

Writing the Executive Summary

The executive summary portion of an engineering report is written for high-level decision makers and other individuals who may not have time to read the full report and yet need to know enough about the project purpose, key results and recommendations, financial implications, and other essential information to intelligently assess the project, discuss it with others, and determine appropriate next steps. This brief document delivers all key points of the larger report and can be read quickly, understood easily, and acted on with confidence by its target audience.

What do executive summaries look like?

As noted in [1], executive summaries share the following characteristics:

- **They are short.** Executive summaries will sometimes run as long as 10 percent of the length of the accompanying report. In most cases, however, one page is the preferred length.
- **They are self-contained.** Executive summaries are often presented to their target audience separately from the rest of the report; so for the most part, references to information presented elsewhere in the report are both unhelpful and unnecessary. *An important exception to this rule relates to decisions and issues that may involve danger or liability.* In such instances, comments such as “as explained in the Conclusions and Recommendations section of this report, additional testing will be necessary prior to design adoption” are important red flags for those who may be reading the summary as a stand-alone document.
- **They are usually constructed as a series of connected paragraphs.** Longer executive summaries with multi-paragraph sections often use subheadings as an organizing device. As shown in Figure 1 on the following page, subheadings can also be used in one-page summaries. When space is at a premium, however, strong paragraph topic sentences can also quickly and effectively communicate summary content and structure, as illustrated in Figure 2 and in the longer executive summary found at [2].
- **They contain only the most important information about the project,** usually focusing on results and recommendations and any other key information that will help decision makers understand the project’s significance, assess its strengths and potential drawbacks, and determine what should happen next.
- **They are written at the technical level of the target audience** and are free of jargon and acronyms with which this audience may not be familiar.
- **They are typically the last report component to be written.** It may be difficult to ensure that a report’s key points are all addressed unless the report has already been written.

EXECUTIVE SUMMARY

Background

Research into Micro Air Vehicles (MAVs) is a promising new area of practical fluid dynamics design and optimization. At Oregon State, one thrust of this research goal involves understanding the performance of small wings experiencing large displacements because of comparatively large variations in the wider flow. Small up- and down-drafts have minimal effect on larger wings, but the reduced scale of MAVs significantly increases the danger of these effects destroying the lift-generating capabilities of the aircraft. Previous Senior Capstone projects have designed and built a test wing and a pitching and heaving mechanism to move the wing through artificial motion profiles.

Project Purpose

This project adds to previous work by building a measurement system to quantify the performance of the wing as it undergoes these maneuvers. Unlike the existing sting balance, this device must be inexpensive and mount to the existing wing and support structure so it can move with the wing throughout the experiment. The device must be able to measure 5 lb loads in the lift and drag directions while rejecting signals from other forces and moments. It must take up minimal space and have as small an effect on the flow as possible.

Design Selected

The budget for this project is significantly below traditional wind tunnel measurement methods, requiring the project to design and implement a non-traditional configuration of load cells. The selected design utilizes a steel flexure to mechanically separate lift and drag forces from pitching moment and other extraneous loads, directing them to a pair of 5 lb Futek load cells. The resulting signals are amplified by a signal conditioning unit then digitized by an existing National Instruments DAQ. A LabVIEW program processes the signals to convert voltages back into lift and drag forces and further conditions the signal to account for errors induced by the pitching process. The entire system is easily calibrated and integrates with existing hardware and software.

Implementation

Thanks to careful design decisions, modifications of the design were minimal; the device is shown in Figure 1. Changes to the existing infrastructure to enable the pitching and heaving mechanism to support the increased load of the flexure were required, however.

Results

Tests show that the device is able to achieve and maintain a calibration, to accurately measure forces, and that it does not impede the functioning of the existing hardware.

