



Analytical Methods for Materials

Technical Communication via Writing

References

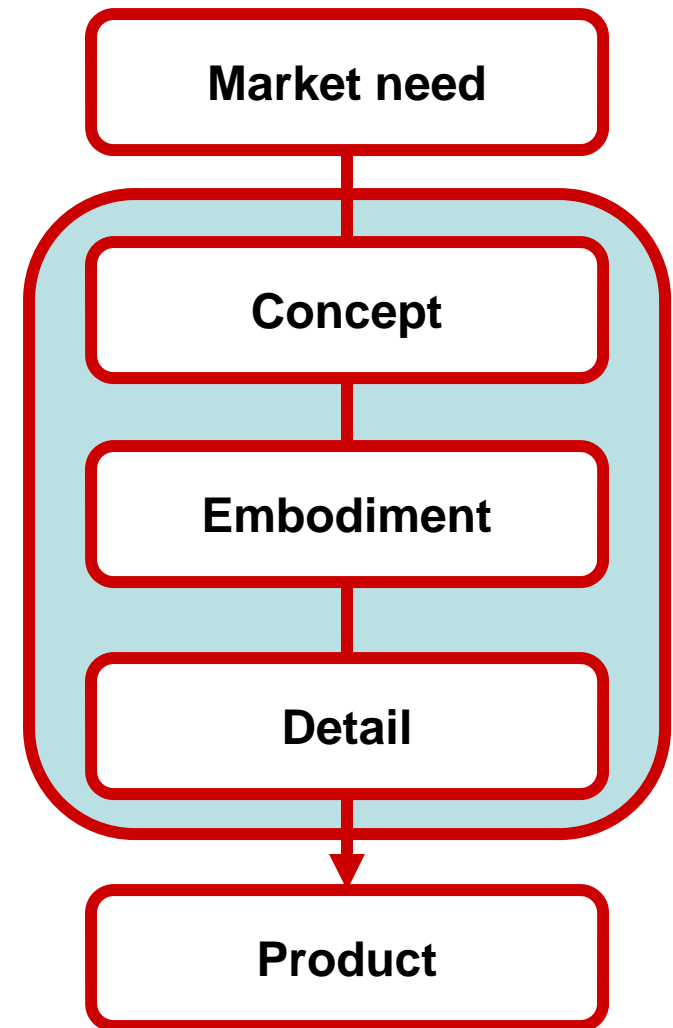
1. M. Markel, Technical Communication, 8th Edition, Bedford/St. Martin's, Boston (2007).
2. D.C. Van Aken and W.F. Hosford, Reporting Results, Cambridge University Press, Cambridge UK (2008).
3. G.J. Alred, C.T. Brusaw, and W.E. Oliu; *Handbook of Technical Writing, 6th Ed.*; (2000) Bedford/St.Martin's, Boston, MA.
4. M.F. Ashby, "How to Write a Paper," (2005). This paper can be found at:
<http://www.grantadesign.com/userarea/teachingresource/writepaper.htm>

Objective

- To provide guidance for writing technical papers or reports about your experiments and/or research.
- Properly written technical papers or reports reflect the type of work that you have done:
 - experimental,
 - theoretical,
 - computational.
- Following Ashby, we will describe, as a model, a materials project that combines experiments, modeling, and computation to explain some aspect of material behavior.

The design process for written communication

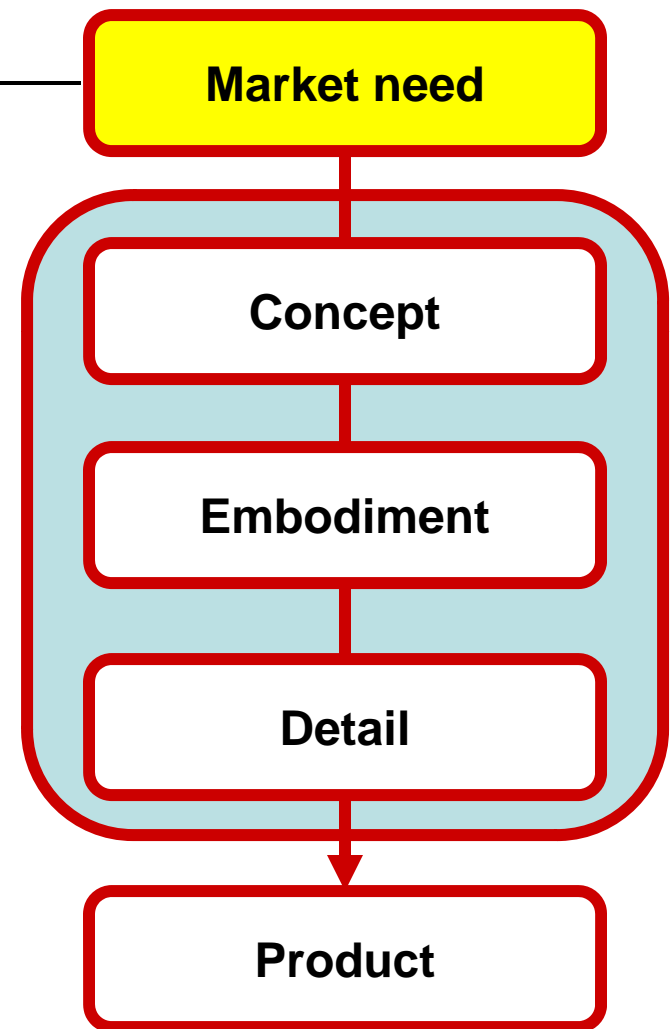
- A well-written paper must be properly designed.
- There are five general steps for designing a good paper.



