

Design Handbook Student Guide

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Background

Design

Design is defined by Webster's Collegiate Dictionary as *To conceive in mind; invent; To form a plan; To create or execute in a highly skilled manner; A reasoned purpose; intention; Details of something according to a plan.* Design is a basic activity found in many disciplines ranging from fashion design to landscape design to sculpture design to engineering. So the question can be asked, what makes Engineering Design different from design found in other disciplines? The basic answer is unlike other disciplines, Engineering Design predicts behavior and solution success before implementation.

Engineering Design

Engineering design is a field of knowledge that does not require artistic skills, but does require specific study. It is a systematic approach that uses five technical assumptions;

1. The problem can be broken down into its components or sub-problems
2. Properties and responses are explained in the natural sciences
3. Functional requirements of the problem maintain their independence
4. Components of the problems are based on principles found in the natural sciences
5. Behavior is predictive and therefore can be optimized

Educational approaches to engineering design can take two paths; the Algorithmic approach and the Axiomatic approaches.

Algorithmic design is a process that uses a prescribed set of design steps for specific situations. Design for assembly is an algorithmic design approach where the engineer tries to optimize the manufacturing of products. In general, the algorithmic approach can be divided into the following activities

- Pattern recognition
- Association/memory
- Analogy/similarity
- Experientially based direction
- Extrapolation /interpolation
- Selection of approach based on probability of success.

A trial-and-error period is necessary so the inexperienced engineer can build a repertoire of algorithmic approaches and solve several engineering problems.

Axiomatic design is a process that follows general principles found in any engineering design activity, that can be done without regard to application and that involves an interplay between

- The Functional Domain (What is to be done; Consist of functional requirements)
- The Physical Domain (How to do it; Consist of concepts/solutions) and
- The Process Domain (the Process to construct; Consist of the manufacturing/fabrication process).

This design approach concentrates on two issues, the functions that the solution must perform and the constraints that bound the functions. However, Axiomatic design requires that the engineer not only identify the functions but the engineer either keep the functions independent of each other when developing the design solution or develop a priority for each function so failure of one function minimally affects the other functions. Mathematical techniques can be used to achieve this requirement and can be

taught in the classroom similar to methods used to teach engineering science subjects.

Accreditation Requirements

The development of design skills is so critical to the engineering profession that A.B.E.T.¹ has mandated that an *accredited engineering program must incorporate one and one-half years of open-ended design experiences in the curriculum. This design experience must be found throughout the curriculum and must culminate in a major project that*

- *requires the knowledge and skills acquired in earlier course work and*
- *incorporates engineering standards and realistic constraints that include the following considerations:*

<i>Economics</i>	<i>Environmental</i>	<i>Sustainability</i>	<i>Manufacturability</i>
<i>Ethics</i>	<i>Health and Safety</i>	<i>Social</i>	<i>Political</i>

The UGA engineering curricula are structured so that two major thrusts are used to help undergraduates develop suitable design skills and gain design experience. One thrust, considered part of the core curriculum, uses three engineering core courses where the general philosophy of engineering design is presented and then built upon. The other thrust uses courses that are found in the UGA engineering programs' areas of emphasis. In this thrust, design activities are related to industry applications that are specific to a given engineering field.

Engineering Design Project (ENGR 4920)

A.B.E.T. specifies that an engineering student's academic career should conclude with a major design experience that integrates all knowledge and skills developed throughout the engineering program of study.

The UGA engineering curricula meet this requirement with ENGR 4920. The learning objectives are

- Integrate knowledge and skills developed in the engineering degree program,
- Apply engineering, mathematical and natural sciences in the development of a product,
- Use of experiments or analysis of published results for development of design criteria,
- Develop quantitative design criteria that include realistic constraints,
- Apply creative thinking techniques for the formulation of conceptual solutions,
- Apply the logical steps of design evaluation,
- Demonstrate the proper use of documentation,
- Demonstrate their mastery of communication skills, and
- Engage in self-learning.