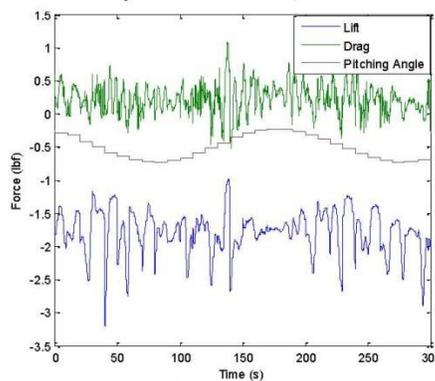


Figure 2. Data gathered from the wing pitching in flow. Pitching angle not to scale.



Figure 1. Completed Device

Initial evaluation indicates that the measurement system exhibits better than expected linearity, noise, and settling time characteristics. Hysteresis from the plastic shield rubbing against the flexure body as well as long-term drift issues had to be resolved after testing. Figure 2 shows data gathered by the wing experiencing dynamic motion in 5 m/s airflow.

Significance

This device provides the final link required to produce meaningful experimental results of a MAV wing experiencing dynamic flight motions in an Oregon State wind tunnel. Beyond the immediate application, however, the device has an easily-adapted, backwards-compatible sting balance attachment, enabling the same mechanism to be used on a wider array of measurement problems.

Figure 1. One-page executive summary with subheadings. Source: [3, p. 2].

EXECUTIVE SUMMARY

Kraemer's Nursery, a medium-sized ornamental nursery located in Mt. Angel, Oregon, provides approximately 27 million plants per year to large retailers within the region. The current inventory management system, however, fails to meet several key needs and presents a large potential for improvement in both capability and cost. This design team was therefore tasked with developing a proof of concept for a new inventory tracking system, using automatic identification and data capture (AIDC) technology, to reduce overhead costs and enable a better understanding of inventory.

The current system used to track inventory is overly simple, consisting of manual counting using paper and pencil. This presents many challenges for the nursery due to human error, illegibility, lost records, and manual entry into an electronic spreadsheet. With such a large inventory to track, the current system requires frequent, expensive, and labor intensive audits to account for errors of up to 100,000 plants.

Requirements for the new system include the specific attributes to be recorded, tracking plants in groups, data access, data manipulation, and system reliability. The attributes to be tracked were defined by Kraemer's Nursery. Data must be accessible from both the field and from in the office. Finally, the system must be able to withstand the nursery environment and provide reliable performance.

To decide how to design the prototype system, the design team researched many existing systems that demonstrate the required functionality either wholly or in part. Among the systems researched were wildlife tracking, border control, and airport baggage handling. The team also researched several systems that performed each of three required sub-functions: item identification, inventory management, and location tracking. After comparing the existing solutions, the team determined that a barcode scanning system paired with a dynamic database was the best solution to pursue.

The proof of concept created consists of a physical model of the nursery, barcode scanning hardware, a database to store inventory data, and the computer code to allow the barcode scanning hardware to interact with the database. A scaled model was used to represent the nursery and allow demonstration of how the system is able to track inventory changes. A dynamic database was created using Microsoft Access to store attributes of plant groups and track changes made to these attributes. Network hardware and a handheld barcode scanning device were used to connect the user to the database and enable data manipulation. Finally, computer code was written to create a simple, user-friendly interface for nursery employees to perform data manipulation within the database as inventory is handled within the nursery.

After the prototype system was fully constructed, extensive testing was performed to ensure that the system satisfied all of the customer and engineering requirements. Testing was completed by preapproved subject matter experts who certified that the system met each requirement. This testing was based on observation and used preapproved checklists to track how well requirements were met. Components tested include the system functionality, reliability, data accessibility, and scalability to meet the needs of a large nursery. The design performed flawlessly; it passed all tests, fulfilled all requirements, and proved that this system would be an improvement to the current inventory tracking system used at Kraemer's Nursery.

Full-scale implementation of this system would require capital investment for consulting personnel and equipment purchase. Consulting personnel would be required to create a more complex, robust database to track the large inventory quantities handled within the nursery. There would also be increased equipment requirements to track this inventory, including handheld barcode scanners, barcode printers, and laminating equipment to protect the barcode labels. The design team recommends that Kraemer's Nursery pursue full-scale implementation of this inventory tracking system to reduce expenditures on inventory management and to increase both the accuracy and quality of their inventory data.