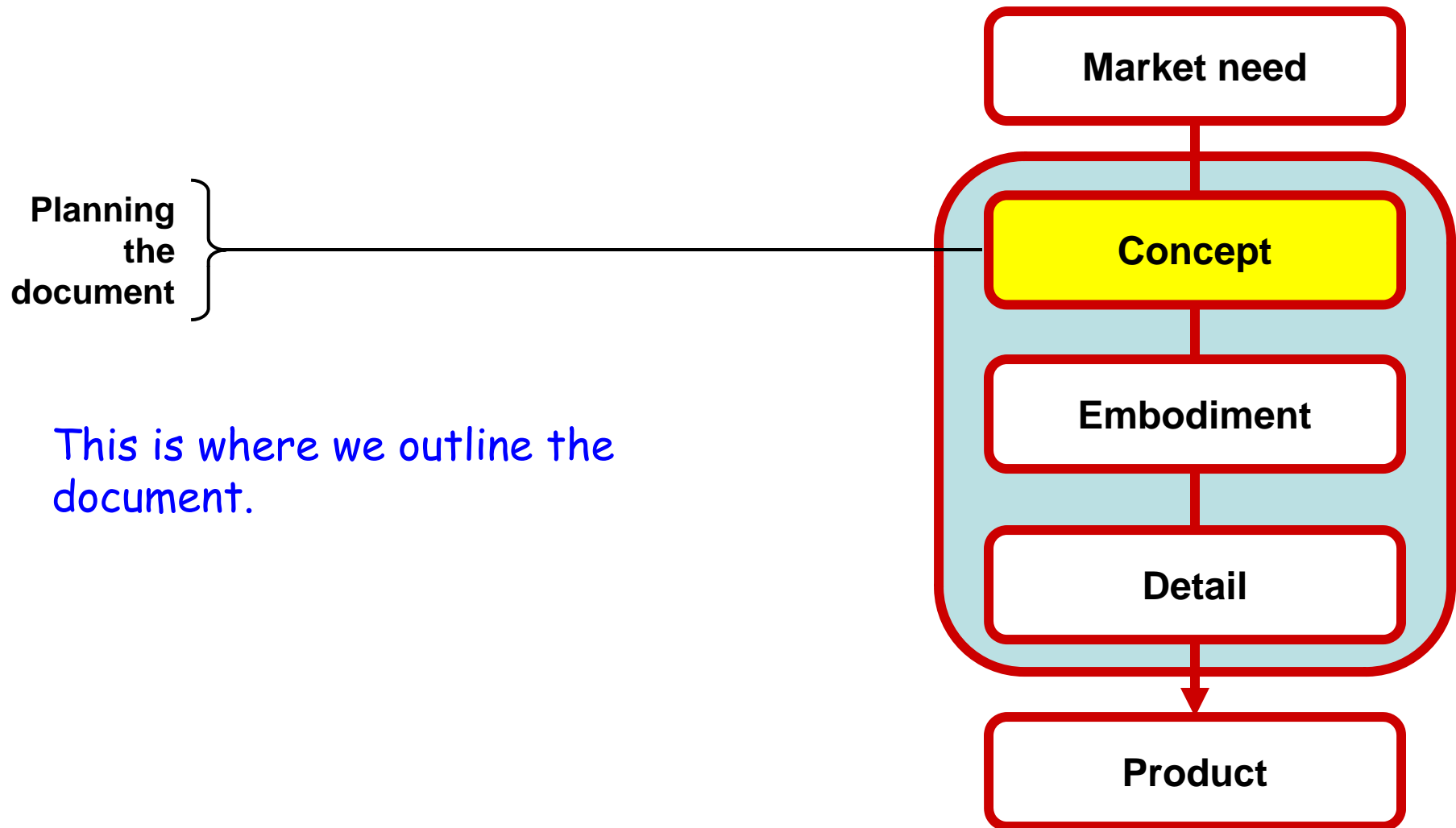
The design process for written communication

What is the purpose?
Who will read the document?
How will the reader use the document?

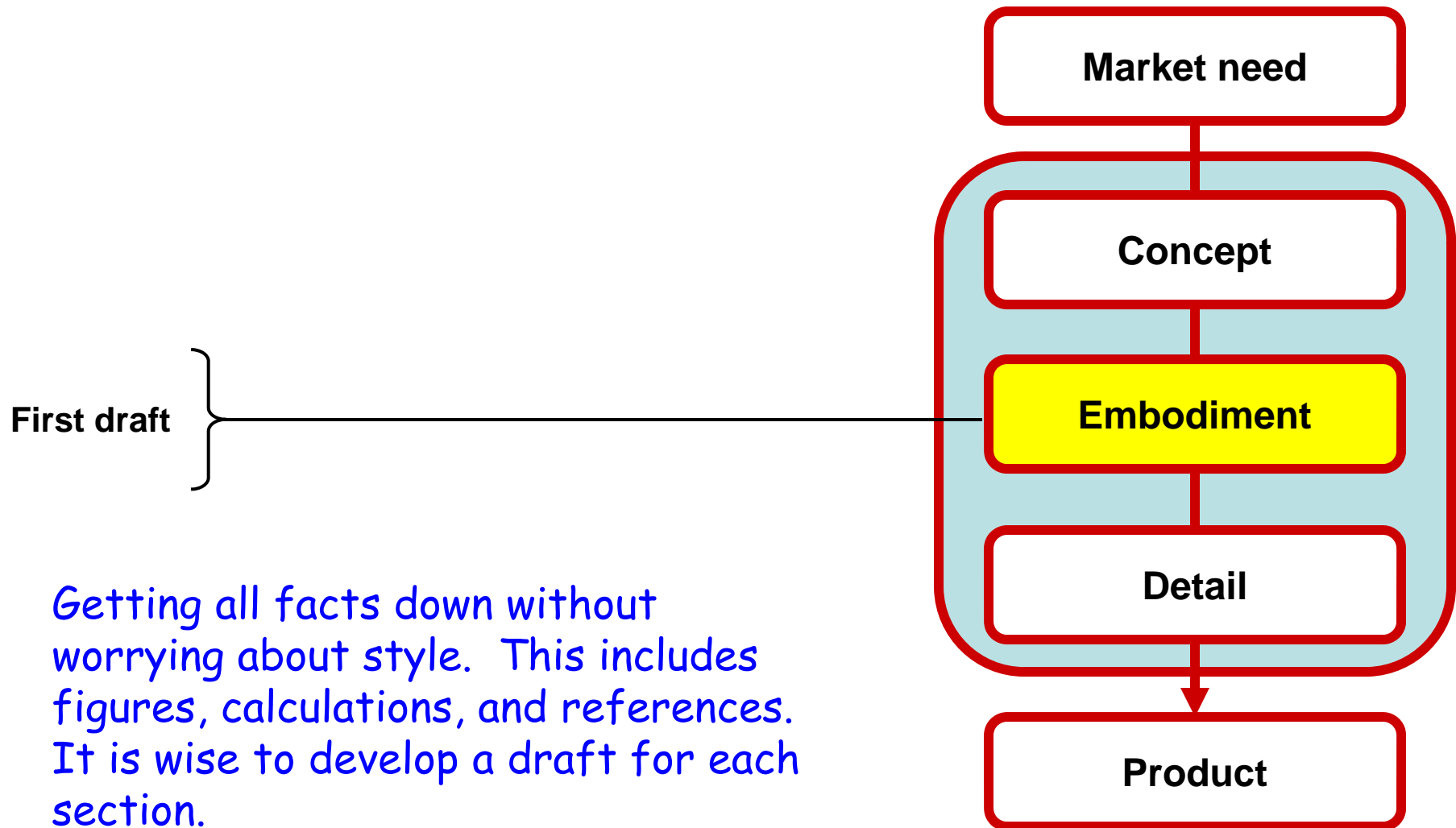
We use this information to determine the document length, style, and level of detail.



