses with one criterion.	One criteria completely missing.	Exceedingly poor		
Visuals (7.4 & 7.5)	4	3	2	0		
SolidWorks drawing (video) is high resolution and of suitable size.	SolidWorks drawing (video) is high <u>resolution</u> and of <u>suitable size</u> .	Minor lapses with one criterion.	Major Lapses.	Exceedingly poor		
Presentation Space (7.4)	4	3	2	0		
Elements of slides are chosen carefully as not to distract from presentation.	Minimize text; text legible; appropriate color scheme; font size/style appropriate	Occasional lapses	Slides distract from presentation	Exceedingly poor		
Timing (3.2)	2	1	0			
Presentation is between 60-90 seconds.	Presentation is between 60-90 seconds.	Presentation is within 30-seconds under/over	Presentation more than 30- seconds under/over			
Delivery (7.4)	5	4	3	2	1	0
Good eye contact; good rate of speech, good volume	<u>Eye contact</u> , <u>rate of speech</u> , and <u>volume</u> all excellent	Minor lapses with one criteria.	Minor lapses with two criteria or major lapses with criteria area.	Minor lapses with three criteria or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
Poise and Professionalism (7.4)	5	4	3	2	1	0
Gestures not distracting; Filler words not distracting; Appropriate attire (business casual); Good posture	<u>Gestures</u> , <u>posture</u> , and <u>attire</u> excellent. <u>Filler words</u> not distracting	Minor lapses with one criteria.	Minor lapses with two criteria or major lapses with criteria area.	Minor lapses with three criteria or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
TOTAL	25					

Research and Development Presentation - Overview

(Week 8)

Purpose

After conducting two weeks of advanced research and development the R & D Oral Presentation gives teams the opportunity to share their findings with other groups.

Constraints

The presentation will be from six to eight minutes in length. Teams should give a brief overview of the AEV project; however, because all teams are working on the same project, the focus should be on your team's approach rather than the MCR. The primary focus should be on the two advanced research studies conducted by the team. Findings should be justified and supported by data. Limitations and delimitations of the methodology should also be addressed. Lastly, an overview of the plan for the Performance Tests should be previewed.

The presentation should be relatively evenly divided among the team members. After your 6 to 8-minute presentation, time will be given to allow for questions from the audience. This question and answer session will not exceed 2-minutes. Please refer to the sample oral presentation in the *Technical Communication Guide* along with the following oral presentation evaluation sheet (below) for specific guidelines.

Evaluation

The R &D Oral Presentation is worth 100 pts. Please see the corresponding rubric.

Research and Development Presentation - Rubric

CATEGORY		POINT DISTRIBUTION				
FORMAT (15)	Introduction (7.3)	5	4	3	0	
	Presentation contains an appropriate and comprehensive introduction.	Team members and roles are introduced. Overview of the presentation is <u>given</u> , <u>relevant</u> and <u>systematic</u> .	One of three parts criteria	Two of three criteria missing	Exceedingly poor	
FORMAT (15)	Flow (7.2)	5	4	3	0	
	Presentation has a natural flow with important takeaways	Sequence is justifiable, takeaways are identified and relevant	Sequence or takeaways lack relevancy	Two of three criteria missing.	Exceedingly poor	
CONTENT (30)	Problem Definition and Plan (1.2, 1.3, 2.5 & 4.1)	10	9	8	6	0
	Problem is defined and measurable. Problem is relevant to MCR. Reasonable plan developed and explained.	Problem is defined and measurable. Problem is relevant to MCR. Reasonable plan developed and explained.	Minor Lapses or loose ends.	Problem is defined and plan is developed. Either problem is not measurable or plan is not well explained.	Problem is defined, but not measurable and plan is not well explained.	Exceedingly poor
	Data Analysis (1.4)	10	9	8	6	0
	Data is collected and presented clearly and systematically. Dependent/ Independent variables are objective. Errors are addressed.	Data is collected and presented clearly and systematically. Dependent/ Independent variables are objective. Errors are addressed.	Minor Lapses or loose ends. (Data presentation may be lacking)	Data is not objective OR errors are not addressed.	Data is not objective, AND errors are not addressed.	Exceedingly poor
	Conclusions (1.5, 2.2, 2.3, 2.4)	10	9	8	6	0
	Conclusions are based on evidence. Recommendations and the "next step" are identified and justified.	Conclusions are based on evidence. Recommendations and the "next step" are identified and justified.	Conclusions are based on minimal evidence or recommendations are not well justified.	Conclusions lack evidence OR recommendations are not justified.	Conclusions are reasonable.	Exceedingly poor
SLIDE QUALITY (15)	Multimedia (7.4 & 7.5)	4	3	2	0	
	Visuals, audio, etc... are appropriately utilized.	All visuals discernable; images are hi-res; tables - readable; audio - audible	Occasional lapses in multimedia	Multimedia distracts more than aids presentation	Exceedingly poor	
	Presentation Space (7.4)	6	5	3	0	
	Elements of slides are chosen carefully as not to distract from presentation.	Minimize text; text legible; appropriate color scheme; font size/style appropriate	Occasional lapses	Slides distract from presentation	Exceedingly poor	
	Consistency (7.4)	5	4	3	0	
Presentation space is uniform and consistent between slides.	Consistent throughout	Occasional lapses in consistency	Inconsistencies distracting	Exceedingly poor		
CONSTRAINTS (15)	Citations (7.3)	5	3	0		
	Citations present and appropriate. (At least one citation required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations		
	Timing (3.2)	5	4	3	2	0
	Presentation is between 6-8 minutes.	Presentation is between 6 to 8-minutes.	Presentation is within 30-sec under/over	Presentation is within 1-minute under/over	Presentation is within 90-sec over/under	More than 90-sec over/under
	Questions (1.5 & 2.3)	5	4	3	2	0
Students address question being asked and answer with supporting evidence or recognize lack of evidence	Students address questions and use evidence to support answer. Some lack of evidence is okay as long as students acknowledge shortcomings.	Students address questions and use evidence to support answer. Excessive lack of evidence.	Students address questions and Lack of evidence to support answer.	Student doesn't address question.	Exceedingly poor	