Students participate in teams to develop solutions to open-ended design problems that commonly solved by professional engineers. Independent work is expected although some guidance from a faculty instructor is provided.

Overview of the Design Process

¹ A.B.E.T: the Accreditation Board for Engineering and Technology

Design is a feed-back process with distinct engineering activities (Figure 1). The outcome from an activity may require the engineer to develop further clarity of the problem and go back to *Understanding the problem*, the first of the five activities; or the outcome from an activity may be refined enough to allow the engineer to move forward to the next activity. The following paragraphs provide more details about these five activities.

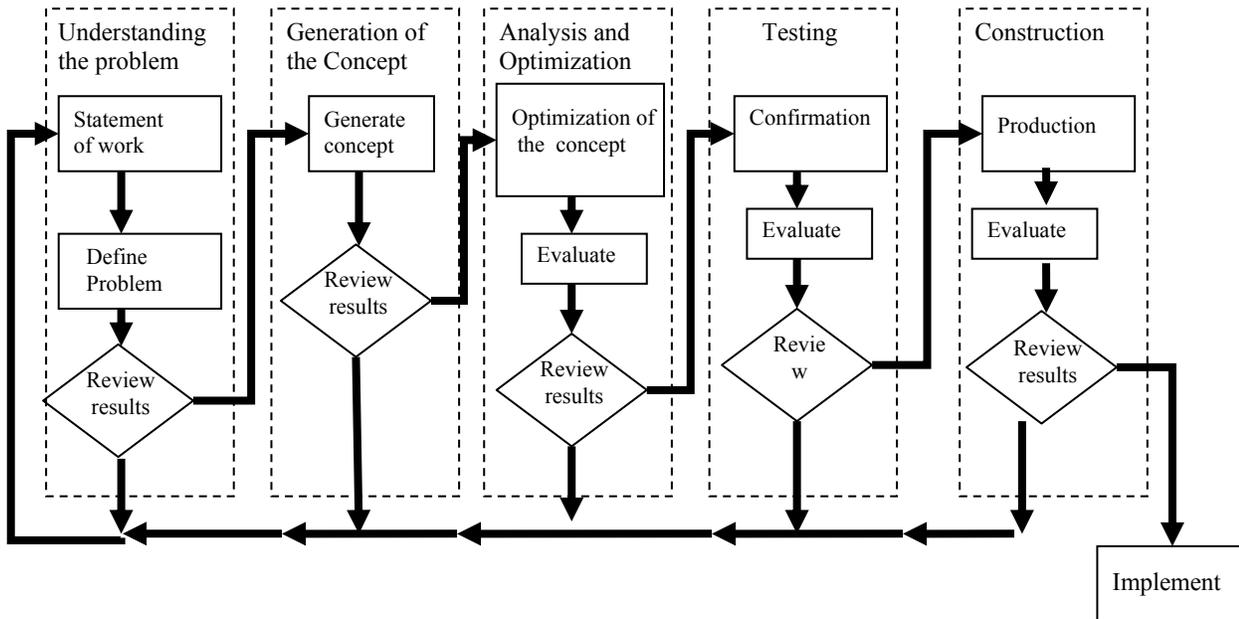


Figure 1 Design is a feedback process that involves five engineering activities

Understanding the problem

This activity involves the transformation of the often nebulous facts into a coherent problem definition such that the engineer fully understands “*what exactly is to be solved*”.

A *Statement of Work* needs to be developed that puts the client’s needs into a framework that drives the design process and that is used to keep all people working on the project focused on a given task. Key motivations for this statement are

- to identify stakeholders² who are affected by the statement of work,
- to learn the stakeholders’ perceptions about the statement of work,
- to research and learn what is already known about the statement of work and
- to identify the functions and scientific principles associated with the statement of work.