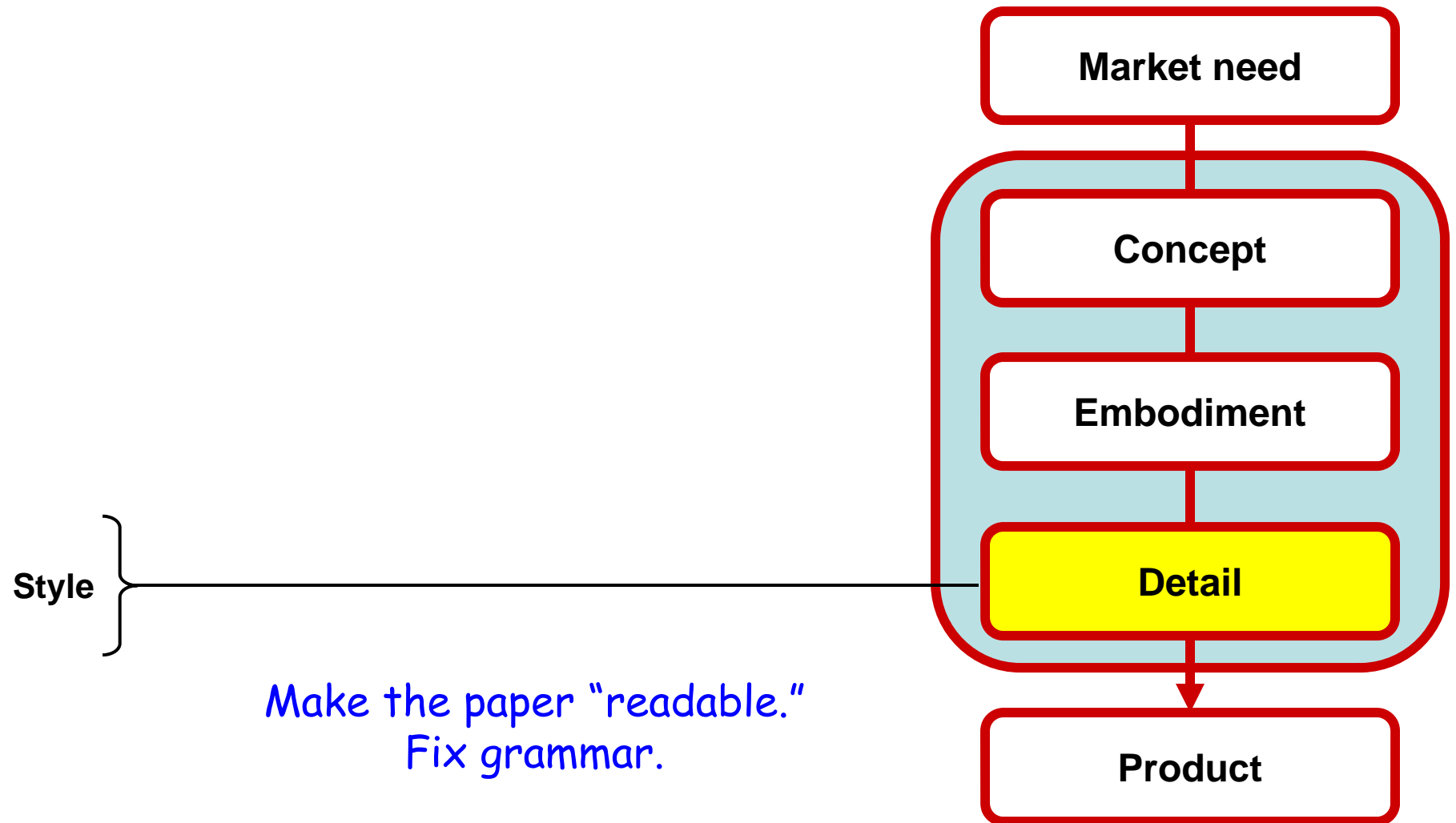
The design process for written communication



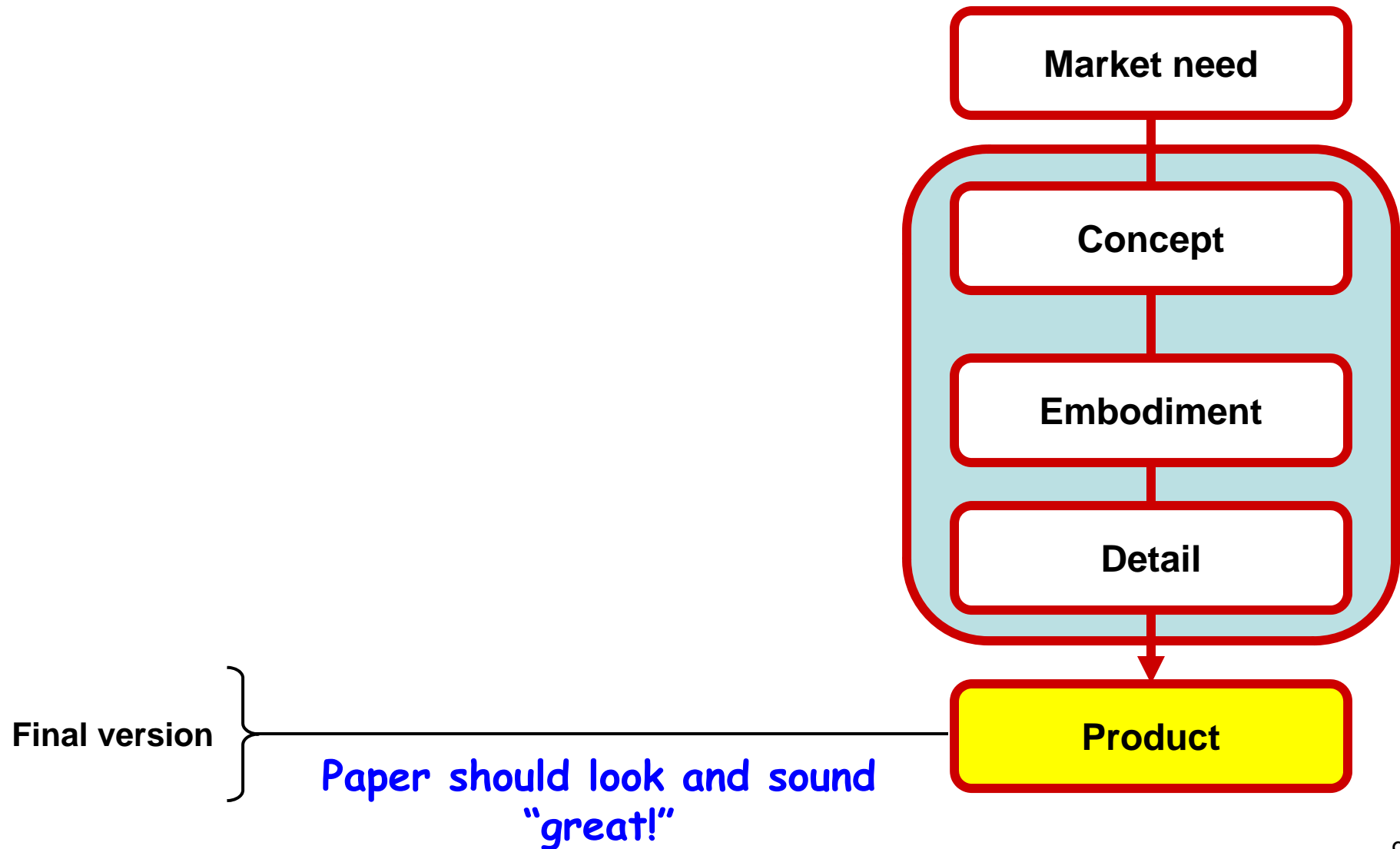
The design process for written communication



The design process for written communication



The design process for written communication



Assessing the Market

- Readers are to be considered “examiners”
 - Instructor
 - Other faculty
 - Other students
 - Other scientists
 - Your department manager or boss
 - Etc...

