Guidelines--Tasks for System Integration (Phase 3)

Tasks for project WBS.

3.1 Finalize System Architecture
   a. **Goal State**--System diagram is completed. Each subsystem of the final design is defined in terms of function, interfaces, and interface specifications and these parameters are documented.
   b. **How**--Follow up from design review to resolve issues, and make final decisions. Chapter 9 of your text is also useful.
   c. **Documentation**. Place results (system diagram + details of each subsystem) on web site.

3.2 Create detailed plan/budget
   a. **Goal State**--Detailed plan for remainder of project is completed. Line item budget for rest of project is completed.
   b. **How**. Create the plan using a WBS and a Gantt Chart or other visual. Create the budget by estimating costs.

3.3 Create Design Proposal Outline
   a. **Goal State**--Outline of final proposal is done. This outline has been reviewed with instructors & changes have been made.
   b. **How**--Create main sections and subsection. Identify what you will write about and what graphic elements you plan to use.
   c. **When**--By 12/1.

3.4 Design Proposal--Interim Draft
   a. **Goal State**--Proposal draft is done. This draft has been reviewed with instructors, technical advisors & mentor and appropriate changes have been made.
   b. **When**--By 12/6.

3.5 DESIGN PROPOSAL SUBMISSION DEADLINE.
   a. **Goal State**--Proposals have been delivered to client, instructor, mentor, technical advisor.
   b. **When** COB 12/9/05

3.6 FINAL PROPOSAL
   c. **Goal State**. All client feedback has been incorporated into the design proposal. Needs and specs have been locked (i.e. will not be changed w/o negotiation). Final proposal is posted on web.
   d. **Heads Up**. The final proposal will be morphed into the final report--thus, work on the design proposal helps you get your project done.
   e. **When**. By 1/12/06.
PURPOSE AND CONTENT

Formal written reports are essential communication media for engineering product design and development projects. Frequently, they augment oral presentations by providing the audience important supplemental information. Written reports typically contain information too exhaustive for inclusion in short oral presentations or content relevant to only a subset of the presentation audience. An effective written report will convince decision makers to authorize project continuation based on the compelling case presented.

The design proposal is written at the end of system level design (phase 3). This proposal is foremost a request seeking decision makers’ approval to continue a design project. As such, the report must effectively communicate the credibility and value of a design concept to supervisors, clients, prospective investors, or other decision makers. A credible conceptual design proposal should document the extent of conceptual design efforts, processes used in concept selection and development, key features of the proposed product concept and their relationships to client needs and societal expectations, and evidence of product value to potential users and investors. The quality of the report’s content and presentation will make a statement about the design team’s professional competence, its attention to detail, and therefore, the credibility of the proposed conceptual design.

Conceptual design proposals are substantive formal written documents, the content of which may vary depending upon requirements of clients. Such reports are usually bound or packaged in a way that communicates professionalism and relevance to the intended audience. Guidelines provided below define elements commonly found in written reports prepared at the conceptual design stage of product development. As indicated in the guidelines, some elements receive greater attention than others. The order of different elements in the report will, in general, follow that of sections below, but order may be altered to achieve desired impact.

LETTER OF TRANSMITTAL

The conceptual design report is submitted to appropriate parties 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 also provides decision makers instructions for obtaining additional information and for communicating their response to the design team. This letter is an important entree to individuals who may not have benefited from an oral presentation on the conceptual design.

COVER PAGE

The cover identifies the report and its authors and creates an important first impression regarding its contents. The cover should include the name of the project, its purpose, names of key team members and/or their group/firm, audience, and date of preparation. Graphic identifiers (such as team/firm logo or a representation of the product) add interest and may communicate other values important to the project. An attractive, high quality cover page creates a positive impression about the team/firm and their project.

FRONT MATTER

The front matter in a formal report may include an Executive Summary, Table of Contents, and other relevant materials. 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. These materials should be brief and should not distract the reader from the main body of the report. The Executive Summary is intended to motivate readers to study the full conceptual design report. The executive summary should present a short, powerful synopsis of the report, highlighting important needs, presenting key features of the proposed solution, and delineating salient benefits of the solution. It should
be less than one page in length and address issues of greatest interest to decision makers, including pivotal technical and business merits of the conceptual design, and it should recommend desired responses to the proposal.