INDIVIDUAL (30)	Delivery (7.4)	14	12	10	8	6	0
	Good eye contact; good rate of speech, good volume	All three areas excellent	Minor lapses in one area.	Minor lapses in two areas or major lapses in one area.	Minor lapses in three areas or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
	Poise and Professionalism (7.4)	16	14	12	10	8	0
	Gestures not distracting; Filler words not distracting; Appropriate attire (business casual); Good posture	All four areas excellent	Minor lapses in one area.	Minor lapses in two areas or major lapses in one area.	Minor lapses in three areas or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
TOTAL		100					

Final Presentation – Overview

(Week 12 and 13)

Purpose

This assignment is a chance for you to share information about your final unique Advanced Energy Vehicle (AEV) with the entire class for their benefit via an oral presentation (with visuals). The oral presentation covering the AEV project is an opportunity for each student team to practice communicating their ideas concisely and in a way that is captivating to the audience.

Constraints

The presentation will be from six to eight minutes in length. Teams should give a brief overview of the AEV project; however, because all teams are working on the same project, the focus should be on your team's approach rather than the MCR. The primary focus should be on how your team accomplished the MCR. Findings should be justified and supported by data. Limitations and delimitations of the methodology should also be addressed.

The presentation should be relatively evenly divided among the team members. After your 6 to 8-minute presentation, time will be given to allow for questions from the audience. This question and answer session will not exceed 2-minutes. Please refer to the sample oral presentation in the *Technical Communication Guide* along with the following oral presentation evaluation sheet (below) for specific guidelines.

Final Presentation (Week 13b & 13c – 100 pts)

Many of the formatting constraints from the draft will be evaluated; however, the main focus of the grade will be on content and individual presentation skills. Once again please consult the rubric.

Final Presentation Draft

Draft (Week 12a – 25 pts)

Although your team may not have completed the MCR by week 12, you should be far enough to begin planning your final presentation. Your team will need to submit a draft of your presentation that demonstrates best practices in visual presentation skills.

In places where information is incomplete, include a slide with a title, a 1-sentence filler, and a figure caption (if applicable). You will be evaluated on organizations, flow, multimedia, citations, presentation space, consistency, and use of notes (see rubric). Feedback will be delivered by Week 13a.

Final Presentation Draft - Rubric

CATEGORY	POINT DISTRIBUTION			
Organization (7.3)	4	3	2	0
Overall organization of presentation is comprehensive.	All sections present (<u>title</u> , <u>overview</u> , <u>questions</u> , & <u>references</u>)	One criteria missing	Two criteria missing	More than two criteria missing
Flow (7.2)	3	2	1	0
Presentation has a natural flow with important takeaways	Sequence is <u>justifiable</u> , takeaways are <u>identified</u> and <u>relevant</u>	Sequence or takeaways lack relevancy	Two of three criteria missing.	Exceedingly poor
Multimedia (7.4 & 7.5)	4	3	2	0
Visuals, audio, etc... are appropriately utilized.	All visuals discernable; images are hi-resolution; tables - readable; audio - audible	Occasional lapses in multimedia	Multimedia distracts more than aids presentation	Exceedingly poor
Citations (7.3)	2	1	0	
Citations present and appropriate. (At least one citation required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations	
Presentation Space (7.4)	5	4	2	0
Elements of slides are chosen carefully as not to distract from presentation.	Minimize text; text legible; appropriate color scheme; font size/style appropriate	Occasional lapses	Slides distract from presentation	Exceedingly poor
Consistency (7.4)	4	3	2	0
Presentation space is uniform and consistent between slides.	Consistent throughout	Occasional lapses in consistency	Inconsistencies distracting	Exceedingly poor
Notes (7.4)	3	2	1	0
Note section is effectively used for content and presentation flow.	Important information not in slide in <u>notes</u> ; <u>Speaker</u> listed; <u>Time</u> estimated	One section missing	Two sections missing	Missing
TOTAL	25			