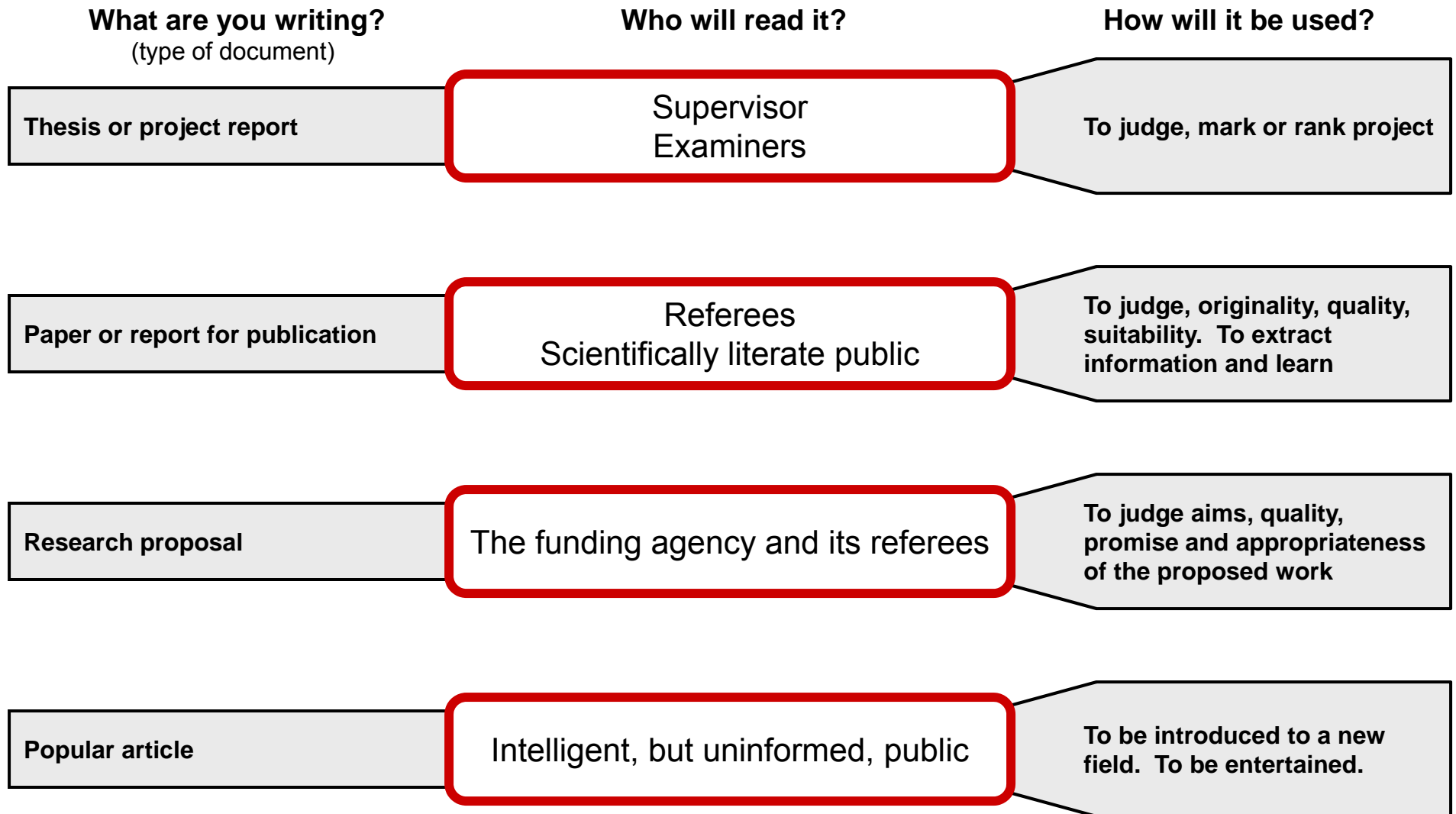
Assessing the Market

- Readers expect a few things:
 - Details of your experiments
 - Why you did it
 - Relevant background (i.e., “literature review”)
 - What you did (i.e., “results”)
 - Your thinking/rationale (i.e., “discussion”)
 - Conclusions and where you think the work is going

Assessing the Market

- Readers don't want irrelevant details:
 - Details on how standard equipment works
 - Step-by-step details on how to run a piece of equipment (unless they are unique and necessary to repeat study)
 - Review of literature that is not related or relevant to the paper
 - Etc...