REPORT BODY
The body of the report contains an organized presentation of the conceptual design, often arranged chronologically. The body provides the reader an understanding of the overall process and considerations that have yielded the conceptual design, giving credibility to the design team’s understanding of the problem addressed and credence to the solution concept proposed. Content should be relatively inclusive yet brief enough for readability. The body should include selected background information, principal design processes and decisions, and noteworthy features of the conceptual design. However, extensive supporting documentation should be deferred to an appendix or separate volume.

The report body is organized, formatted, and written to meet professional standards of quality. Typical sections within the body include: Background, Problem Definition, Concepts Considered, Concept Selection, System Architecture, Economic Analysis, and Future Work.

Background (1/2 page)
The Background section explains the problem context and presents a justification for directing resources to the design problem. This section describes the present situation, identifies “clients” affected, and postulates opportunities and benefits expected from a viable design solution.

Problem Definition (1 page)
The Problem Definition section states problem needs in terms that establish specific requirements (product attributes or performance expectations) for a high quality design solution. Frequently, this section begins a summary of key needs, a goal statement that concisely defines the purpose of the product development effort, the deliverables to be produced, primary and secondary clients, and key business objectives. This is followed by a list of project requirements and metrics that will be used to demonstrate that these have been satisfied. It also identifies specific constraints and societal expectations that must be satisfied by the design solution. As appropriate, constraints should include: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. Details of the problem definition process, such as the needs document and the specification document, should be left to the appendix. The Problem Definition section summarizes the contractual obligations of the design team relative to the specified product development effort.

Concepts Considered (2-5 pages)
The Concepts Considered section describes the landscape explored by the design team in its search for creative solutions. This landscape includes project learning and it should address both original ideas and those derived from other sources. It should summarize the scope of ideas considered and highlight the most creative and relevant concepts for the overall solution and for its component parts. Because this section reflects the effort of the design team to identify relevant solution ideas, it communicates a message about the team’s expertise and its effort invested in this project. Additional engineering analysis, test results, project learning, alternative concepts may be reported in an appendix.

Concept Selection (1 page)
The Concept Selection section describes the processes and rationale used for selecting the “best” concepts for the overall product (the product architecture) and for the component parts of the design product. It may include summary tables comparing concepts against design criteria (e.g., screening matrices or selection matrices) or summary evaluations of specific concepts; however, more extensive details should be included in a section of the appendix.

System Architecture (2 pages)
The System Architecture section presents the conceptual design and asserts its potential to meet or exceed client expectations, those to be achieved after subsequent detailed design and development. This section describes the selected product concept with its overall architecture and component integration. It also explains how major com-
ponents satisfy important design requirements. Novel features are highlighted to show their potential to outperform competing products. If available, results from component testing or analysis are presented to defend performance claims. Overall, this section must make a convincing case for the technical and functional merits of the design.

**Economic Analysis (1/2 page)**

The Economic Analysis section builds a financial case for continuing product development beyond the conceptual design phase. This case should include a detailed budget, outlining expenses incurred to date as well as anticipated expenditures through the end of the project. This should include estimates of student labor costs ($20/hour) for the conceptual design, detail design, and fabrication phases. These estimates should be validated through consultation with your IEW mentor.

**Future Work (1/2 page)**

The Future Work section sets forth clear recommendations and rationale for project continuation. It summarizes principal technical and non-technical features of the product that satisfy important needs of clients. Any unresolved issues should be highlighted at this time. This section should provide details on the anticipated work schedule and milestones for the next phase of the project. If specific approvals or authorizations are needed for project continuation, this section should request these. Detailed project plans should be placed in an appendix.

**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 be referenced in the report body as appropriate.

**GRADING**

The quality of a conceptual design proposal is determined by its impact on the client and project supervisor. The document must build a compelling case for continuation of the product development effort and leave no doubts about the value of the product or the potential of the design team to deliver the contracted product within the allowed time and budget. The proposal must present a high quality interim product in a very professional manner.