Final Presentation - Rubric

CATEGORY		POINT DISTRIBUTION				
FORMAT (15)	Introduction (7.3)	5	4	3	3	0
	Presentation contains an appropriate and comprehensive introduction.	<u>Team members</u> and <u>member roles</u> are introduced. Presentation overview is <u>given</u> , <u>relevant</u> and, <u>systematic</u> .	One criterion missing	Two criteria missing	Three criteria missing	Exceedingly poor
FORMAT (15)	Flow (7.2)	5	4	3	0	
	Presentation has a natural flow with important takeaways	Sequence is <u>justifiable</u> , takeaways are <u>identified</u> and <u>relevant</u>	Sequence or takeaways lack relevancy	Two of three criteria missing	Exceedingly poor	
EDP CONTENT (30)	Description of Design Process (2.4 & 2.5)	10	9	8	6	0
	Key data and corresponding decisions are addressed/ justified. Descriptions of previous prototypes are included.	Key data and corresponding decisions are addressed and justified. Descriptions of previous prototypes (design and code) are included.	Key data and corresponding decisions are addressed and justified. Prototypes for code or design are missing.	Flaws in decision logic or lack of prototype (code or design).	Flaws in decision logic. Lack of prototypes and descriptions.	Exceedingly poor
	Description of Final Design (2.1)	10	9	8	6	0
	Final design is described orally and visually (videos, pictures, cost, etc...). Final design is justified based evidence.	Final design is described both orally and visually (videos, pictures, etc...). Final design is justified based evidence.	Small lapses in description or evidence.	Final design is described incompletely OR lacks some evidence.	Final design is described incompletely AND lacks some evidence.	Exceedingly poor
	Description of Final Performance (2.3)	10	9	8	6	0
	Data for final run, energy efficiency, time, and cost are all addressed and supported with evidence.	Data for <u>final run</u> , <u>energy efficiency</u> , <u>time</u> , and <u>cost</u> are all addressed and supported with evidence.	Small lapses in description or evidence.	At least one major performance descriptor missing.	Multiple major performance descriptors missing.	Exceedingly poor
SLIDE QUALITY (15)	Multimedia (7.4 & 7.5)	4	3	2	0	
	Visuals, audio, etc... are appropriately utilized.	All visuals discernable; images are hi-resolution; tables - readable; audio - audible	Occasional lapses in multimedia	Multimedia distracts more than aids presentation	Exceedingly poor	
	Presentation Space (7.4)	6	5	3	0	
	Elements of slides are chosen carefully as not to distract from presentation.	Minimize text; text legible; appropriate color scheme; font size/style appropriate	Occasional lapses	Slides distract from presentation	Exceedingly poor	
	Consistency (7.4)	5	4	3	0	
Presentation space is uniform and consistent between slides.	Consistent throughout	Occasional lapses in consistency	Inconsistencies distracting	Exceedingly poor		
CONSTRAINTS (15)	Citations (7.3)	5	3	0		
	Citations present and appropriate. (At least one citation required)	Non-original material cited parenthetically on page and full citation in reference.	Non-original material cited in only one place.	No citations		
	Timing (3.2)	5	4	3	2	0
	Presentation is between 6-8 minutes.	Presentation is between 6 to 8-minutes.	Presentation is within 30-sec under/over	Presentation is more than 30-sec under/over	Presentation is within 90-sec over/under	More than 90-sec over/under
	Questions (1.5 & 2.3)	5	4	3	2	0
Students address question being asked and answer with supporting evidence or recognize lack of evidence	Students address questions and use evidence to support answer. Some lack of evidence is okay as long as students acknowledge shortcomings.	Students address questions and use evidence to support answer. Excessive lack of evidence.	Students address questions and Lack of evidence to support answer.	Student doesn't address question.	Exceedingly poor	

INDIVIDUAL (30)	Delivery (7.4)	14	12	10	8	6	0
	Good eye contact; good rate of speech, good volume	All three areas excellent	Minor lapses in one area.	Minor lapses in two areas or major lapses in one area.	Minor lapses in three areas or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
	Poise and Professionalism (7.4)	16	14	12	10	8	0
	Gestures not distracting; Filler words not distracting; Appropriate attire (business casual); Good posture	All four areas excellent	Minor lapses in one area.	Minor lapses in two areas or major lapses in one area.	Minor lapses in three areas or one minor lapse and one major lapse.	Multiple major issues.	Exceedingly poor
TOTAL		100					

PERFORMANCE TESTS

(Weeks 9c, 10c and 12c)

In addition to the final performance test, there will be two other performance tests due Week 9c and Week 10c to ensure groups are on the right track.