Markets for technical writing



Concept Development

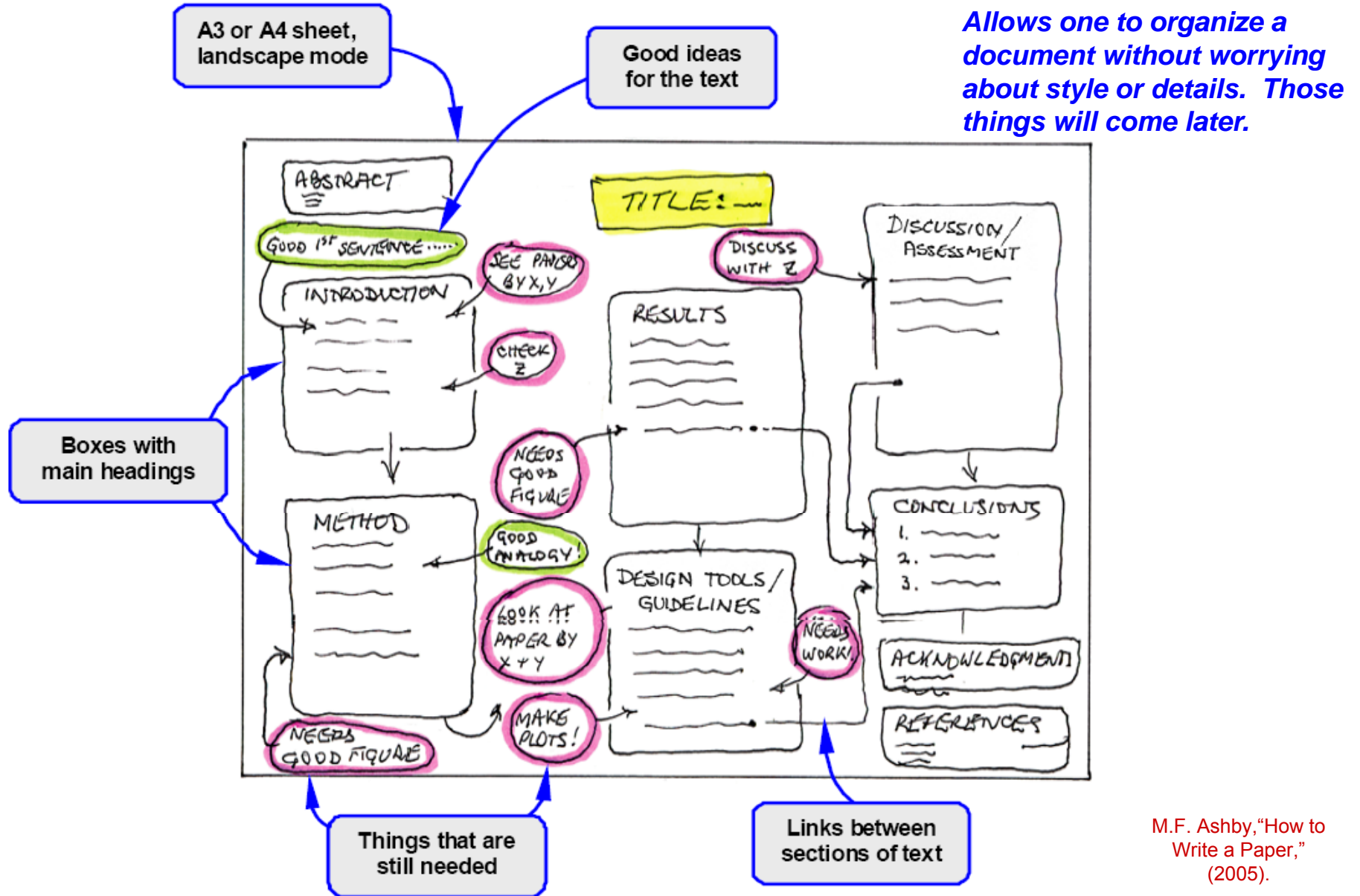


Figure 3. A model for a concept sheet.

M.F. Ashby, "How to Write a Paper," (2005).

Embodiment or “First Draft” (1)

- Title:
 - Brief but meaningful.
 - Use a 14 pt bold font unless otherwise specified.
 - E.g., “Fatigue of Metallic Coatings” rather than “The Mechanical Response of FeCrAlY Coatings under Biaxial Cyclic Loadings”

Embodiment or "First Draft" (2)

- Attribution:
 - Names of authors, with all initials; affiliation (i.e., organization or Institute); full address; date

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*Only include date
for lab or
technical reports.*

Embodiment or "First Draft" (3)

- Abstract:
 - Write at least one sentence each describing:
 - Motivation for work;
 - Methods used;
 - Key results/findings;
 - Conclusions
 - Do not exceed three sentences on any one topic.
 - Limit the abstract to 100 words or less.

A person reading an abstract has been attracted by the title. They will use the abstract to decide whether it is worthwhile to read on.

Embodiment or "First Draft" (4)

- Introduction:
 - What is the problem? Why is it interesting?
 - Outline problem and why we are studying it.
 - Who are the primary contributors? What did the primary contributors do?
 - Review literature, summarize status of field. Provide any specialized information that the reader might need to understand what follows.
 - What novel thing will you reveal?
 - State what you will do that has not been done before (e.g., new experimental approach, new data, new model, new interpretation, etc.). Be brief.

Embodiment or "First Draft" (5a)

- Introduction:

- Make your opening sentences good ones.

- Here is an example of a bad one:

“Metal foams are a new class of material attracting interest world-wide and with great potential... X, Y, Z have measured their strength properties ...P, Q, and R have developed theoretical models ... Comparison of the experiments with the models suggests that the measured strength are less than those predicted ...”

This first sentence is boring and says nothing. The remaining sentences bring in details, however, we don't know why. The 4th sentence isn't bad.

Embodiment or "First Draft" (5b)

- Introduction:

- Make your opening sentences good ones.

- Here is a better example:

“Metal foams are not as strong as they should be. Models, which describe polymer foams well, overestimate the strength of metal foams by factor of 2 to 5. This research explores the reasons why.”

The first two sentences highlight the problem clearly. The third tell us what the paper will do. The details that follow are now relevant.

Method (1)

- This is the 'Experimental Procedure' section
- Just say what you did in as few words as possible.
- Methods section depends on type of work you are reporting.
 - Experimental paper: equipment, materials, methods.
 - Modeling paper: assumptions, mathematical tools, methods.
 - Computational paper: inputs, computational tools, methods.

Method (2)

- Explain what is especially different, if anything, about your methods.
- * Provide sufficient detail so that the reader can reproduce what you did.
- Don't mix Methods with Results and/or Discussion.

Results

- In this section, present the output of the experiments, model, or computation.
- This is where you report results without interpretation.
- Data should be presented in a useful form.
- Define all symbols and units. Use appropriate significant digits.
- Emphasize most important aspects of figures and tables in the text.
- Provide error bars. Statistics must be meaningful.

Results

- Use a concise, economical style.
- Poor
 - It is clearly shown in Fig. 1 that cold working caused the tensile strength to increase.
- Better
 - Cold working produced an increase in tensile strength (Fig. 1).

Discussion

- Extract principles, relationships or generalizations from the results.
- Present analysis, model, or theory.
- Show relationships between results and analysis, model, or theory.

Function of Discussion

- To describe ideas, models, and theories; and to lead the reader through a comparison of these with the experimental or computational data.
- Describe the most significant conclusions first. Develop less significant conclusions subsequently.
- Be clear and concise.

Results and Discussion

- In some journals, results and discussion are merged into a single section.
- Format:
 - Present result 1. Then discuss result 1
 - Present result 2. Then discuss result 2
 - Etc...
- Can make it difficult to distinguish between new and old work.

Conclusions

- Bring together the most important results and their implications.
- List any uncertainties or limitations.
- Do not duplicate your Abstract as Conclusions (or vice versa).
- Conclusions sum up the advanced in knowledge that has emerged from your work.

Acknowledgements

- Thank those who have helped you with ideas, technical input, materials, or financial support.
- Be brief
 - The authors wish to thank Prof. B.C. Day of American University for technical assistance. This research was supported by the NSF under grant number DMR 07282xx.

References

- Tell readers where ideas, prior results, and prior data have come from.
- You must cite references in the text.
- References must be complete:
 - Name, initials, year, title, journal name, volume, starting and finish pages.
 - Actual format depends upon what you are citing. See pp. 21-22 in Van Aken for a start.

Formats for References

- In text use bracketed or superscripted numerals or the name/year system.

Formats for References

BRACKETED NUMERALS

- [1] for a single reference, for a ranges use commas and hyphens [1-9], [1,3,4-6,8].
- The numbers should begin at 1 and increase as you progress through the document. If you have cited something earlier in the document and wish to cite it again later, you refer back to the original citation number. Citation numbers are assigned in the order that the citation is made in the document.
- Brackets are placed either right where cited or at the end of the sentence (inside of the period).

Formats for References - cont'd.

SUPERSCRIPTED NUMERALS

- for a single reference use a single number.¹
- For ranges use commas.¹⁻⁹
- Hyphens are appropriate for ranges that are not continuous.^{1,3,4-6,8}

Formats for References - cont'd.

NAME/YEAR

- “Lu (1998)”.
- If there are two names then “Lu and Chen (1998)”.
- If there are more than two, then “Lu et al. (1998)”.