Figure 2. One-page executive summary without subheadings. Source: [4, p. ii].

How do executive summaries differ from abstracts?

While executive summaries and article abstracts are both devices for summarizing a larger text, previewing document content, presenting key information, and facilitating some kind of decision making, they have fundamentally different audiences, purposes, and content, as described in Table 1 below.

Table 1. Executive summaries and report/article abstracts: Key differences

| | Audience | Purpose | Content and Length |
|--------------------------|--|--|---|
| Abstract | Colleagues who typically possess the same level of technical knowledge and are fluent in the language of your field. | Tool for determining whether consulting the associated document would be worth the reader's while. Not intended to substitute for document consultation but rather to draw readers in. | A progression of short (1–2-sentence) summaries of the information in each report section. Typically 1-2 paragraphs long; no visuals. |
| Executive Summary | High-level decision makers who may lack technical expertise and may be unfamiliar with the language of your field. | Tool for learning key information in the associated document without having to consult the actual document, and for determining next steps based on this information. For target audience, often replaces a full document reading. | Focuses primarily on key results, conclusions, and recommendations as basis for decision-making. All claims made in the summary must of course be fully substantiated by the report content, but the summary itself will contain little of that supporting detail. Typically 1 page long but can be as much as ~ 10% of report length. May include visuals. |

Should executive summaries include visuals?

While longer executive summaries often include figures and tables, one-page executive summaries more typically do not. However, there is no law against including them, especially when they can be used to demonstrate an important project result, support a key recommendation, or communicate other essential information more quickly and effectively than can be done in words. The one-page-summary example in Figure 1 includes two visuals.

- Visuals included in an executive summary should be both integral to the summary content and reasonably self-explanatory. Using visuals that require lengthy explanations and/or captions may not be the best use of the available real estate, especially in one-page summaries.
- Numbering of visuals in executive summaries is optional. To introduce unnumbered visuals, simply cite their relative position on the page, e.g., “the table below,” “the figure at right,” etc. Note that if you do choose to number the executive summary visuals, figure and table numbering in the report body should still begin at 1.
- Also, regardless of whether or not the executive summary visuals are numbered, these visuals should not be included in the report’s list of figures or tables.

How do I go about writing an executive summary?

1. First, map out the summary structure and basic content.
 - Consult the report template or editorial guidelines (if these exist) to identify whether the summary has any specified structure and/or content requirements. The MIME capstone report template, for example, specifies a one-page executive summary and lists three areas that the summary must address.
 - In the absence of other conflicting specifications, create a summary outline that parallels the report structure and that touches on all level-one sections of the report while emphasizing the background information, results, and conclusions/recommendations.
2. Next, think about any other details a high-level manager might need when considering whether to continue your project, implement your proposal, or do whatever else you are recommending as the appropriate next steps. Examples of such information appear in Figure 3 below.
3. Then, draft a summary that fulfills the structure and content requirements identified in step 1 and addresses any additional key questions identified in step 2.
4. Finally, review and revise the draft to ensure that the final version is logically organized, grammatically correct, and uses clear, concise, and audience-appropriate language. A sample rubric for self- or peer-review is appended to this document; this rubric should be adjusted as necessary to fit your executive summary requirements.