For week 9c, teams must simply make it to the gate, stop for 7-seconds and proceed from the gate.. For week 10 the teams must stop at the gate, and connect with the load, pause for five seconds and then exit the loading zone..

Performance Test 1 - Rubric

		RUN	
Performance Constraint		Pts Earned	Pts Possible
Starting Dock Routine	Team Member uses proper safety techniques at "starting dock"		2
	AEV begins at "starting dock"		2
Gate Routine	Team Member uses proper safety techniques at "gate"		2
	AEV stops between gate sensors		4
	AEV pauses for 7 seconds		4
	AEV proceeds through "gate"		2
Other Divisions	Other Division 1 (out of 16)	0	2
	Other Division 2 (out of 16)	0	2
TOTAL POINTS		0	20

Performance Test 2 - Rubric

		RUN	
Performance Constraint		Pts Earned	Pts Poss
Starting Dock Routine	Team Member uses proper safety techniques at "starting dock"		1
	AEV begins at "starting dock"		1
Gate Routine	Team Member uses proper safety techniques at "gate"		1
	AEV stops between gate sensors		1
	AEV pauses for 7 seconds		1
	AEV proceeds through "gate"		1
Loading Zone Routine	Team Member uses proper safety techniques at "loading zone"		2
	AEV connects to load		2
	AEV does not recoil out of "loading zone"		4
	AEV pauses for 5 seconds and then leaves loading zone		2
Other Divisions	Other Division 1 (out of 16)	0	2
	Other Division 2 (out of 16)	0	2
TOTAL POINTS		0	20

Final Performance Test - Rubric

		RUN 1	RUN 2	RUN 3	
Performance Constraint		Pts Earned	Pts Earned	Pts Earned	Pts Poss
Starting Dock Routine	Team Member uses proper safety techniques at "starting dock"				2
	AEV begins at "starting dock"				2
Gate Routine	Team Member uses proper safety techniques at "gate"				2
	AEV stops between gate sensors				2
	AEV pauses for 7 seconds				2
	AEV proceeds through "gate"				2
Loading Zone Routine	Team Member uses proper safety techniques at "loading zone"				2
	AEV connects to load				2
	AEV does not recoil out of "loading zone"				4
	AEV pauses for 5 seconds				2
Transport Routine	AEV remains connected to load through elevation raise				2
Gate Routine	Team Member uses proper safety techniques at "gate"				2
	AEV stops between gate sensors				2
	AEV pauses for 7 seconds				2
	AEV proceeds through "gate"				2
Transport Routine	AEV remains connected to load through elevation drop				2
Starting Dock Routine	Team Member uses proper safety techniques at "starting dock"				2
	AEV stops and does not recoil out of "starting dock"				4
TOTAL POINTS		0	0	0	
TOTAL TIME (S)					
TOTAL ENERGY (J)					

Critical Design Review

Draft – Overview

(Week 9a)

Write a Lab Report

- For details on content and formatting, see the Technical Communications Guide on Lab Report specifications.

Executive Summary

- Clearly define the purpose of the lab. Address the overall goals, objectives and briefly explain what you did to complete the tasks.
- Discuss in depth the need for an Advance Energy Vehicle (AEV) and how the AEV will be used to meet the objectives and requirements as stated in the **Technical Communications Guide**.

Results

- Description of Two Concepts - Provide a brief description of the group's two prototype AEV concepts used in Performance Test 1 (include a figure of each concept in the report). How did the four designs the team came up in the Preliminary Research and Development evolve to the two prototype concepts used in Performance Test 1?
- Screening and Scoring Matrices - Provide a screening and scoring matrices to help defend prototype designs to the four concepts from Preliminary Research and Development and Sample AEV.
- Observations from Run - Address the observations the group made while comparing the two concepts. (How did the two designs behave differently with the same control program? Was there a significant difference in the total energy consumed by each design? Was that what the group was expecting?)
- Advanced Research and Design – Address data collected from chosen tests, not only from your Divisions, but where applicable the other Divisions in your Company.

Conclusions and Recommendations

- Develop a thoughtful yet concise conclusion from the results obtained in the lab.
- Select a design with which the group will proceed and defend the group's selection with experimental results.
- Reasons for Incompleteness/ Resolving Error/ Recommendations - Provide any recommendations for future lab analysis and/or reasons for incompleteness of the performance test.

Appendix

- Schedule - Provide the group's project schedule with the tasks that need to be completed, start and end dates, due dates, the group members' percent completed, their roles for tasks that need to be completed, and the percentage completed (See Technical Communications Guide for example).

- SolidWorks - Provide the SolidWorks model of the two prototype designs and ensure that the figure has the 3 primary orthographic views with overall dimensions, estimated weight, estimated cost, and bill of materials.

