Stop Slipping and Sliding:
Methods to Reclaim Expert Engineering Space by Using Slides to Best Advantage

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1 SEE THE PATH TO IMPROVEMENT: RECOGNIZING THE NEED FOR CHANGE

Whether it is entity relationship diagrams, histograms, circuit diagrams, CAD drawings, congruence models, cell trajectory maps, magnetic imaging, a bar chart, or any of hundreds of other kinds of visualizations, engineering work requires explaining complex ideas with pictures and diagrams. Engineering practitioners and educators know that there is power in visual evidence. We propose that the design of most engineering and technical presentations, both in the professional and educational realm, adapt to use visual representations and complete assertions to support optimal communication.

This shift is needed because, despite knowing that pictures tell the best engineering stories, engineering presentations are often terrible representations of the skills and expertise of their speakers. All too often, engineering and technical presentations are full of slides that contain only textual bullet points. We have all experienced those kinds of presentations; we all want to avoid being the kind of person who gives those kinds of talks. The methods we describe and recommend herein will support speakers and educators to better meet the visual needs of their audiences. We propose the use of three specific techniques--visuals, sentence headers, and notes--as slide design innovations for use in educational and professional realms.

In the engineering realm, most presentations address multiple goals and strategies. Such presentations must necessarily appeal to multiple experts using the appropriate tone and level of technical vocabulary. There is no industry or educational standard because the needs and expectations for technical talks are so wide and varied. The one common denominator is this: the audience needs to understand the information.

Whether it is good or bad, slides have become powerful vehicles for engineering and technical information dispersal. To start, we want to ground our argument in recent findings about engineering communication. Following that groundwork, we articulate our approaches to slide re-design. The last change to common practice shows how to better address the need for slides to also contain teaching and/or instructional notes that serve as archival pieces for users.

2 START ON FIRM GROUND: COMMUNICATION AS AN ESSENTIAL ENGINEERING SKILL

When engineers are at work, they clearly identify good engineering with good engineering communication. In the United States, the accreditation body called ABET built a list of essential engineering skills, and that list includes good communication practices as an identified engineering skill that students should graduate with from a university program [1]. Other influential engineering bodies and organizations also outline the same [2-5].

As instructors, we take those recommendations seriously. To that end, we were part of a team that recently completed a three-year National Science Foundations study [6] that, in part, studied the working practices of six engineering firms in the U.S., with the goal of providing situated descriptions of engineering work, constraints, skills, and values. Using the idea of “knowledge cultures” [6, 7], we honed our ideas about communicating technical information with slides as a tool. Much as anthropologists might, we gathered data by observing engineers at work [6]. We saw clear evidence of what the engineering practitioners valued in skill sets of highly prized colleagues.

Thus, we had evidence, both anecdotal and via our study, that engineering communication is a core skill, highly valued in today’s cutting-edge engineering teams. What we also heard, however, was that presentation practices were an area where most engineering professionals needed improvement. And because engineering is the embodiment of a fix-it attitude, we have found through candid discussions and careful changes, engineering presentations, whether by educators or practitioners, can become powerful vehicles for information.

3 CATCH THE SLIP: POOR PRESENTATION PRACTICES IN ENGINEERING

We want to contextualize our own engineering communications teaching, starting with the graduate students. Unlike many graduate engineering programs in the U.S., admission to the graduate programs where we teach requires that applicants be at least four years into their career paths. Participants in the program hail from organizations of all sizes and specialties. We routinely work with practicing engineers from the United States military, automotive companies (all sectors), large earth moving equipment makers, and aerospace. Others are engineers from companies in software development,

the pharmaceutical industry, food production, packaging, energy, public works, civil engineering, entrepreneurial endeavors, and others.

These practicing engineers experience almost daily what one of them came to call “the decks of drudgery.” They see presentations daily that fail. At the same time, these practitioners slip into their own poor practices, despite knowing that their own talks could be better. Sadly, many of them report that they saw these less-than-optimal practices modeled by their own undergraduate instructors. They are not shy about explaining how badly those bullet-heavy and text-heavy slides collapse. Bad presentations become the focus of jokes and even anger.

We understand the impulse to use text and bullets: engineers and technical experts want to show their work, and they want to show all of it. Thus, the slides themselves become a document, what we call a “deck doc.” This impulse of combining the speech with the documentation effort clouds the purpose of a talk. For technical work, a fundamental shift needs to take place in the use of slides, where speakers realize the two lives of slides.