Formats for References - cont'd

- In reference lists

Papers

[1] Initials. Last Name; "Title of paper;" *Journal Title*;
Volume (year) start page – end page.

Books

[2] Initials. Last Name; Book Title, Publisher, City and
country of publisher, (year) chapter number (if
relevant), start page – end page (if relevant).

Formats for References - cont'd

- In reference lists

Edited Books

[3] Initials. Last Name; Book Title, edited by Initials. Last Name; Publisher, City and country of publisher, (year) chapter number (if relevant), start page – end page (if relevant).

Figures

- General
 - Flow charts are used to show methods and procedures.
 - Graphs are used to plot data.
 - Schematics are used to show how equipment works or to illustrate a mechanism/model.
 - Drawings and photographs are used to illustrate equipment, microstructures, macrostructures, etc.

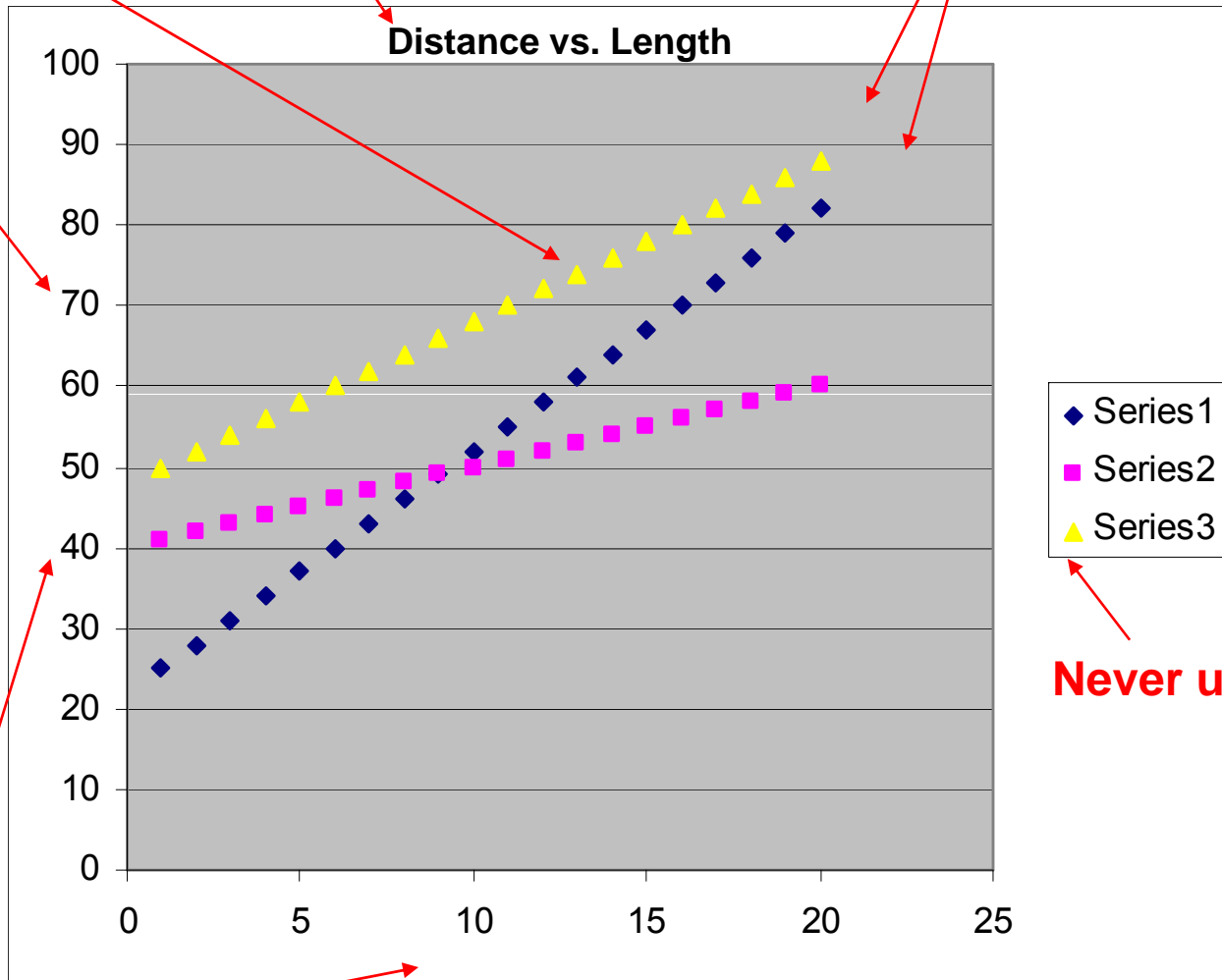
Figures - cont'd

- Keep the following in mind
 - Everyone will look at your figures and the figure captions.
 - Make figures as self-contained as possible. Give figures an informative caption.
 - Titles are not added to figures in reports or published papers. Titles are only to be used for oral presentations.
 - Captions go below the figure.
 - Label axes correctly, being sure to define units. Use proper symbol and font sizes.

Fonts & symbols are too small. They will reproduce poorly

Titles are not acceptable in papers

Grey background and grid lines!
Looks un-professional



Never use yellow!

No axis labels!

Do not put boxes around your figures!

This is an example of a bad data plot.