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- | | |
|---|--|
| <ul style="list-style-type: none">• Problems What is it? Why is solution undertaken? Magnitude and importance? What is being done? By whom? Approaches used? Are they thorough and complete? Suggested solution? Best? Consider others? What now? Who does it? Time factors? | <ul style="list-style-type: none">• Tests and Experiments What tested or investigated? Why? How? What did they show? Better ways? Conclusions? Recommendations? Implications to company? |
| <ul style="list-style-type: none">• New Projects and Products Potential? Risks? Scope of application? Commercial implications? Competition? Importance to company? More work to be done? Any problems? Required personnel, facilities, and equipment? Relative importance to other projects or products? Life of project or product line? Effect on company's technical position? Priorities required? Proposed schedule? Target date? | <ul style="list-style-type: none">• Materials and Processes Property characteristics, capabilities? Limitations? Use requirements and environment? Areas and scope of application? Cost factors? Availability and sources? What else can be used? Problems in using? Significance of application to company? |
| | <ul style="list-style-type: none">• Field Troubles and Special Design Problems Specific equipment involved? What trouble developed? Any trouble history? How much involved? Responsibility? Others? Company? What is needed? Special requirements and environment? Who does it? Time factors? Most practical solutions? Recommended action? Suggested product design changes? |

Figure 3. What managers want to know: Key questions in considering executive summary content. Source: [5, Table II].

What rhetorical strategies will help persuade my target audience to buy into the conclusions and recommendations presented in my executive summary?

Rhetorically effective executive summaries—that is, executive summaries that have the intended impact—demonstrate the following to their target audience:

- Awareness of the project sponsor’s business goals and interests.
- A clear understanding of the project goal, scope, and technical issues.
- Acknowledgement that the reader’s time is valuable through writing that is clear, concise, logically organized, and grammatically correct, answers all key questions and is accurately gauged to the reader’s level of technical understanding.

References

- [1] W. S. Pfeiffer. *Technical Communication: A Practical Approach*. Upper Saddle River, NJ: Pearson, 2006, pp. 300-301.
- [2] Federal Emergency Management Agency. “World Trade Center Building performance study executive summary.” U.S. Dept. Homeland Security, Washington, D.C., FEMA Pub. 403, Sept. 2002 [Online]. Available: http://www.fema.gov/pdf/library/fema403_execsum.pdf
- [3] B. Converse, D. Lincoln, and B. Weiss. “Lift and drag measurement in a wind tunnel.” Capstone design report, School of MIME, Oregon State Univ., Corvallis, OR, 2011 [Online]. Available: <http://ir.library.oregonstate.edu/xmlui/handle/1957/21834>
- [4] A. Brown, E. Wellington, and J. Reed. “Utilizing AIDC technologies for tracking plants at Kraemer’s Nursery.” Unpublished capstone design report, School of MIME, Oregon State Univ., Corvallis, OR, 2012.
- [5] J. W. Souther, “What to report,” *IEEE Trans. Prof. Comm.*, vol. PC-28, no. 3, pp. 5–8, Sept. 1985.



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Appendix

MIME CAPSTONE REPORT EXECUTIVE SUMMARY: Rubric for Draft Review

| TECHNICAL CONTENT | COMMENTS |
|--|----------|
| <p>Content is well organized and appropriately balanced. Summary begins with problem statement (project description and why solving the product or process design problem is important). Balance of summary focuses on key aspects of project, e.g., approach taken, design selected, implementation process, testing results, and conclusions and recommendations.</p> | |
| <p>Summary can be read and understood independently of report. Summary text does not reference specific details or visuals included elsewhere in the report (unless danger or liability issues are involved) and contains no unexplained abbreviations, acronyms, or other unfamiliar terminology.</p> | |
| <p>Level of detail and technical complexity is appropriate for the target audience (i.e., those who will make decisions about next steps for the project) and provides key information for determining next steps.</p> | |
| LAYOUT AND GLOBAL WRITING QUALITIES | COMMENTS |
| <p>Page Layout. 1-page, single-column, single spaced. Same font and margins as the report body.</p> | |
| <p>Structure. Summary is constructed in paragraph format; subheading use is optional. Each paragraph addresses a single topic, and the first sentence of each paragraph clearly lays out the topic being addressed.</p> | |
| <p>If summary includes tables and/or figures, they are cited in the text and include brief explanatory captions.</p> | |
| <p>Usage and Style. Writing demonstrates excellent control of standard writing conventions (punctuation, spelling, capitalization, grammar), and tone and vocabulary are appropriate for the specified target audience.</p> | |