- The first life for slides is for the actual talk, where the goal is to engage audience members. In this mode, the most critical goal is to harness the opportunity of gathering individuals together. Visuals take prominence along with sentence headers in the slide acreage.
- The second life is as an informational document that can function as asynchronous documentation of the live proceeding. In this mode, technical experts and educators should use the “notes” feature to record necessary material that would otherwise be lost from the synchronous event.

There is scientific reasoning for moving away from heavy text and bullets, and we want to address that in brief before getting to the specifics of the new slide methodology.

4 REGAIN FOOTING: RESEARCH INFORMS NEW PRESENTATION DESIGN

Recent work that has focused on multimedia’s influence on how humans learn [8-11] informs the techniques that we recommend for engineering presentations. We have taken the lessons learned from influential work in cognitive science and applied it to presentation techniques. First, the practice of employing heavy text and bullets on a slide while, at the same time, talking to the audience must end. Simply put, the human brain cannot efficiently process both audio and textual information effectively. When processing channels are overloaded, the learner naturally shuts down, tunes out, and fails to receive the message that is being communicated.

The familiar slide template, riddled with bullets and too much text, is a direct example of poor multimedia design for effective information transfer. To combat this problem, we offer a three-pronged approach:

- We begin by encouraging engineers, engineering educators, and technical people to use some of their greatest weapons: visualizations instead of heavy text in the body of the slide.
- We promote the use of sentence headers, following the assertion-evidence model of slide design [12-14]. By transforming a header from a fragment to a complete assertion, speakers create a mini executive summary that highlights the main point of the speaker and the supporting slide.

- We acknowledge and understand the need for slide files to contain detailed information. Thus, for archival needs and for educational needs, the “notes” pane in slide programs is the appropriate repository (not the slide field itself).

4.1 First, harness visuals for teaching and informing

Bullets and heavy text are an easy target for improvement, and technical work can often use visualizations to communicate better, replacing bullets. Bullets can be signs of hurried preparation, unorganized thoughts, speaker unease, and a lack of consideration for the audience and purpose. They also function primarily as an aid for the speaker instead of as an aid for the audience. Figure 1A and 1B shows a side-by-side comparison.

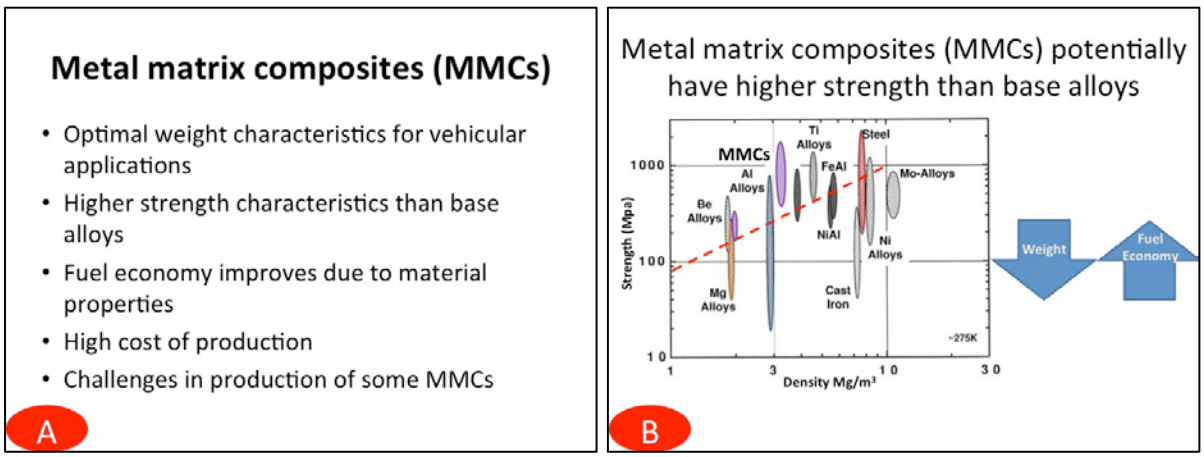


Figure 1A and 1B: Compare the text-heavy (1A) approach to the visual approach (1B). Slide used with permission [15].

To muster the courage to break out of bullet use, we rely on cognitive science research [8-11] and current publications on slide use [17-20]. These resources address the problems that arise when bullets are overused. In excellent presentations, the slides have been configured for the highest information conveyance for the audience; the focus is in the audience and what it needs.