The *Problem Definition* activity involves the development of the functions that need to be accomplished in order to solve the design problems and to develop the constraints (bounds) placed on each function. This activity determines the remainder of the design process and thus time must be dedicated to insure

² A stakeholder is someone who uses, affects the use of or affects the development of a design solution. A stakeholder can be defined as a focus group who represents a population, as an expert who represents the interest of non-human entities such as the environment, as the administrative authority who is funding the development of the solution, just to name a few.

that a complete definition is developed. Initially, the engineer should work with the stakeholder(s) to develop the criteria used by the stakeholder to scrutinize the success of the final design solution (this set of criteria is called the *stakeholder problem definition* which is often expressed in qualitative form). The engineer then needs to transform the stakeholder criteria into a set of criteria used by the engineer to scrutinize the success of the design solution (this set of criteria is called the *engineering problem definition* which consists of functional requirements and measurable constraints)

The engineering problem definition is critical to several activities found in the design process. The functional requirements and measurable constraints are used to analyze, optimize, and predict the design solution.

Generation of Concept

This activity is the creative process that transforms the defined problem or “what is needed” into conceptual solutions or a proposal of “how to solve the need”. There is a constant interplay between *Understanding the Problem*, *Generation of the Concept* and the next activity *Analysis and Optimization*. Each time that the concept is cycled through these three activities, the solution becomes more mature.

Analysis and Optimization

This activity takes the conceptual solution and refines it in a detailed solution. However, there is a distinct interplay between this activity and the previous two. During the first iteration, optimizing the concept solution may simply involve comparing the concept to the engineering problem definition. As the number of iterations increases, the solution will take on system-level characteristics that are overviews of the design. In order to optimize the solution, simple models that integration of the mathematical, natural and engineering sciences will be required. As the iterations or interplay between the *Understanding the Problem*, *Generation of a Concept* and *Analysis and Optimization* continues, precise models are generated which involve greater use of the mathematical, natural and engineering sciences, and details of the solution’s smaller components are developed. The interplay between the *Understanding the Problem*, *Generation of a Concept* and *Analysis and Optimization* continues until the solution details allow the development of mechanical drawings, etc. At this point, the process can proceed to the fourth activity, *Testing*.

Testing

This activity involves checking the solution against the original problem definition (stakeholder and engineering definitions), confirming assumptions made during the analysis/optimization activity and identifying problems related to use and production. This activity commonly involves computational simulation, prototyping and field testing.

Construction

This last activity relates to the construction of the solution and eventually the release of the solution for the benefit of society. However, construction practices may result in a re-design of the solution.

Concurrent Design

The design process has been described above as a linear series of activities (Figure 1). If the design

engineer has sufficient knowledge to manage the entire process, then this linear approach can work effectively. However, the complexities of a global market and the rapid advances of technology have made it extremely difficult if not impossible for a single person to have the knowledge needed to manage the entire design process. As a result, the linear approach to the activities of design results in inefficient use of resources.

Concurrent design is an approach that allows design activities to be done (Figure 2). [Concurrent design is taught in the 2nd year course Design Methodology]. Thus, decisions made during the *Understanding the Problem* activity must also consider downstream activities such as construction. The use of concurrent design results in a shorter solution-development time, less resource requirements and better quality control.

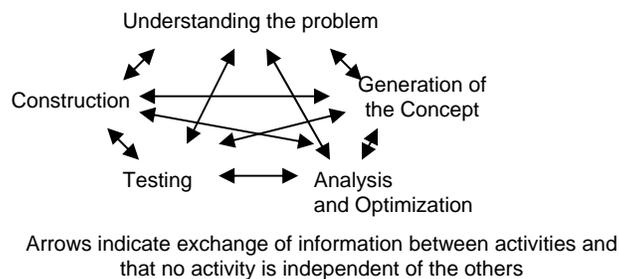


Figure 2 Concurrent design allows the five engineering activities to evolve simultaneously

