



## Capstone Program

## Report Guidelines

Last Updated: April 2018

**Electrical and Computer Engineering Department  
Rutgers University, Piscataway, NJ 08854**

## General

This document includes the recommended breakdown of section for the report, cover page and required content for the capstone report.

## Cover Page

Should include the following info:

Project Title

Submitted by:  
... Names of team members

Team Project Number: .....

Advisor[s]:  
Advisor Name  
Advisor Name

October 1, 2016

Submitted in partial fulfillment of the requirements for senior design project

**Electrical and Computer Engineering Department  
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# 1. Introduction

General guidelines for Section 1: The capstone project report is a very important part of your work and counts towards a significant portion of your final project grade. This section should provide relevant background information on the project and provide the motivation for it. It should emphasize the problem identified and significance of the project compared with other existing solutions.

The introduction should include:

- a) A background review of the state of the art in the relevant field.
- b) The problem addressed in the project.
- c) Objective of the proposed projects.
- d) The adopted approach

Include a discussion on the current trends in the relevant field of interest.

Describe real world systems that are related to your capstone project. Address issues such as ethics, economics and sustainability, research and development.

Research the literature and provide formal citations from publications in the Reference Section.

## 2. Methods / Results / Approach

General guidelines for Section 1: In this part of the report please include the specific project details. For example, include description of the approach taken, how problems were solved, detailed system architecture, experimental results (if relevant), etc.

### 2.1. Methods

Includes a description of the work done within the scope of the project by the team and methods used in solving the problem described in the Introduction section. Detail how each component in the objectives is achieved. Detail the work done by the individual team members.

Include any relevant equations and algorithms. Algorithms should be detailed in an appropriate table.

Some important projects aspects that need to be addressed in the project reports are:

- a. System design and implementation challenges and how they have been addressed.
- b. Time constraints and their impact on design.
- c. Required knowledge base for the project.
- d. Required hardware and software tools and accessibility.
- e. Existing standards impacting the system design requirement (such as IEEE standards, software standards etc.). Please check a detailed list in the next subsection.
- f. Regulatory issues that impact design (such as energy efficiency, electric code, FCC, etc.)
- g. Existing technology limitations.

### 2.2. Use of Standards

Some examples of standards that might impact design choices:

- a. Standardized network technologies: e.g. Bluetooth, Zigbee/IEEE 802.15.4, IEEE 802.11a/b/g, Internet Protocol—IPv 4 and IPv6, TCP, etc.<sup>[1]</sup>
- b. Standardized security mechanisms and protocols: IPSEC, SSL/TLS, SMIME, PGP, SET, Kerberos, AES, etc.
- c. Standards for electric power systems: IEEE 1547, IEEE 2030, UL 1741, etc.<sup>[1]</sup>
- d. Powerline communication standards: IEEE 1901.2, x10 (an open industry standard for home automation)

- e. Standardized software development tools, and software environments: Java Software Development Kits, JVM, JRE, MATLAB, Cadence, Labview, etc. [SEP]
- f. Standardized software engineering practices: MIL-STD-498, IEEE 12207, POSIX, etc.
- g. Standardized quality management guidelines: ISO 9000, ISO 9001, etc.
- h. Hardware standards: microcontroller standards, plug-and-play standards, measurement bus standards (GPIB/IEEE 488, PCI, PXI), etc. [SEP]
- i. Open source standards, software, and operating systems: Linux, Apache server, Gnu, OpenGL, etc.

### **2.3. Experiment / Product Results**

Include details of any measurements performed, repeated trials (for validation), error/performance analysis (as a function of system parameters). Include plots, images or tables to describe measurement values.

### 3. Cost and Sustainability Analysis

Sustainability consideration and constraints includes economic, environmental, and social (equity) aspects that need to be evaluated and taken into account in project research and development. There is a strong relationship between these three pillars of sustainability. These need to be considered and incorporated in this section with a discussion on their design constraint and the positive and negative effects of the project within this scope.

Beyond the feasibility of the technical solution an engineering project needs to take into account the following aspects:

- a. Economics (cost) impact: should consider, when relevant,
  - i. Prototype design and production cost, including the manner in which production cost can be reduced, when applicable.
  - ii. Device cost in mass production, including materials, operations, supports etc.
  - iii. Cost saving of the product should be considered when appropriate. For example, energy savings compared with the use of other products, water saving, reduction in operation cost, etc.
  - iv. Tax incentives to be considered towards final product cost. For example, renewable energy and energy efficient products tax incentives, carbon footprint reduction, etc.
  - v. Environmental aspects, such as availability of resources, may affect the product cost and therefore price and their market vulnerability.
  
- b. Environmental impact of the product: when relevant, please consider
  - i. Increase or reduction in emissions obtained through modifications in processes that emit greenhouse gasses (GHG) or products that do so.
  - ii. Change in consumption or use patterns, which effect the environment such as use of water, food, energy, wood, etc. (positive or negative affect).
  - iii. Reliance on resources that are scarce (such as precious material) or abundant. For examples, some fuel cells technologies use rare material while other use abundant ones. This will have an impact on the availability of these materials as well as their prices.

- iv. Project production and operation effect on natural resources availability and competition on the planet resources. Considering their availability in nature and the impact of their consumption on the balance of nature.
  - v. Environmental regulation
- c. Social impact of the product: when relevant, please consider
- i. How can the developed product impact people lives. Is it a positive or negative impact?
  - ii. What community or personal needs does it address?
  - iii. Is the product going to change consumption patterns?
  - iv. Is the product automating a task currently performed manually and therefore might impact employment?
  - v. Does the product create new jobs or fields?
  - vi. Safety aspects and health concerns
  - vii. Regulation constraints that address social and environmental concerns

The above-mentioned examples are a partial list of sustainability consideration that includes the economic, environmental, and social (equity) aspects that need to be evaluated for any real-life project.

Your project advisor will provide specific detail/guidance about cost/sustainability as appropriate.

## 4. Conclusions / Summary

This section should provide a short summary of the project's activities and results. A conclusion section contains high-level material that refers to the main part of the paper (methods) and was not included in the introduction, including solution proposed, main results, and significance of the project compared with other existing solutions.

If relevant, indicate if there are any suggestions for further development of the work done.



## **5. Acknowledgments [if applicable]**

When relevant, acknowledge each person, company, or organization that contributed in any way to the project.

## 6. REFERENCES

[1] A. Name, “paper title,” Source details, Date<sup>[1]</sup><sub>SEP</sub>

[2] B. NameToo, *Book Name*, Publisher, Edition, year

Use one consistent system for citing works in the body of your report. Several such systems are in common use in textbooks and in conference and journal papers. Ensure that any works you cite are listed in the references section, and vice versa.

IEEE standards for citation should be used (check the IEEE citation standard uploaded in the resources)

Make sure any sites used as sources are mentioned as well.