FINAL DESIGN REPORT GUIDELINES
Final Written Documentation for Capstone Engineering Design Projects

PURPOSE AND CONTENT
This formal written report presents the final design product and includes vital supplemental information not included in an oral report due to limited time or interests or background of the audience. An effective final design report decisively convinces readers that the design product meets their needs and makes business sense. Because the detail design report is foremost a decision package for the final design product, it must effectively convey the credibility and value of the product to all stakeholders. The thoroughness of the report and its appearance reflect the design team’s professionalism, and therefore, affect the report’s credibility with readers.

The remainder of this document describes the common sections of the final design report and contents of those sections.

LETTER OF TRANSMITTAL
The detail design report is submitted to the client and other important stakeholders with a cover letter or letter of transmittal introducing the report. The letter is addressed to the proper decision maker(s), states the purpose of the report, and asks for specific actions. It provides instructions for obtaining additional information and for communicating a response to the design team. The letter of transmittal is especially important to readers who did not benefit from an oral presentation on the design.

Key features:
• Addressed to sponsor and other interested parties
• Says “here’s an (interim, final) report on the XYZ project
• Thanks addressee for help provided to date

COVER PAGE
The cover gives readers their first impression of the design product, its quality, and its impact. The cover should principally identify the product and its intended purpose. It should also present names of team members and/or their group/firm, the report’s intended audience, and date of preparation. Because its visual impact is important, the cover should use images and words strategically to communicate attractive features of the product and/or team or to highlight values radiated by the product. An excellent product will have a professional cover page and/or packaging for the report.

Key features:
• Title
• Authors
FRONT MATTER

The front matter in a formal report includes an Executive Summary and Table of Contents. Typically, the Executive Summary appears first to catch the reader’s attention and to prepare the reader for the substance of the report. The Table of Contents presents an outline of the report and page numbers to guide the reader to sections of interest.

Table of Contents

- Uses Numbered Sections (1.0 …) and Subsections (i.e. 1.1 …)
- Includes Informative Labels
- Enumerates Appendices along with Labels (A … , B… , C… , etc.)

Executive Summary (up to 1 page)

The Executive Summary is intended to motivate readers to study the full design report. It should present a short, powerful synopsis of the report, highlighting important needs, presenting key features of the proposed solution, and delineating noteworthy benefits of the solution. It should be less than one page in length and address issues of greatest interest to decision makers—notably, the principal technical and business merits of the design product—and should recommend appropriate next steps for adoption of the design product.

Key features:
- Intro sentence => what are you designing and who are the stakeholders
- Needs sentence => what are the key customer needs
- Methods sentence(s) => what alternatives were considered/selected
- Results sentence => what features and test results were obtained
- Discussion sentence => what benefits/merits are derived from the design
REPORT BODY
The body of the report contains an organized presentation of the design product and crucial steps in its development. The body should include selected background information, principal design processes and decisions, noteworthy features of the design, and defensible evidence of product performance. Extensive supporting documentation should be deferred to an appendix or separate volume.

Background (1 page)
The Background section explains the problem need and its context. This section describes the scope of the need, identifies stakeholders who are affected, and describes benefits that can accrue from a responsive, viable design solution. This section should present data to document the need and potential benefits from a solution.

Key features:
- Provides motivation for the work
- Summarizes prior work by sponsor
- Identifies need/opportunity
- Describes expected benefits

Problem Definition (1-2 page)
The Problem Definition section states the specific design requirements (product attributes or performance expectations) satisfied by a high quality design solution. This section includes a succinct list of project requirements with measures or indicators that these have been achieved. The requirements and measures often appear in tabular form, supplemented by a brief discussion in the body. This section should identify constraints that limit the design solution, possibly including: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political.

Key features:
- Problem statement/goals
- Table of specifications
- Discussion of key constraints
- Identify key sources for project learning
- Deliverables

Concept Development (2-4 pages)
The Concept Development section describes the process used by the design team in its search for feasible solutions. It should identify sources of important concepts considered. It identifies methods used to select solution concepts and principal factors that led to the chosen design solution. The Concept Development section gives evidence of the team’s effort and proficiency in selecting viable solution concepts.

Key features:
- Can be done at a sub-system by sub-system level (from functional map)
• Explore original ideas + those derived from other sources
• Quantitative data (from preliminary experiments, calculations, or prototypes)
• Include illustrative sketches/drawings/diagrams
• What selections have you made?
• How did you arrive at your final selection(s)?
• Include morphological charts and decision matrices as appropriate

**Product Description (3 pages)**

The *Product Description* section presents the selected and detailed design and highlights features important to its success. This section describes the overall product, its primary components, and their interrelationships. It describes how the product performs its intended functions and features of its interfaces with users, society, and the environment. This section should contain photos, drawings, or diagrams that explain the key features and/or function. More extensive drawings, specifications, instructions, and explanations should appear in an appendix.