Critical components of concurrent design are strategic planning, cross-functional teams and vendor partnering. Strategic planning (detailed below) is used to identify, develop and secure resources needed to complete the design process and is used as a map showing how to schedule the 5 activities of design. A cross-functional team consists of members who have expertise in one or more design activities and who may serve on the team only when needed. It is important that members of the team have the authority to make decisions with little or no consultation with other team members, but it is very important that all team members must be aware of all activities being conducted on behalf of the team. Vendor partnering refers to the need to make vendors quasi- members of the cross-functional team. Vendors can provide technical expertise and can assist in the selection of components.

Strategic Plan

Successful use of the concurrent design approach requires a solid foundation for sequencing of the 5 design activities, for determining the resources needed for each activity, for identifying the cross-functional team member responsible for specific activities and for the efficient and effective exchange of information among team members and others involved in the design process. No matter which method is used to sequence the design activities, each sequence of events needs to have the following information; task, objectives of the task, estimate of time and resources needed for the task, tasks sequencing and task cost. In the Design Methodology course (ENGR 2920), UGA engineering majors are taught to use Gantt Charts (Figure 3) for strategic planning.

Task	Objective	Resources	Weeks into the semester				
			1	2	3	4	5
Understanding the problem	1. Develop statement of work		█				
	2. Develop stakeholder and engineering definition	Design Engineer: 100% of time Marketing manager: 30% of time Production engineer: 10% of time Travel Time: 16 hours Clerical Support: 10 hours	█	█	█		
	3. Develop functional requirements and constraints of the problem			█	█		
Concept Generation	4. Develop 20 concepts for each identified functional requirements					█	
Develop field testing protocol	Research standardized test methods	Engineering Technologist: 50% of time Quality Control Engineer 50% of time	█	█			
	Establish test method	Engineering Technologist 5% of time Clerical Support: 30% of time Quality Control Engineer: 100% of time				█	
	Secure user and test site	Field technical 100% of time Clerical Support: 30% of time				█	█

Figure 3 Example of a Gantt Chart (only partially completed)

ISO 9001 and 14001

The International Organization for Standards (ISO) has established design procedures that a majority of companies use for quality assurance practices. ISO 9001 outlines information, documentation and other activities needed for quality assurance in design, production, installation and servicing of new products. ISO 14001 outlines information, documentation and other activities needed for environmental sustainability. Efforts are being made by the engineering profession to align ISO 9001 and 14001 into a single procedure. To prepare the UGA engineering student for the global marketplace, ENGR 2920 teaches the design process as outlined in ISO 9001 and ISO 14001.

ISO 9001 and ISO 14001 require that the design process must

1. identify the human and non-human stakeholder(s) involved or impacted by an activity,
2. identify representatives for stakeholder groups,
3. identify the needs and expectations of the stakeholder related to the activity,
4. transform the stakeholder needs and expectations into realistic and measurable design constraints,
5. show that the solution meets the Stakeholder requirements,
6. establish procedures to ensure the quality/environmental sustainability are met,
7. formulate objectives of each design activity,
8. demonstrate a plan to achieve the objectives, to manage the design activities and to define responsibilities of the participants,

9. demonstrate a plan to communicate with stakeholders throughout the design process,
 10. legally document and maintain records of activities,
 11. have procedures for reviewing activities, and
 12. analyze and verify all decisions and solutions.
- Strict documentation procedures also are required.

Design Notebooks

ENGR 2920, Design Methodology, extensively covers the proper procedures for maintaining design notebooks and the use of notebooks for obtaining patents. Students are provided with a list of rules for design notebooks and these rules are given in Table 1. Proper use of the design notebook should provide the instructor with evidence of logical and chronological progress toward a project solution and of the contributions made to the project solution. Much of the information provided in the notebook will not be found in other design documents such as progress reports or final reports. A good notebook is one that can be used to reconstruct work even years after the original project has been completed. The 2003 A.B.E.T. Review Team encouraged the use of design notebooks as a means to monitor student progress and to provide proof that Program Objectives are being met.