CDR Draft – Rubric

ABSTRACT	Purpose 1.2	2	1	0
	State purpose of lab and what the report will tell the reader. Why are the goals important?	Purpose Identified and clear	Purpose Identified, not clear	Poor/Missing
	Results 2.3	2	1	0
	Results should be clear and concise. Final results are most important.	Clear and Concise	Wordy and/or unclear	Poor/Missing
INTRODUCTION	Recommendation 1.5	2	1	0
	Provide recommendations for your AEV based on the Preliminary R & D.	Direct & Justified	Unclear and/or weak	Poor/Missing
	Purpose 1.2	2	1	0
	Purpose should be clearly stated in the writer's own words.	Good/Restated	Poor/Copied	Missing
EXPERIMENTAL METHODOLOGY	Background 3.1	2	1	0
	The reason for the report is stated (what information is meant to be conveyed). Create a roadmap for the remainder of the text.	Complete	Incomplete/not specific	Missing
	Procedure 1.3	2	1	0
	Activities described (both order and methods). Reader should be able to replicate. Do not copy lab documentation.	Could replicate experiments	Missing SEVERAL important steps	Exceedingly poor
RESULTS	Equipment 1.3	2	1	0
	Describe what equipment was used and how it was used in order to replicate the experiment.	Thorough description w/pictures or diagram of setup	Missing pictures/diagrams	Exceedingly poor
	Objectivity 1.4	2	1	0
	The report must be free of bias, feelings, and independent of the researchers influence.	Objective Results	Some Subjectivity	Mostly Subjective
	Observations 1.4	2	1	0
	Observations should describe what was noticed during the experiment. Observations should be objective and relevant.	Objective Observations	Some Subjectivity	Missing
	Data Placement 1.4	2	1	0
	Raw and processed data is often in Results. Large tables that can clutter and cause confusion are kept in the appendix.	Easy to Find	Some Difficulty	Mostly Hidden
DISCUSSION	Data Analysis 1.4	2	1	0
	Describe data obtained and what was done with it. Raw and processed observations are presented. There is enough descriptive text to guide reader through results and explain assumptions.	Logical steps/ thoroughly explained	Difficult to follow or missing critical steps (i.e. sample calculations)	Exceedingly poor
	Figures and Tables 1.4	8	4	0
	Figures and Tables should be introduced before they appear and discussed as close to the reference as possible. If they are on a separate page their location should be referenced.	Good use of tables and figures	Needs more/ fewer tables/ figures	Exceedingly poor
	Analysis 1.5	2	1	0
	Data should be described, and presented in a way that shows inferences and trends (or lack thereof).	Clear trends identified & relate to purpose	Trends unrelated to purpose/ some missing	Exceedingly poor/ missing
	Potential Error 1.5	2	1	0
	Potential errors are mentioned and there is a discussion how they affect data.	Reasonable/ well justified	Unreasonable/ poorly justified	Exceedingly poor/ missing
DISCUSSION	Comparison to Theory 1.5	2	1	0
	Compare your results, both in general and some specific examples. Quantitative reasoning and logically compare your results to what was expected.	Quantitative and logical	Poor/ Lacking critical details	Exceedingly poor/ missing
	Description of Two Prototypes 2.2	2	1	0
	Two prototypes are described, compared with data and final selection is justified.	Justified w/data & theory of matrices	Not fully reasoned/ verified	Exceedingly poor/ missing
	Screen AND Scoring Matrices 2.2 & 2.5	2	1	0
	Data from concept screening and scoring matrix is displayed and rankings are justified with theory and data.	Justified w/data & theory	Not fully reasoned/ verified	Exceedingly poor/ missing
	Observations from Run 2.2	2	1	0
	Observations from runs are displayed. Observations are primarily quantitative and justified with data and theory.	Justified w/data & theory	Not fully reasoned/ verified	Exceedingly poor/ missing