Key features:
• Describe system design and detail design
• Describe integration of components, including user interface
• Highlight novel features and their relation to specs – your “value added”
• Summarize important manufacturing and assembly details

**Design Evaluation (2 pages)**

The *Product Evaluation* section presents summary results of evaluations conducted to check performance against the established design requirements. It should include a table that summarizes key items from DFMEA analysis, summaries of key design calculations, and results from experiments. Details of these evaluations should be included in an appendix. Because the *Product Evaluation* section is pivotal for decision makers, it must prove to the reader’s satisfaction that the product satisfies design expectations of major stakeholders. It should contain an accounting of costs incurred in prototype development as well as a forecast of cost in production. Costs estimates should include engineering time for conceptual design, drafting time for drawing creation, manufacturing time in the shop, and materials/components.

Key features:
• Comment on how well you’ve meet project specifications
• Describe product testing and results obtained
• Anticipate failures using DFMEA
• Estimate cost to replicate prototype

**Recommendations and Future Work (up to 1 page)**

The *Conclusions and Recommendations* section sets forth clear recommendations and rationale for adoption and implementation of the design product. It brings attention to the most important features of the product: projected financial benefits and performance strengths or advantages over competing products. As appropriate, it may note less tangible benefits, such as desirable social impacts or enhanced client image. Recommended actions should be stated clearly and convincingly.
Key features:
• Recommendations for continued development
• Size, duration, and cost of the required effort

APPENDICES
Appendices are used to present supplemental materials that support the report body but are too lengthy or have less refinement than those contained in the body. These may be calculations, drawings, lists, computer programs, tables, figures, or narrative. Each appendix should be self explanatory, and each should be referenced in the report body where appropriate. Special sections should be included containing the following items:

Key features:
• Calculations
• Drawings
• Computer programs
• Long tables/figures
• Vendor data sheets
• Operating Manuals/Procedures
MEASURES OF REPORT QUALITY

The quality of a detail design report is determined by its impact on the client and project supervisor. The report must build a compelling case for product adoption and implementation and leave no doubts about the value of the product to the client or final user.

Specific criteria for assessing the report are defined below.

<table>
<thead>
<tr>
<th></th>
<th>Engineering Intern</th>
<th>Entry-Level Engineer</th>
<th>Project Engineer</th>
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</thead>
<tbody>
<tr>
<td><strong>OVERALL REPORT QUALITY</strong></td>
<td>Report is incomplete, unattractive, can be misunderstood, has distracting errors; presentation or supporting materials lack professionalism and credibility</td>
<td>Report is complete, understandable, attractive, nearly flawless; presentation, supporting materials give moderate credibility to team and design product</td>
<td>Report is very complete, flawless, very clear and understandable, compelling, beautiful; entire package emotes product quality, credibility and professionalism</td>
</tr>
<tr>
<td><strong>BACKGROUND</strong></td>
<td>Identifies basic client needs for product; acknowledges few existing products or resources that may influence the development of a solution</td>
<td>States problem context relative to clients and the state of technology within society; reviews most important literature, patents, competitive products</td>
<td>Describes and analyzes problem context in terms of clients’ needs, societal and global issues; thoroughly analyzes literature, patents, competing products</td>
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<tr>
<td><strong>DESIGN REQUIREMENTS</strong></td>
<td>Few design requirements defined; most are loosely defined, performance-related, qualitative; few or none based on documented client needs; broader considerations* neglected</td>
<td>Defines important design requirements based on primary and secondary clients; addresses technical and non-technical requirements and constraints*; many measurable requirements</td>
<td>Skillfully defines comprehensive design requirements based on needs of clients and stakeholders; addresses system-level and life-cycle requirements and constraints*; all are measurable</td>
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<tr>
<td><strong>CONCEPT DEVELOPMENT</strong></td>
<td>Vague process to identify, select concepts; little record of decision making process; poorly-defined criteria; little analysis or understanding of concepts evident</td>
<td>Defined process to identify, select concepts; clear measurable criteria for design decisions; aware of state-of-art; basic analysis and understanding of concepts evident</td>
<td>Thorough documented process to identify, select concepts; clear quantitative, qualitative criteria; fully understand state-of-art and concepts; extensive analysis</td>
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<tr>
<td><strong>PRODUCT DESCRIPTION</strong></td>
<td>Product features lack client-focus; performance not linked to design requirements; no integration of parts; little or no awareness of constraints* or standards</td>
<td>Product evidences client-focus; meets key design requirements; some system integration; some consideration of realistic constraints*, standards</td>
<td>Product delights client; fully meets design requirements; components skillfully integrated into whole; careful consideration of life cycle issues, constraints* and standards</td>
</tr>
<tr>
<td><strong>ECONOMIC ANALYSIS</strong></td>
<td>Vague estimates of product costs; does not consider other business issues</td>
<td>Reasonable estimates of costs and value to client; markets/users identified for product</td>
<td>Reliable estimates of life cycle costs and benefits to client; markets/business potential defined</td>
</tr>
<tr>
<td><strong>SUMMARY: CASE FOR ADOPTION</strong></td>
<td>Project strengths questionable; serious doubts about project success or business viability</td>
<td>Some project strengths, risks identified; reasonable potential for success and business value</td>
<td>Compelling case for success of project; risks managed; clear, strong business potential</td>
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</table>

* Incorporate engineering standards and realistic constraints that include most of the following considerations: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political.