Instead of bullets, the main acreage in the body of the slide should be devoted to visuals that enhance the technical information. Sometimes, those visuals are simple SmartArt® illustrations that illustrate relationships, hierarchies, flow, or order. Other visuals will be complex charts or 3D renderings. Maybe an equation will even be the visual. The point is this: visuals are easier for humans to process and remember, and they are many times quicker for the brain to process than words.

It must be emphasized that not any image will do. A poor image or a silly bit of clip art has no place in slides for the technical fields. Making poor choices for graphics can damage the credibility of the speaker and the information. Consider the choices being made with graphical pieces, critically assessing if they help convey technical complexity or if they hinder that effort. Use high contrast visuals with clean design elements for best viewability.

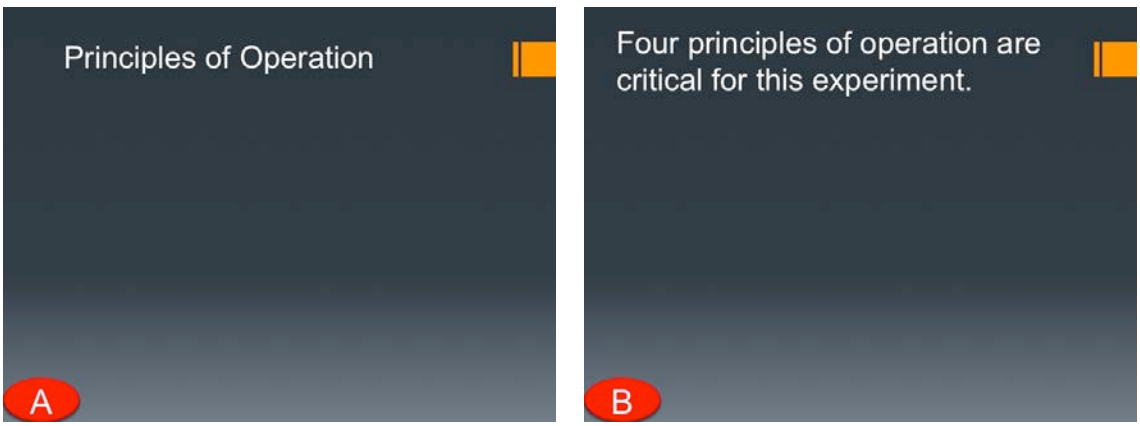
An additional tool that can be used by speakers to control the presentation of graphics is the concept of layering in images, as they are needed. For example, bringing in a visual piece by piece can help a speaker or instructor build an idea at the right pace. In contrast

to throwing all of the information onto the slide at once, where participants are actually encouraged to look everywhere and nowhere at the same moment, a planned information "build" methodically and logically imparts pieces of information at the moment they are needed and not before. Using shapes, arrows, and other devices can also get people to look at the right spot on the slide. At times, we recognize that a bulleted list is precisely the best format for a set of information. When that rare occurrence happens, we advise that speakers bring in bullets one by one, instead of dumping them all on to the slide at once.

While the alternative strategies presented here may sound logical and appealing to you, like other adopters, you may recognize certain audience members who would not welcome this change (or any change, for that matter) at all. If your audience analysis indicates that this is the case, be strategic in your design. Perhaps your first, and only step, will be to animate your bullets to control the pace of your information release. That new strategy alone may be all your audience will appreciate at first. Recognize the opportunities for change and work toward them, within the bounds of what your audience might be willing to accept. But do not be afraid to experiment and innovate with your own information delivery, because the results of those changes can be so positive.

4.2 Second, climb to the top: Revisit the purpose of a slide header

While it may be extremely easy for technical experts and teachers to accept the idea of visuals in the slides instead of bullets and too much text, the next element we promote can be more challenging to employ. Following the work of Michael Alley [12-15], we encourage speakers and instructors to use a sentence header, also called a "top-level takeaway" by some. Instead of a fragment at the top of the slide, as shown in Figure 2A, create a very concise, short sentence that captures the main point of the slide, such as that in Figure 2B. Not only does this practice enable more graceful transitions, it also eliminates the problem for many audience members of guessing what the point is.



Figures 2A and 2B: Instead of fragments (2A), use short sentences to show complete thoughts. Clarifying the main point can cognitively engage the audience.

In the past, some users question the effectiveness of the sentences, concerned that sentence headers could contribute to cognitive overload, just as bullets would. Fortunately, previous work has shown [12-14] that concise sentence assertions can decrease overload because they are a clear, full statement, not a fragment. For the audience, the talk becomes less a game of guess-what-the-speaker-meant and more of an information session with fully articulated and vetted main points.