CONCLUSION AND RECOMMENDATIONS	Summary 1.5	3	2	1	0	
	Underscore the experiment and results, highlighting key points from the discussion.	Summarized experiment, results, & discussion	Summary lacking in parts or missing critical part	Poor/ missing two parts	Exceedingly poor/ missing	
	Conclusions 1.5	3	2	1	0	
	Ultimate knowledge gained is stated and compared to lab objectives and results.	Supported by data & relevant to purpose	No link to results/ discussion	Lacking critical thinking	Very poor/ missing	
	Resolving Error 1.5	3	2	1	0	
	Discuss potential solutions for all errors previously discussed.	Address error/ reasonable	Unaddressed or unreasonable	Poor/ Lacking thought	Missing	
	Recommendations 1.5	3	2	1	0	
	Provide your individual responses and recommendations based on lab procedure.	Well thought out/ reasoned	Not fully reasoned	Very poor	Missing	
	Reasons for Incompleteness 2.3	3	2	1	0	
	There are bound to be parts that have not worked well yet. These shortcomings should be described and justified with data.	Justified w/ data, theory, & subtle references	Justified w/ data or theory, or subtle references	Not reasoned/ verified	Very poor/ missing	
Format & Language 7.2	3	2	0			
Overall writing is free of mistakes in format and language.	< 2 mistakes in format, < 2 mistakes in language	4-6 mistakes in total	> 6 mistakes			
APPENDIX	Schedule 3.2	8	6	4	2	0
	Schedule addresses roles, d tasks, and timeline.	Has completed/start/end dates, group members, percentage completed, roles, tasks, and percentage completed. Formatted Correctly.	Lacking a few components from above	Has very basic information, formatting issues	Lacking or exceedingly poor	Missing
	SolidWorks Models 9.7	8	6	4	2	0
Two SolidWorks drawings are completed (one for each prototype) with bill of materials and three basic dimensions (Length, Height, Depth)	Has BOTH prototypes with bill of materials, overall dimensions, weight, cost and 3 views	Lacking a few components from above	Missing prototype/ has very basic information	Exceedingly poor	Missing/ Hand drawn	

CONTENT PLACEMENT	Body Content 7.3	2	1	0
	Document is arranged appropriately and logically. Headers provide a guide.	All in correct sections	Minor misplaced content	Large sections of misplaced content
	Appendix Content 7.3	2	1	0
	Extra graphs that contain similar information or large sets of data.	Appropriately placed	Minor misplaced content	Too much content in appendix
LABELS & REFERENCES	Labels & Placement 7.3	2	1	0
	Captions clearly describe figures and tables. Captions for figures are below the figure. Captions for tables are above the table.	All present w/descriptions & placement	Some missing or poor description	Missing or no description
	Referencing 7.3	2	1	0
	Figures and tables are references in the body of the text. When they are not on the same page as the text, their location is referenced.	Well referenced & described in body	Poor descriptions and/or references	Missing references
GENERAL FORMAT	Errors 7.3	2	1	0
	Avoid errors in style and formatting (font, alignment, headings, etc....)	Fewer than 2 mistakes	2-5 mistakes	More than 5 mistakes
	Citations 7.3	2	1	0
	APA style should be used for all outside references (including lab manuals and user guides)	Proper citations	Few citation mistakes	Poor/ missing citations
STRUCTURE	Brevity 7.2	2	1	0
	Point made without flashy or unnecessary words.	Concise	Very wordy	Exceedingly Poor
	Clarity 7.2	2	1	0
	Results and observations clearly and concisely stated, keeping report coherent.	Clear	Many parts confusing	Confusing overall
	Flow 7.2	2	1	0
	Paragraphs are not completely divorced from each other. Transitions are used between sentences, paragraphs and sections. It is not possible to tell when the author changes.	Smooth	Many disjointed parts	Very disjointed
WORDING	Professionalism 7.2	2	1	0
	Some degree of technical jargon is acceptable; however, keep in mind this report may not stay in the office so it cannot be assume the reader understands all technical jargon.	No slang, jargon, etc.	Distracting/ poor	Exceedingly poor
	Tense/Person 7.2	2	1	0
	Reports should be in third person, past tense.	No slips in tense/ person	4-8 slips in tense/ person	More than 8 errors
GENERAL	Spelling/Grammar/Punctuation 7.2	2	1	0
	Document should be edited and free of mistakes.	Minor errors	Distracts from readability	Complete lack of proofreading

CDR Final Report - Overview

(Week 12c)

Write a Lab Report

- For details on content and formatting, see the Technical Communications Guide on Lab Report specifications.

Executive Summary

- Provide the research focus on the need for an Advance Energy Vehicle. Address the overall goals and objectives.
- Briefly discuss the research methods used to obtain results.
- Discuss major results and findings from the Performance Tests 1-3 to help obtain the final design vehicle.

Results & Discussion

- Provide a brief description of the group's two prototype AEV concepts used in Performance Test 1 (include a figure of each concept in the report). Describe the evolution of the concepts (Preliminary R&D) to the two prototypes in Performance Test 1 to the final product.
- Provide a screening and scoring tables (Preliminary R&D) to help defend the final design to all concepts and prototypes.
- Discuss the cost of the system. What was done to reduce the cost of the overall system?
- How did this Performance Test affect the team's design process? Discuss the results from the design cycle and the energy optimization during the performance tests.
- Incorporate appropriate figures into the discussion (from preliminary R&D, Advanced R&D, and Performance Tests)

* Make sure you include a brief discuss of the figures and tables. Verify that the figures and tables are labeled correctly with appropriate units, title, and x- and y-axis labels

** What observations did the team make during final testing? How did the AEV behave? How efficient was the vehicle? This is where you discuss the scores on the final test score sheet (include the team's score sheet in the Appendix).