Besides showing the use of the mathematical, natural and engineering sciences, notebooks should show evidence that the student used engineering standard practices, incorporated environmental, manufacturability, political, economical constraints, and considered the solutions effects on sustainability and public health.

Technical Reports

The results of any design activity are not complete unless they are communicated to other team members, the supervisor of the design team, the clients and others associated with the design. Such communications should be done by written reports and oral presentations. Students enrolled in ENGR 4920 are required to prepare a final report that includes all specifications needed for fabrication of the design solution and to make two oral presentations (one status report near the mid-point of the semester and one final report at the end of the semester). Other methods of communication may be required by your instructor.

Guidelines for these communications are

- Understand the recipient
 - who is the audience and their level of technical understanding
 - How does this audience understand the best
- Carefully consider the order of presentation
 - what is the purpose of the presentation
 - what are the important points to be made

The Appendix has formats and examples that you should consider using.

Progress Reports:

The engineer needs to communicate, regularly, with managers, customers and team members. This communication is in both the oral and written form. Written progress reports are an excellent method to document and insure that everyone understands the status of the project. Progress reports should

- provide an overview of the overall objectives of the project
- provide the objectives of the task done during the reporting period
- provide the results of the task
- provide interpretation of the results
- provide guidance on how this interpretation provides progress

Detailed Reports

Formal reports are used to provide detailed information about the project, are aimed at an audience with a wide range of technical backgrounds, and should be stand-alone documents. The format of these reports include

- | | | |
|--------------------------|------------------------|-----------------------|
| 1. Letter of Transmittal | 2. Title or Cover Page | 3. Executive summary |
| 4. Table of Contents | 5. List of Figures | 6. List of Graphs |
| 7. List of Tables | 8. Acknowledgements | 9. Body of the report |
| 10. Appendix | | |

The Appendix has the format of these reports. These reports should include drawings or other documents that allow for the “construction” of the solution.

Appendix

Outline of a progress report

MEMORANDUM

To:
From:
Date:
RE:

Goals/Objectives

Less than six sentences

Objective: state the purpose of the report and work and how it affects progress of the project

Work Accomplished

Two to three paragraphs

Objective: explain the nature and scope of the work, problem areas, depth of findings, techniques used

Goals for next reporting period

Objective: explain the activities for the following period and how it affects the project

Resources Needed:

Objective: conclude with specific suggestions on a course action

Outline Format of a Formal Design Report

Sections prior to the body of the report should include

- Letter of Transmittal (one-two pages maximum)
- Title or Cover Page
- Executive summary
- Table of Contents that includes the location of figures, graphs, tables, etc
- Acknowledgements

