Designing Engineering Proposals

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January 14, 2010

Three-Step Process for Proposals

- Understand the format
- Develop the text
- Edit the “writing”

Understanding the Format

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Purpose of using proposal format

- Offering to perform *specific* work for a client
- Presenting all the information & details needed to enable the client to make a *confident* decision
- Shaping your offer as the most suitable "*fit*" for the project/need

Identifying proposal format

- Technical reports: IMRD
  - Introduction
  - Materials & Methods
  - Results
  - Discussion

- Proposals: IMRD (+/-)
  - Introduction
    - Purpose /Objectives
    - Background
  - Methodology
    - Proposed Work
    - Explanation of choices by evaluating outcome
  - (Timeline)
  - (Costs)

Using effective layout

- Begin with adequate type size & font/correct margins/clear headings/usable visuals
- Include all required parts
    - Forematter: Letter of Transmittal & Executive Summary
    - Main Text: Introduction + Background & Proposed Work + Deliverables
    - Management: Schedule/Budget/Terms & Conditions
- Mark sections clearly: informative headings
- Separate paragraphs with clear openings for each

Developing the Text

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Designing the "openers"

Letter of Transmittal

- Direct statement of the purpose of proposal
- Describe the project objectives
- Reasons plans are effective, proposal a reasonable "fit"

Executive Summary

- Goal expected for this problem/situation (opportunity/constraints/assumptions)
- Key features of planned process/solution & the supporting details
- Explanation of why specific choices

Constructing the main text

- Identify exactly what propose to do
  - Describe by type: performance/process/product
  - Present as concrete & measurable
- Define what methods will be used
- Detail what activities will take place & which resources be used
- Clarify where work begins and where ends

Confirming the details

- Provide clear statement of the management details, usually as a figure (list or table), for the areas shown below:
  - Timing
  - Costs
  - Terms & Conditions
- Use informative headings and adequate labels on figures to permit easy reading (scanning)

Editing the “Writing”

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Section identification

- **Informative heading**
- **Adequate text**—as much as is needed to make the section content clear
  - Argument for point of view
  - Details of process or product
  - Procedures involved
  - Extent of work (coverage)

Section development

- Name the **concept** or idea concerned here
- Make a **claim/assertion** about the concept
  - What it adds
  - Why it's included
  - How it relates to the overall proposal
- Present **evidence** to support claim/assertion
  - Begin with most important if possible
  - End with least—unless other order needed
  - Any references noted to reinforce conclusions
- Add **visuals** to clarify/strengthen/complete

Paragraph identification

- **Every paragraph** (**EPp**) presents knowledge about a key point
- **EPp** Sticks to one point at a time
- **EPp** features concepts instead of actions or events
- **EPp** uses a Core Sentence to direct attention to the conclusion desired

Paragraph development

- **Beginning sentences** focus the reader's attention on what is learned at this point
- **Sentences** link from the end of one to the beginning of the next
  - Reference by repetition/relation/difference/degree of connection
  - Shows logical development
- **Total of sentences** only that necessary to cover the ideas being presented for purpose

Sentence identification

- **Concept sentences**
  - Used to designate "what" is being talked about
  - Concerns idea (concept), not a person or event

    Ex.- "Increasing the size of the membrane provided increased flow of … ." instead of "The next step was to increase the size of the membrane to provide … ."

- **Expansion sentences**
  - Add "how" and "why" to the original "what"
  - Relate to the featured concept—reinforce/modify/extend/contrast

    Ex.-"The timing alteration resulting from the increase allowed …, and reduced the overall length of processing from … ."

Sentence development

- **Comprehensibility**
  - correctness of structure (what is understood by people who read the language)
  - Idiomatic phrasing (familiar but not casual usage))
- **Readability**
  - Clarity of phrasing (avoiding overuse of description and other modifiers)
  - Efficiency in number of words used (conciseness)

Reviewing the Outcome

Assessing Proposal Content

- **Rationale:** degree to which the statement of the problem or opportunity makes sense to client
- **Methodology:** technical merits of the work proposed
- **Outcomes**: usability of the work proposed
  usability of the work proposed
- **Management:** effective use of personnel/time/resources

Assessing Communication Skill

Structure
- Organization illogical
- Assertions not supported
- Coverage lacking
- Section transitions unhelpful
- Discontinuity overall

Form
- Format not followed
- Major sentence error (RO, Frag)
- Grammar error
- Punctuation error
- Usage error

Language
- Audience can't follow
- Tone level too casual/formal
- Sentences ambiguous
- Wording needlessly complex
- Sentence informativeness lacking

Visuals
- Illustration not introduced
- Illustration misplaced
- Illustration not captioned

Executive Summary

This project involves the design and implementation of an interactive immersive virtual reality system allowing rapid high-resolution rendering of large scale datasets including, but not limited to, astronomical, biomedical, and seismic data. The purpose of the project is to study how large sparse datasets can be rendered interactively, and how the user can be enabled to effectively navigate large, mostly empty spaces without getting lost in a void and by maintaining precision in the navigation when needed, that is in the proximity of the object. A prototype implementation of the system framework will be applied to 3D models of different datasets featuring … Spatial and temporal scaling issues, which are essential to the study due to specifics of sparse data processing, will be addressed; a dynamic navigation method will be developed, with scaling parameters readjusting in real time for efficient representation of the data.