Note: if the AEV did not finish the final test, discuss why it did not complete the scenario and provide reasons not excuses to why.

Conclusion and Recommendations

- Develop a thoughtful yet concise conclusion from the results obtained in the course.
- Summarize important results from the report.
- Defend the final design and discuss why the team's AEV is the best design compared to the rest of the class (what advantages does the team's AEV have?).
- Provide any recommendations for improvements to the AEV project.
- Appendix

- Provide the group's project schedule for the entire semester: start and end dates, due dates, the group members' percent completed, their roles for tasks that need to be completed, and the percentage completed (See Technical Communications Guide for example).
- Provide the SolidWorks model of the final design and ensure that the figure has the 3 primary orthographic views with overall dimensions, estimated weight, and estimated cost.

CDR Final Report - Rubric

ABSTRACT	Purpose 1.2	3	2	0	
	State purpose of lab and what the report will tell the reader. Why are the goals important?	Purpose Identified and clear	Purpose Identified, not clear	Poor/Missing	
	Results 2.3	4	2	0	
	Results should be clear and concise. Final results are most important.	Clear and Concise	Wordy and/or unclear	Poor/Missing	
INTRODUCTION	Recommendation 1.5	3	2	0	
	Provide recommendations for your AEV based on the Preliminary R & D.	Direct & Justified	Unclear and/or weak	Poor/Missing	
	Purpose 1.2	4	2	0	
	Purpose should be clearly stated in the writer's own words.	Good/Restated	Poor/Copied	Missing	
EXPERIMENTAL METHODOLOGY	Background 3.1	4	2	0	
	The reason for the report is stated (what information is meant to be conveyed). Create a roadmap for the remainder of the text.	Complete	Incomplete/not specific	Missing	
	Procedure 1.3	3	2	1	0
	Activities described (both order and methods). Reader should be able to replicate. Do not copy lab documentation.	Could replicate experiments	Some details missing	Missing SEVERAL important steps	Exceedingly poor
RESULTS	Equipment 1.3	3	2	1	0
	Describe what equipment was used and how it was used in order to replicated the experiment.	Thorough description w/pictures or diagram of setup	Setup unclear or equipment left out	Missing pictures/diagrams	Exceedingly poor
	Objectivity 1.4	2	1	0	
	The report must be free of bias, feelings, and independent of the researchers influence.	Objective Results	Some Subjectivity	Mostly Subjective	
RESULTS	Observations 1.4	2	1	0	
	Observations should describe what was noticed during the experiment. Observations should be objective and relevant.	Objective Observations	Some Subjectivity	Missing	
	Data Placement 1.4	4	2	0	
	Raw and processed data is often in Results. Large tables that can clutter and cause confusion are kept in the appendix.	Easy to Find	Some Difficulty	Mostly Hidden	
	Data Analysis 1.4	4	2	0	
	Describe data obtained and what was done with it. Raw and processed observations are presented. There is enough descriptive text to guide reader through results and explain assumptions.	Logical steps/ thoroughly explained	Difficult to follow or missing critical steps (i.e. sample calculations)	Exceedingly poor	
	Figures and Tables 1.4	16	8	0	
Figures and Tables should be introduced before they appear and discussed as close the reference as possible. If they are on a separate page their location should be referenced.	Good use of tables and figures	Needs more/ fewer tables/ figures	Exceedingly poor		