The body of the report should include the following

<p>Introduction or Background <i>Objective: Define market, opportunities, goals and resources, tell reader what exactly is being solved</i> Section needs to include 1) market need and/or opportunity 2) statement of work or problem identification, 3) stakeholder identification, 4) general resource requirements</p> <p>Problem Definition/Design Specification <i>Objective: Identify constraints and functional requirements</i> Section needs to include 1) stakeholder definition, 2) engineering definition that include constraints and functional requirements, 3) benchmarking constraints</p> <p>Conceptual Design <i>Objective: Provide an overview of the preliminary design solution without getting into details (use sketches to help describe the idea)</i> Section needs to include 1) an overview of the concepts developed, 2) evaluation of concepts, 3) selection of final concept and relationship to engineering definition, 4) overview of the final concept including a description of key characteristics and/or components</p> <p>Optimization and analysis of the solution <i>Objective: Design and develop product that meets problem specification and develop process for manufacturing final product (use drawings to help communicate the idea)</i> Section needs to include 1) identification of critical components/processes, 2) critical theories, principles, etc. used in engineering analysis, 3) results of the analysis or evaluation, 4) confirmation of results, 5) conclusions relating results to design solution</p>	<p>Testing and Design Improvement <i>Objective: Verify design assumptions and design effectiveness</i> Section needs to include 1) identification of testing method or procedures, 2) results, 3) confirmation of results, 4) conclusions relating results to design solution</p> <p>Construction <i>Objective: Describe how to manufacture the product</i> Section needs to include 1) the description of manufacturing techniques, 2) drawings needed to manufacture the design solution</p> <p>Cost of the product <i>Objective: Describe the cost to produce the solution</i> Section needs to include 1) development cost, 2) direct production cost, 3) indirect production cost</p> <p>Solution's benefit to society <i>Objective: Impact of the solution issues</i> Section needs to include the impact on 1) environment, 2) society, 3) political issues, 4) public health and safety</p> <p>Ethical Issues <i>Objective: Identify any conflict of interest or ethical concerns related to the solution and/or its development</i></p> <p>Recommendations <i>Objective: Corrective actions plan</i></p>
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Sections after the report include

- Figures
- Graphs
- Tables

Mechanical Drawings

Appendix (The objective of the appendix is to provide information that supplements the report, but should NOT include materials that have to be read in order to understand the report)

Cover Page

PROJECT TITLE
(Give your project a title that identifies problem area)

for
CLIENT NAME
CLIENT ADDRESS

by
LIST OF DESIGN TEAM MEMBERS AND THEIR ADDRESS

Name of Faculty
Address

DATE

Letter of Transmittal

This letter is addressed to the person, agency, institution or company that is sponsoring the project and should identify the purpose of attached documents or reports. It is important that this letter summarizes the project. The letter should always be signed and your signature indicates that you acknowledge your responsibility for the contents of the letter. Only a signed document is acceptable since an unsigned document will be considered a draft or other unofficial or unauthorized version. All team members responsible for the work or design solution should sign the letter. The following format should be used.

Name of Design Team

Address of team

Date:

Re: Subject of this letter

Dear ,

Introduction (Paragraph 1); Tell the reader that accompanying the letter he or she will find the article you produced on Topic X, as agreed upon by the two of you.

Body (Paragraphs 2-?): In one or two paragraphs, add any details about the article you believe to be necessary.

Conclusion (Paragraph): Thank the reader for his or her willingness to publish the article. Give contact information.

Sincerely

Signatures of team members

Name of team members

Abstract

An abstract differs from an Executive Summary in that it is a synopsis of the full report and it focuses on the same issues as the full report. The purpose of the abstract is to give an overview of the work and should help the reader decide whether the full report should be read. The content of abstract should be sufficient to help the reader put the details of the full report in perspective. As with the Executive Summary, abstracts should be clear, concise and convincing. An abstract should start on a new page, and nothing else should appear on that same page.

Executive Summary

This executive summary should focus on issues that management will use to make decisions about the fate of the project. Conclusions of the work or solution and recommendations related to the solution are to be given. Details should be given if they are unusual or unexpected. The summary should tell the reader what was done, what was concluded and what is recommended for future activity. The summary should be clear, concise and convincing. Graphs, tables and figures can be used in the executive summary but should not compromise the length of the summary. The executive summary should start on a new page, and nothing else should appear on that page.

Examples

Executive Summary

Canine Artificial Hock Joint

The University of Georgia College of Veterinary Medicine has contracted with four Biological Engineering students to re-design the existing UGA hock implant. The objectives of this new design is to lower the current cost of the implant, increase tibial stability, reduce the removal implant wear, reduce stress shielding, promote increased bone in-growth and increase the life of the implant. Overall, all objectives are met pending animal trials to verify the engineering predictions.