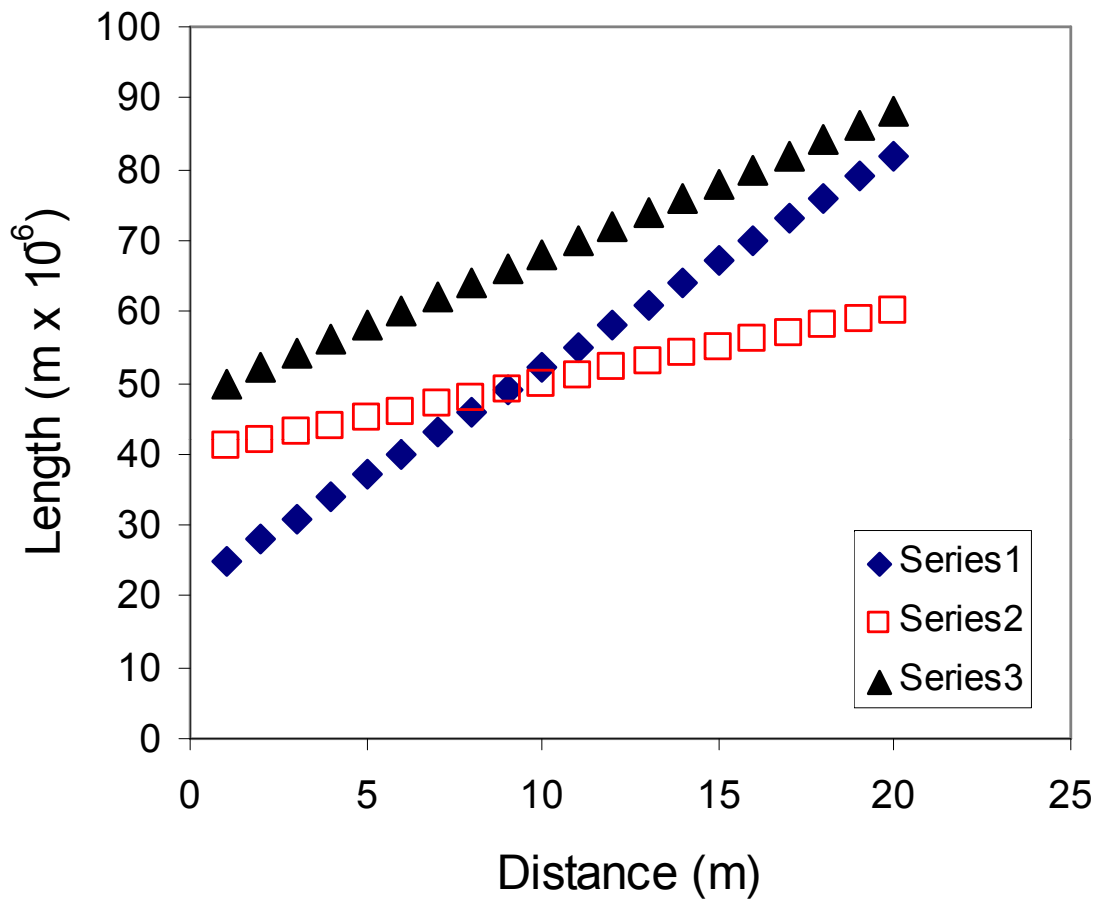


Fig. X. Distance versus length for test specimens. Series 1 corresponds to condition x; Series 2 corresponds to condition y; etc...

This is an example of a better data plot with a caption.

Tables

- Table captions go above the table.
- You should use appropriate significant digits (undergraduate students, this is just like you learned in MTE 252).
- Example
 - 31.32999% is meaningless when accuracy isn't that good.
 - 31.3% would be sufficient
 - You'll see what I mean when we do XRD experiments.

Appendices

- This is where we put things that would disrupt the flow of the main text.
- E.g., details of derivations, large data tables, or detailed descriptions of experimental techniques or apparatus.
- It is not a place where you dump all of your data.
- You are not to have appendices in the lab reports that you produce in this class unless I specifically tell you otherwise.

Spelling

- Be certain to spell check your document prior to turning it in.
- With modern word processing software, there is no excuse for misspelled words.
- Should I find more than two misspelled words within your document, your maximum possible grade for the report will be reduced to 85%.
- Be careful. Spell checkers do not always select the proper word. After running the spell checker, re-check the document by hand.
 - Their vs. there; form vs. from; affect vs. effect; etc...

Grammar

- Parts of Speech:
 - NOUN – names of people or things.
 - Metal, plate, Charpy, Mike ...
 - PRONOUN – stands for a noun
 - He, she, it, they ...
 - ADJECTIVE – qualifies a noun
 - A red light, a large computer, a small frog ...
 - VERB – signifies action
 - Is, seems, go, interpret, understand ...

Grammar

- Parts of Speech – cont'd:
 - ADVERB – qualify verbs
 - *Today* we interpret this *differently*...
 - CONJUNCTION – link words and sentences
 - And, but, or, because ...
 - PREPOSITIONS – precede nouns, deal with place or time
 - *On* the table, *after* this procedure, *on* the graph, *in* the appendix ...
 - INTERJECTIOS – exclamations
 - *Great! Cheers! ...*
 - Not generally appropriate in technical writing.

Types of Verbs

- VERB – signifies action
 - TRANSITIVE VERBS – have subject and object
 - *The load / deforms / the material*
 - INTRANSITIVE VERB – have no object
 - *Flowers / bloom. The research / evolved*
 - “BEING” VERBS – have a complement
 - The test /was/ **completed**. The theory /seemed/ **correct**.
 - Many verbs have both transitive and intransitive forms
 - *Time / passed. Pass the bread. ...*

Sentence structure

- All sentences should have a subject and a predicate.
- Subject - what or whom the sentence is about.
- Predicate - says something about the subject; contains a verb.

SUBJECT

PREDICATE

The sample.....> failed.

The measurements> fell into two classes

Fatigue-loading> causes microstructural damage

Phrases and clauses

- Groups of words that do the jobs of parts of speech (i.e., nouns, pronouns, adjectives, verbs, etc...).
- Phrases do not contain verbs
- Clauses contain verbs and their subjects/objects
- Examples follow.

Phrases

TYPE OF PHRASE

EXAMPLE

- Noun phrase
The interpretation of the experiment presents a problem.
- Adjective phrase
The red and white striped cable is live.
- Adverbial phrase
We examined the results with considerable care
- Conjunctive phrase
The test ended owing to the fact that the specimen failed.

You would be wise to avoid the use of a conjunctive phrase. It is simpler to use a on-word conjunction such as “because”

Clauses

TYPE OF PHRASE

- Adjective clause
- Adverb clause

EXAMPLE

A computation *that uses FE methods* is appropriate.

The modem will operate *wherever a phone-line is available*.

Compound sentences

- This type of sentence has two equal clauses linked by a conjunction. The parts of the compound sentence must be of equal weight.
 - We measured the temperature and we adjusted the thermostat.
 - The tooling cost is high but the material cost is low.

Complex sentences

- Have a main clause and a subordinate clause
 - What these results signify / is the subject of a paper by Wegst (1998).
 - Maine (1998) demonstrates / that technical cost modeling is feasible.
 - It is possible / that the conclusions were mistaken.

Use of "that" and "which"

{Subordinate – qualifies the noun}

- The computations that were performed on the Cray were the more accurate

Adjective clause. Qualifies "computations".
Distinguishes work done on a "Cray" from
that done on similar equipment.

{Coordinate – introduces a new fact}

- The computations, which were performed on a Cray, were the more accurate.

Says that computations were performed on a Cray; and they were more accurate. Does not distinguish.

Punctuation

- Period (.)
 - Used at the end of a sentence or to signify abbreviation.
- Comma (,)
 - Separates two words or larger parts of sentences which could confuse if they touched.
 - BAD: “The measurements employed a photo-diode and a laser was used to check adjustment.”
 - CORRECTED: “The measurements employed a photo-diode, and a laser was used to check adjustment.”

Use a comma when it improves the sense of a sentence.

Punctuation - cont'd

- Semicolon (;)

- Used when a comma is not enough. We generally use it between independent statements or clauses.

- At one time the optical microscope was the principal tool of metallography; today, it is the scanning electron microscope.

- Also used to separate members of a long list.

- The literature includes Gibson (1997), who studied simple compression; Olurin (1998), who studied the effect of holes and notches; Deshpande (1999), who....

Punctuation - cont'd

- Semicolon (;)
 - When the conjunctive adverbs *accordingly, also, hence, likewise, similarly, ...* are used to link clauses, they are preceded by a semicolon.
 - Ballistic impact induced damage; accordingly, the bridge fell down.