Criteria for measuring the proposal are defined in the table entitled *Measure of Performance in Design* (see next page). This measure will be be used to establish your grade. Your grade will be determined in two areas:

- Overall report quality (see next to the last row in the measure)
- Concept quality (see the last row in the measure)

Grading is done using:

\[
\text{Grade} \, (\%) = 20\% \times (\text{Score on measure}) + 20\%
\]

The table below shows how this formula is applied.

<table>
<thead>
<tr>
<th>Overall score on measure</th>
<th>Grade/Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0+</td>
<td>Honors--100%</td>
</tr>
<tr>
<td>3.75</td>
<td>A--95%</td>
</tr>
<tr>
<td>3.25</td>
<td>B--85%</td>
</tr>
<tr>
<td>2.75</td>
<td>C--75%</td>
</tr>
</tbody>
</table>
### MEASURE OF PERFORMANCE IN DESIGN--DESIGN PROPOSAL

<table>
<thead>
<tr>
<th><strong>Your Score</strong></th>
<th><strong>Scoring Scale</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>1</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>BACKGROUND</strong></th>
<th>Identifies most basic client needs for product; acknowledges few existing resources that may influence the development of a solution</th>
<th>States problem context relative to both client and the state of technology within society; aware of relevant literature, patents, and existing products</th>
<th>Describes and analyzes problem context in terms of clients' needs and societal/global issues; thoroughly analyzes relevant literature, patents, and products</th>
</tr>
</thead>
<tbody>
<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*; includes 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>
</tr>
<tr>
<td><strong>CONCEPTS CONSIDERED</strong></td>
<td>Limited number of useful concepts; do not reflect knowledge of state-of-art; little creativity</td>
<td>Useful concepts for components and overall; reflect knowledge of state-of-art for at least some parts; moderate creativity</td>
<td>Many useful concepts for components and overall; reflect knowledge of state-of-art for all components; significant creativity</td>
</tr>
<tr>
<td><strong>CONCEPT SELECTION</strong></td>
<td>Vague process to select concepts; little record of decision making process; poorly-defined criteria</td>
<td>Rational, documented process to select concepts; clear measurable criteria in making design decisions</td>
<td>Quality client-focused process for selection; fully documented; clear quantitative and qualitative criteria</td>
</tr>
<tr>
<td><strong>PRODUCT ARCHITECTURE</strong></td>
<td>Product features lack client-focus; performance not linked to design requirements; no integration</td>
<td>Product evidences client-focus; meets key design requirements; some system integration</td>
<td>Product delights client; fully meets design requirements; components skillfully integrated into whole</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 identified for product</td>
<td>Reliable estimates of life cycle costs and benefits to client; business potential well-defined</td>
</tr>
<tr>
<td><strong>CASE FOR CONTINUATION</strong></td>
<td>Project strengths unclear; serious risks to project completion or to business viability</td>
<td>Project strengths and risks identified; reasonable potential for project success and for business value</td>
<td>Compelling case for success of project; risks managed; clear, strong business potential</td>
</tr>
<tr>
<td><strong>OVERALL REPORT QUALITY</strong></td>
<td>Conceptual design is incomplete or meets few design requirements; little or no evidence justifying product financially; report is incomplete, unattractive, can be misunderstood, has distracting errors</td>
<td>Sound conceptual design meets most design requirements; some indication that product will be economically feasible; report is complete, understandable, attractive, few flaws</td>
<td>Innovative and competitive conceptual design meets all design requirements; credible evidence that product will be financially successful; report is very complete, very clear, compelling</td>
</tr>
<tr>
<td><strong>CONCEPT QUALITY</strong></td>
<td>Team partially understands needs of clients; concept not viable; does not address some important criteria*</td>
<td>Team understands main technical and non-technical needs of clients; concept plausible, addresses most crucial requirements, constraints*</td>
<td>Team fully understands diverse needs of clients, society; concept innovative, viable, satisfies all requirements and constraints*</td>
</tr>
</tbody>
</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.