The final design solution focused primarily on material problems associated with the tibial tray component. A new tibial tray design includes the use of TI-6Al-4V coated with 0.9 μm hydroxyapatite beads. This new design will promote bone in-growth and should stabilize the component within a 2 month healing period. Full weight bearing should occur within one month although live animal trials must verify this prediction. Prototype production of this tibial tray for configuration can be accomplished using the CNC machinery located in the Driftmier Engineering Center. Prototype production for animal trials should be assigned to a third party at an approximate cost of \$2500.

To increase the life of the implant, to reduce friction between major components and to reduce stress shielding, the new design incorporates a middle component that fits between the femoral

and tibial parts. This middle component is to be made of ultra-high-molecular-weight polyethylene (UHMWPE). ASTM Wear Test procedure of the UHMWPE indicates that the new middle component design increases the implant life to 10 years. Prototype production of this component can be accomplished with the Straunt Rapid Prototype Machine owned by the University. Cost of this production is approximately \$550 for a 60 pound dog.

Literature and other documents indicate that proper installation of the implant affects 60% of the life of that implant. Therefore, the design team recommends an expansion of the project to include the design of a surgical template which will assist surgeons during initial implantation. Time needed for the development of this template should be less than 40 working hours. The design team also recommends live animal trials in order to confirm some assumptions made in the development to this solution. Approximately, six trials will be needed and each trial should last six months. Cost on a per dog basis, assuming 50-70 pound dogs, will be \$900 excluding the cost of the animal.

Total cost for production of a prototype and for conducting live animal trials is approximately \$6700 excluding the cost of the dog.

Letter of Transmittal

Steven Budsberg, D.V.M.
Small Animal Department
The College of Veterinary Medicine
The University of Georgia
Athens, Georgia 30602

Re: Design of the Artificial Canine Artificial Hock Joint

Dear Dr. Budsberg,

The accompanying report provides design details for the canine artificial hock joint project. This report includes design specifications, an overview of the concept, detailed analysis and descriptions of critical components, results from prototype testing, cost analysis for producing the product and mechanical drawings for production.

The final design introduced a new wear resistant middle component that allows better friction control between the tibial and femoral plates and improved manufacturing procedures for promoting implant bone in-growth. The design team will be happy to make engineering notebooks available to you if you wish to review engineering calculations and other analysis used in the development of the design. Patent information will be housed at the University of Georgia Research Foundation facilities pending review by the UGA Patent Office. The prototype currently is housed in the Gait Analysis Laboratory Driftmier Engineering Center and is available for trial implantation.

The design team would like to thank you for sponsoring this ENGR 4920 Project and for all of the assistance that your department provided. We hope that this design fulfills the medical needs of the UGA Veterinary Clinic and look forward to seeing this design solution used at other facilities. If you have any questions, please contact Melanie Moss in the Engineering Academic Office, 120 Driftmier Engineering Center, The University of Georgia, Athens, Georgia 30602. Ms. Moss has the telephone numbers and addresses of each member of the design team.

Sincerely,

James Kuman, Megan Dawson, Lindsay Shauber and Shannon McAdams

Progress report

MEMORANDUM

To: James Dooley, President
Silverbrook Limited, Federal Way, Washington

From: I.M. Hipp, Design Engineer
Thompson Consulting, Conetoe, NC

Date: 1-25-95

RE: Wildlife Friendly Fence Design: Bi-weekly Progress Report for period ending 1-23-95

Goals/Objectives

The design team's primary objective for the last two weeks was to understand the functional requirements of the design. The specific objectives delegated to me were to understand the design constraints associated with endangered species particularly the *Pleurocera Acuta*.

Work Accomplished

Based on data gathered from Don Herring of the Harrington Company, the functional requirements associated with the field-to-field cross over lanes were identified. Water transfer rates and grass density appear to be key functions that can not be disturbed if the migration of the *Pleurocera Acuta*. Mr. Herring provided a list of stakeholder constraints which are too numerous to include in this report. However, the cost of the final product appears to be more flexible than previously indicated.