Techniques employed in the design of this system can potentially be used to build scalable, easily navigable and extensible models of large-scale entities. During the study, the following data models will be used: … these data sets are available and share the same properties: large size and sparsity. The system will be designed as an intuitive simulation tool, helpful in identifying novel approaches for control and visualization in such applications as simulated space flights, cardiovascular disease treatment, and earthquake ground motion and structural response analysis.

Introduction

Use of truss lattice structures in aircraft wings, ship hulls, and submarines is promising because they dramatically improve fuel efficiency over that of solid steel. The NAVY is particularly interested in the class of materials out of need for more blast-resistant marine vehicles. All of these applications dictate that the most important consideration in the design of truss lattice structures is resistance to bending. In response to this, our research will examine of leaving the ceramic foam in the panels after processing. The presence of this very lightweight material can provide a significant increase in the buckling stiffness of the core members, and may dramatically improve the mechanical properties with only a small weight penalty.

(Section of Introduction providing background)

Recent research has led to a new class of sandwich structures with cores made of truss networks of small diameter. These cores can perform better in compression and shear at equivalent weight, if the core is designed properly. A key concept is to design the cores to respond to panel loading so that the individual core elements are loaded in compression or tension – not bending. These new structures have cores that are open (as opposed to closed, sealed cells in the honeycomb materials) that enable ‘multifunctional’ use of the lightweight structures. For example, in addition to supporting mechanical loads at minimum weight, the structures can act as efficient heat exchangers, using cooling air flowing through the core. This multi-functionality makes these materials quite promising for future use.

An alternative processing approach for truss core panels has been developed where a high temperature, ceramic insulation material (foam) is used to support the pins at a designed spacing and angle during brazing in a vacuum furnace. To date, research has been initiated to find the ideal geometric arrangement of pins in the foam (3). Some panels have been made with the pins in a pure pyramidal arrangement (1). Theoretical formulas have been put forth that compare the mechanical performance of alternative designs and arrangement of the pins in the structures (2). However, these designs have not yet been manufactured and tested. The research I am proposing will begin to do that.

Work Proposed & Deliverables (product)

In order to produce an ideal facility layout, several Industrial Engineering tools, such as computer simulation and analytical models to include relationship diagrams, will be used to analyze data provided by Company X to better understand the interdependent relationships between departments and processes within the widget repair process. This analysis will be used to produce a layout which will aid in making the repair process as lean as possible. Next, the proposed layout will be modeled by the simulation package, Arena. An Arena simulation will account for many real-world variables, be flexible in both the design and analysis of a layout, and will produce an accurate estimate of the facility's capabilities. Lastly, Arena will be used to simulate batch sizes in order to increase the efficiency of both the facility and its workers.

Upon completion of the project in May, deliverables to Company X will include:

- A facility layout incorporating lean manufacturing principles
- Analysis of the teams Arena model, not quantify operating characteristics under a range of operating parameters.
- A recommendation on optimal batch sizes for the new layout.

All deliverables will be presented to Company X through a Final Report and Presentation on <date>. The Final Report will discuss in detail all results, findings, and methodologies.

Work Proposed & Deliverables (process)

The team will concentrate on improving the FWO processes. Company X has provided specific "pain points" that should be given special consideration, but every process will be thoroughly analyzed to determine a more efficient way of completing the tasks, with the ultimate goal of reducing cycle times in all areas of the FWO. After carefully review-ing a time-motion study provided by Company X, it is clear that special attention will be given to the "generic" process, as this is the area that utilizes the most time.

In order to effectively solve the inefficiencies in the FWO processes, the team will utilize three valuable and tested Industrial Engineering tools. Two simulation models using ARENA will be built. The first model will expose any and all bottlenecks in the current process so that more emphasis may be placed on those steps of the process. Eventually, a second model will serve as an explanatory one demonstrating how much time may be saved by implementing the recommendations. A value stream mapping of the process will be performed to determine what steps are critical and which are repetitive and unnecessary. Based on this tool, the team will proceed with designing creative alternatives to current tasks. An economic analysis of all recommendations will be constructed in order to substantiate all proposals.

At the conclusion of the project, Company X will receive the following:

- A visual, easy to understand value stream mapping model of the FWO processes.
- A series of recommendation for future improvements.
- An Arena model simulation of the current and improved processes including all decision variables.
- A thorough report that will have detailed information, including an economic analysis of the impact of the changes recommended and the potential benefits they could generate.

Schedule & Budget

Timeline

Date	Tasks	Responsible
January 2010	Present Proposal Study characteristics and ranges of (specific) data presented in different formats; work with CIVL	Nathan Amanda Joseph
February 2010	Design algorithms to provide dynamic scaling of hierarchical data. Design and implement a navigation module featuring interactive temporal and spatial scaling and panning controls	Joseph Nathan & Amanda
March 2010		