4.3 Form terra firma: Using the notes feature for archival and detailed information

The final piece of the puzzle is what to do with all of the text that used to be in the slide itself. Losing those words is of great concern to engineering practitioners, teachers, and students alike. The beauty of slideware programs, however, is that the need is addressed. Both PowerPoint® and Keynote® include a notes feature for speaking points, citations, links, class notes, hints, answers, discussion points, edited bullets, and other content support. Using the notes feature allows speakers and instructors to keep their full complement of text, if needed, within the file. For instructors, the innovation that allows for a good set of speaking slides to function as a good set of class notes is revelatory. Remember, speakers do not show those notes during the talk; rather, they become part of the slide's file that can be printed out for later use and reference (Figure 5A and 5B).

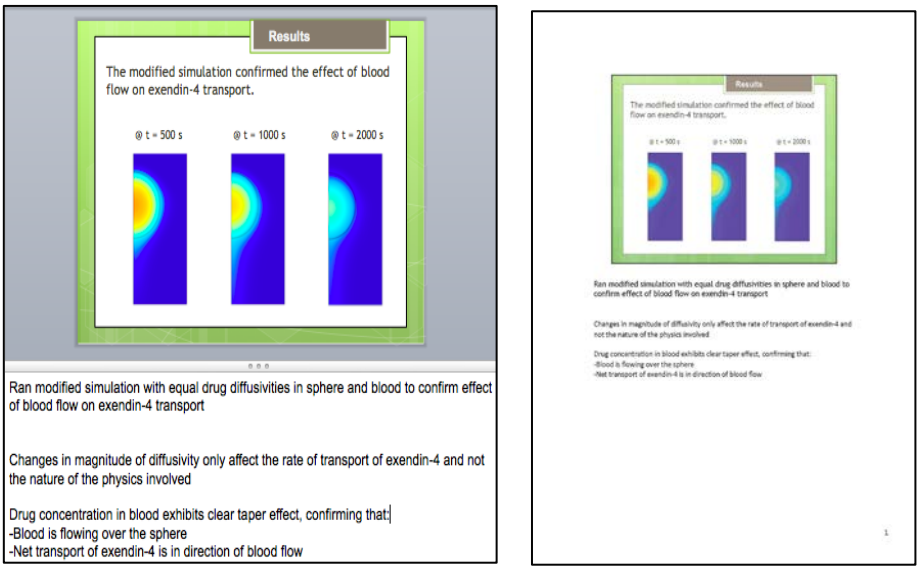


Figure 5A and 5B: Use the Notes pane to an advantage. In the screenshot shown in 5A, we see the slide and its notes. Remember, do not show the notes pane during the talk. In 5B, see how the PDF format looks on the printed page. Example slide [21] used with permission.

If the slide file is to be shared, we recommend formatting that distributed file as a PDF, using the option to "Print Notes" for document output. If using PowerPoint®, the output will look like that shown in Figure 5B.

5 CONCLUSION

Because these techniques have had such a profound impact on our work and the success of our students, it is easy for us to slip into a bit of evangelism when we talk and write about them. However, we also recognize that the changes we promote here can be challenging to implement and that they are not the norm in most circles of practice yet. For the more bold among us, the uniqueness of the design strategies is part of the appeal, while for others, standing out from the crowd can be a daunting prospect. Yet, as hundreds of our former students have attested, the techniques work and they are worth

the trouble. A frequent request heard from students after they learn these techniques is, “Why don’t you teach these things to our other faculty?” Truly, once students learn the power of these techniques on their own presentations, they have little patience for sitting through the old-style, bullet-laden talks. They have experience firsthand what better learning looks like, and they expect better. Teachers, students, and experts alike need to find best practices for their talks, and experimenting with the techniques we promote is a good start towards that effort.

It is also important to note that an excellent presentation is not just slides. To fully engage one’s audience requires strong delivery skills as well as solidly organized content knowledge. Yet, an exciting aspect of the techniques described here is that they free the speaker to have a conversation with the audience, leading to better delivery in most cases, and they force the speaker to think carefully about the main messages of the presentation, leading to better organized content. In this way, the investment of time and effort is a smart way for good speakers to gain ground in their journey to becoming great.

In the classroom, the innovation in the way instructors use slides is almost a way of returning to the basics. By framing the big ideas well (using sentence headers), by using visuals to support those points, and by providing fully-realized, well-articulated sets of notes, we provide a classroom and/or presentation experience where we return the speaker to the center of the exchange of ideas, pushing slides back to where they belong—as backdrops and support.

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