Communication with wild-life and environmental engineering scientist at NCSU has revealed a current product that might be available for solving this design problems. Due to proprietary constraints, the specifics of this product have not been obtained but each faculty member is willing to discuss options.

An Internet search has provided some data related to the project. However, verification of the accuracy of this data has not been accomplished and thus, the results of the search have not been incorporated into the current design activities.

The design team has conducted a Functional Decomposition (FD) of the project and these results will be reported by the team manager.

Goals for next reporting period

Meetings with the NCSU faculty have been arranged for February 1st. It is anticipated that this meeting will result in the team's ability to assess a current product which may solve this problem. My specific task will be gather more research information on the *Pleurocera Acuta* and verify the results of the FD activities.

Resources Needed

A request for assistance has been forwarded to the clerical department. It is anticipated that 8 hours of staff time will be needed to conduct literature searchers. Approximately \$250 needs to be allocated for travel to NCSU for consultations and access to library resources.

Not a suggested style for a progress report

MEMORANDUM

To: James Dooley
President
Silverbrook Limited,
Federal Way, Washington

From: I.M. Hipp
Design Engineer
Thompson Consulting
Conetoe, NC

Date: 1-25-95

RE: Wildlife Friendly Fence Design: Bi-weekly Progress Report for period ending 1-23-95

On Monday January 13th, I toured the Harrington Company facilities and interviewed Don Herring. I asked him questions about the qualities that he wanted in the Wildlife Friendly Fence and he gave me the state regulations for the endangered *Pleurocera Acuta*. I was able to generate some project objectives and arranged for the design team to meet with Mr. Herring.

On January 16th, and 18th, I traveled to NCSU and located several researchers who were interested in this project. I was able to ask each of them questions concerning the "wants" of this type of design. I am still waiting for a response from two of these people.

Two other team members and I conducted an INTERNET search on January 19th and located two interesting articles. These articles are described in my design logbook. Later that day, we held a team meeting and shared information gathered during the week. A final list of engineering definitions was developed for the project.

I also conducted research in the library on the OSHA requirements for the project. These requirements are taped in my design logbook. Our group met on January 22nd and conducted a Functional Decomposition of the project. We divided sections of the Functional Decomposition among the team and developed a detailed FD. During the weekend, the team brainstormed possible design concepts using this detailed FD.

In the coming weeks, I will continue researching the various OSHA regulations and continue my email conversations with the professors interested in the design. Our team will meet again on January 26th.

POSTER GUIDELINES

The poster

- Should emphasize the use of engineering to solve the problem
- Provide an explanation of
 - The problem
 - Functional requirements
 - Constraints
- Be written so that the reader can be grasped quickly and easily
 - Theories and analysis used to solve the problem
 - The final solution
 - Fabrication/manufacturing of the solution
 - Cost of the solution
 - Impact of the solution

Poster Organization

- There is a clear and concise statement of the problem
- One short paragraph or list for each subheading
 - Summary
 - Problem Definition
 - Conceptual Solution
 - Analysis and Optimization
 - Final Solution/Design
 - Construction (or fabrication, manufacturing, etc)
 - Cost
 - References/Acknowledgements
- Organization is logical with a clear flow of ideas from one heading to the next
- Use of color and design attract attention to major ideas
- Title and Team Members (sponsors)

Text

- Text is an appropriate size for viewing from a comfortable distance
- Sufficient content is given to understand the importance of the problem
- Methods, results, and conclusions are easily understood in a reasonable amount of time
- Details are adequate to convey the main idea
- Correct use of grammar

Visuals

- Adequate visuals are included to communicate the subject (use pictures, figures, charts, etc to help explain ideas, analysis, etc)
- No unnecessary visuals are included to complicate interpretation of crucial ideas
- Visuals are attractive and of high quality
- Visuals stand alone (i.e. self explanatory)