DISCUSSIO	Analysis 1.5	4	2	0		
	Data should be described, and presented in a way that shows inferences and trends (or lack thereof).	Clear trends identified & relate to purpose	Trends unrelated to purpose/ some missing	Exceedingly poor/ missing		
	Potential Error 1.5	3	2	0		
	Potential errors are mentioned and there is a discussion how they affect data.	Reasonable/ well justified	Unreasonable/ poorly justified	Exceedingly poor/ missing		
	Comparison to Theory 1.5	4	3	2	0	
	Compare your results, both in general and some specific examples. Quantitative reasoning and logically compare your results to what was expected.	Quantitative and logical	Qualitative or illogical	Poor/ Lacking critical details	Exceedingly poor/ missing	
	Defense of Final AEV Model 2.2	5	3	2	0	
	Final AEV Model described, compared with data and final selection is justified.	Justified w/data & theory of matrices	Justified w/o data or theory of matrices	Not fully reasoned/ verified	Exceedingly poor/ missing	
	Screen AND Scoring Matrices 2.2 & 2.5	3	2	1	0	
	Data from concept screening and scoring matrix is displayed and rankings are justified with theory and data.	Justified w/data & theory	Justified w/o data or theory	Not fully reasoned/ verified	Exceedingly poor/ missing	
Observations from Final Run 2.2	3	2	1	0		
Observations from runs are displayed. Observations are primarily quantitative and justified with data and theory.	Justified w/data & theory	Justified w/o data or theory	Not fully reasoned/ verified	Exceedingly poor/ missing		
CONCLUSION AND RECOMMENDATIONS	Summary 1.5	7	5	3	0	
	Underscore the experiment and results, highlighting key points from the discussion.	Summarized experiment, results, & discussion	Summary lacking in parts or missing critical part	Poor/ missing two parts	Exceedingly poor/ missing	
	Conclusions 1.5	7	5	3	0	
	Ultimate knowledge gained is stated and compared to lab objectives and results.	Supported by data & relevant to purpose	No link to results/ discussion	Lacking critical thinking	Very poor/ missing	
	Resolving Error 1.5	6	4	2	0	
	Discuss potential solutions for all errors previously discussed.	Address error/ reasonable	Unaddressed or unreasonable	Poor/ Lacking thought	Missing	
	Recommendations 1.5	7	5	3	0	
	Provide your individual responses and recommendations based on lab procedure.	Well thought out/ reasoned	Not fully reasoned	Very poor	Missing	
	Reasons for Incompleteness 2.3	7	5	3	0	
	Describe and justify any shortcomings with data. If your AEV has exceeded expectations, please address this.	Justified w/ data, theory, & subtle references	Justified w/ data or theory, or subtle references	Not reasoned/ verified	Very poor/ missing	
Format & Language 7.2	6	3	0			
Overall writing is free of mistakes in format and language.	< 2 mistakes in format, < 2 mistakes in language	4-6 mistakes in total	> 6 mistakes			
APPENDIX	Schedule 3.2	18	12	9	5	0
	Schedule addresses roles, tasks, and timeline.	Has completed/start/end dates, group members, percentage completed, roles, tasks, and percentage completed. Formatted Correctly.	Lacking a few components from above	Has very basic information, formatting issues	Lacking or exceedingly poor	Missing
	SolidWorks Models 9.7	18	12	9	5	0
Two SolidWorks drawings are completed (one for each prototype) with bill of materials and three basic dimensions (Length, Height, Depth)	Has BOTH prototypes with bill of materials, overall dimensions, weight, cost and 3 views	Lacking a few components from above	Missing prototype/ has very basic information	Exceedingly poor	Missing/ Hand drawn	

CONTENT PLACEMENT	Body Content 7.3	4	2	0	
	Document is arranged appropriately and logically. Headers provide a guide.	All in correct sections	Minor misplaced content	Large sections of misplaced content	
LABELS & REFERENCES	Appendix Content 7.3	4	2	0	
	Extra graphs that contain similar information or large sets of data.	Appropriately placed	Minor misplaced content	Too much content in appendix	
GENERAL FORMAT	Labels & Placement 7.3	4	2	0	
	Captions clearly describe figures and tables. Captions for figures are below the figure. Captions for tables are above the table.	All present w/descriptions & placement	Some missing or poor description	Missing or no description	
GENERAL FORMAT	Referencing 7.3	4	2	0	
	Figures and tables are references in the body of the text. When they are not on the same page as the text, their location is referenced.	Well referenced & described in body	Poor descriptions and/or references	Missing references	
GENERAL FORMAT	Errors 7.3	4	2	0	
	Avoid errors in style and formatting (font, alignment, headings, etc....)	Fewer than 2 mistakes	2-5 mistakes	More than 5 mistakes	
GENERAL FORMAT	Citations 7.3	3	2	0	
	APA style should be used for all outside references (including lab manuals and user guides)	Proper citations	Few citation mistakes	Poor/ missing citations	
STRUCTURE	Brevity 7.2	4	3	1	0
	Point made without flashy or unnecessary words.	Concise	Some wordy areas	Very wordy	Exceedingly Poor
	Clarity 7.2	4	3	1	0
	Results and observations clearly and concisely stated, keeping report coherent.	Clear	Few parts confusing	Many parts confusing	Confusing overall
STRUCTURE	Flow 7.2	4	3	1	0
	Paragraphs are not completely divorced from each other. Transitions are used between sentences, paragraphs and sections. It is not possible to tell when the author changes.	Smooth	Few disjointed parts	Many disjointed parts	Very disjointed
WORDING	Professionalism 7.2	5	4	2	0
	Some degree of technical jargon is acceptable; however, keep in mind this report may not stay in the office so it cannot be assumed the reader understands all technical jargon.	No slang, jargon, etc.	Some slips in professionalism	Distracting/ poor	Exceedingly poor
WORDING	Tense/Person 7.2	5	4	2	0
	Reports should be in third person, past tense.	No slips in tense/ person	1-3 slips in tense/ person	4-8 slips in tense/ person	More than 8 errors
GENERAL	Spelling/Grammar/Punctuation 7.2	5	3	1	0
	Document should be edited and free of mistakes.	Minor errors	Few errors, but not distracting	Distracts from readability	Complete lack of proofreading

REFERENCES

Smart City Columbus <https://www.columbus.gov/smartcolumbus/projects/>