Punctuation - cont'd

- Colon (:)
 - Used to introduce part of a sentence to exemplify, restate, or explain the preceding parts.
 - This raises the question: is the model right or wrong?
 - There are two reasons for repeating this experiment: the first, to improve the precision; the second, to establish reproducibility.

Punctuation - cont'd

- Exclamation mark (!)
 - Used to signal surprise, excitement, imperative, or contradiction.
 - Not used in scientific writing.
- Question mark (?)
 - Used after a direct question or to indicate uncertainty.

Punctuation - cont'd

- Hyphen (-)

- Connects part of a compound word.

- Well-known; half-expected; state-of-the-art; bar-chart...

- Generally used when a noun is used as an adjective

- Dash (–)

- Links, separates, and encloses portions of a sentence. Easy to overuse.

- Three of the applicants – John Smith, Patrick Henry, and Mark Calhoun – seem well qualified for the job.

Punctuation - cont'd

- Dash (–)
 - The dash sets off parenthetical elements more sharply than commas. Parentheses tend to reduce the importance of what they enclose.
 - Only one person – Dr. Weaver – can change your grade.
 - Only one person, Dr. Weaver, can change your grade.
 - Only one person (Dr. Weaver) can change your grade.

Punctuation - cont'd

- Quotation mark (“ ”)
 - Used to enclose direct “word-for-word” quotations or dialogue. Also used to enclose original, ironic, or unusual phrases.
 - “One small step for man; one giant leap for mankind.” – Neil Armstrong, US astronaut (1969).
 - This research too a “try-it-and-see approach.”
 - We generally try to avoid these things in scientific writing. Quotations must be cited in the references.

Punctuation - cont'd

- Apostrophe (')
- Used to show (1) possession or (2) contraction.
 1. Sutcliffe's theory; everyone's idea.
 2. Don't, isn't, it's ("it is")
- Contractions are inappropriate in scientific writing.

Punctuation - cont'd

- **Italics, underlines, bold type**
 - Used to attach emphasis or importance to a word or phrase.
 - Italics are preferred in scientific writing.
 - Bold is reserved for headings.
 - Underlines are generally too severe.
 - “The critical value of the fatigue limit, or *fatigue threshold*, is listed...”
 - Exceptions to the rule are references. They will have pre-described formats. Book and journal titles are often italicized or underlined.

Punctuation - cont'd

- Parentheses ()
 - Face-centered cubic materials (Cu, Ag, and Au, for instance) have nine independent elastic constants.
 - Jones (1995) surveys the status of corrosion in Metallurgical Engineering.
- Brackets []
 - Used to indicate editorial comments, words inserted as explanation, and reference numbers.
 - [continued on p. 99]; [see footnote]; ...

Style

- Be clear. Use simple language. Short words rather than long are preferred. Don't use obscure words.
- Don't waffle. Get to the point.
- Plan and organize your paper before writing it. A paper should progress logically.
- Define all symbols and abbreviations. Once defined, you can use the symbol or abbreviation in place of a full name.
 - The scanning electron microscope (SEM) ...
 - The force, F , equals the mass, m , divided by the cross-sectional area, A .

Style - cont'd

- Avoid clichés and jargon.
- Avoid weak qualifiers
 - Very, rather, somewhat, quite...
 - E.g., “This very important point...” vs. “This point...”
- Don't overstate, overemphasize, or apologize. This will undermine confidence in your work.
 - E.g., “Unfortunately, there was not enough time to complete the final set of experiments.”

NEVER do this!



Style - cont'd

- Don't be patronizing, condescending or eccentric
 - Don't patronize:
 - “The amazingly perceptive comment by Fleck ...”
 - Don't be condescending:
 - “Readers familiar with my work will know ...”
 - Do not affect a breezy manner, what you might call Web-speak.
 - “Hi! me again with some hot news about engineering at CUED, or Q'Ed as we call it. It's been a helluva term for good stuff—we got more going on here than ever before...The author says nothing and is showing off, drawing attention to himself.”

Style - cont'd

- Use appropriate language and standard symbols.
 -
 - Minimize the use of acronyms and abbreviations.
 - “The MEM, analyzed by FE methods, was photographed by SEM and chemically characterized by SAM.” What does this mean? The sentence should be changed.
 - Never start a sentence with an acronym or abbreviation.
 - “SEM was used to characterize the microstructure.” This sentence should be changed.
 - Avoid jargon.

First sentence

- Make it a good one. Avoid clichés/platitudes.

- POOR

- “Metal foams are a new class of material attracting interest world-wide and with great potential... X, Y, Z have measured their strength properties ...P, Q, and R have developed theoretical models ... Comparison of the experiments with the models suggests that the measured strength are less than those predicted ...”

- Better

- “Metal foams are not as strong as they should be. Models, which describe polymer foams well, overestimate the strength of metal foams by factor of 2 to 5. This research explores the reasons. To be more specific... (details of literature X, Y, Z, P, Q, R here).”

Good Technical Writing

- More details on good technical writing are covered in the paper that I have referred you to.
- There are many good technical communication books. Every engineer should have one to refer to. You will be writing reports for the rest of your life. Good communicators get promotions and raises. Poor communicators get fired.
- I recommend:
 - D.C. Van Aken and W.F. Hosford; Reporting Results; (2008) Cambridge University Press, Cambridge UK.
 - G.J. Alred, C.T. Brusaw, and W.E. Oliu; *Handbook of Technical Writing, 6th Ed.*; (2000) Bedford/St.Martin's, Boston, MA.
 - There are many others that cover the same topics.

Plagiarism

- Merriam-Webster's Online Dictionary
(<http://www.merriam-webster.com/dictionary/plagiarizing>)
 - to steal and pass off (the ideas or words of another) as one's own;
 - to use (another's production) without crediting the source;
 - to commit literary theft;
 - to present as new and original an idea or product derived from an existing source.

This portion of the notes is derived from Plagiarism.org
[<http://www.plagiarism.org/index.html>]

Plagiarism - cont'd

- “Simply put, plagiarism is the use of another's original words or ideas as though they were your own. Any time you borrow from an original source and do not give proper credit, you have committed plagiarism and violated U.S. copyright laws.”
[1]
- Plagiarism is fraud. It constitutes stealing the work of someone and lying about it.

“DON'T DO IT!”

- The penalties for plagiarism can be surprisingly severe, ranging from failure of classes and expulsion from academic institutions to heavy fines and jail time!

[1] <http://www.plagiarism.org/index.html>

Plagiarism - cont'd


- Examples:

- Turning in the work of someone else as your own;
- Copying/stealing words or ideas from someone else (or even your own prior work) without giving credit;
- Failing to put a quotation in quotation marks;
- Providing incorrect information about the source of a quotation;
- Incorrectly citing references;
- ▶ Changing words but copying the sentence structure of a source without giving credit;
- Copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not (see our section on "fair use" rules).


For an example of good writing, download and read the following paper.

T.G. Nieh and J. Wadsworth, "Homogeneous deformation of bulk metallic glasses;" *Scripta Materialia* 54 (2006) 387-392.

volume



Year



Page numbers



ASSIGNMENT

Write a two-phage critique of this paper assessing it's organization, style, and grammar.