

The PowerPoint presentation that cost lives.

**A lesson in how important visual
communication can really be.**

by Alex Pribula

What happened?

On the 16th of January 2003, NASA launched space shuttle Columbia into orbit.

It was assumed that the launch was successful.

NASA officials sat down with Boeing engineers who had created a 28 slide PowerPoint presentation on the issue.

Columbia and her seven person crew were lost on re-entry.

NASA reviewed the launch footage and discovered a piece of foam detached and damaged some tiles on the left wing of the shuttle.

It was decided that re-entry would be completed as normal, due to the NASA officials' understanding of the presentation.



What went wrong?

After the incident, an investigation by the Columbia Accident Investigation board was completed.

They came to a tragic, regrettable conclusion.



“

The Board views the endemic use of PowerPoint briefing slides instead of technical papers as an illustration of the problematic methods of technical communication at NASA.

”

– the Columbia Accident Investigation Board


What was on those slides?

It wasn't as much *what* was on those slides, as to how those slides were put together that led to the Columbia disaster (Lasoen, 2015).

Multiple design principles were violated.

Before we can attempt to 'fix' the Columbia slides and design a solution that would have prevented the disaster, we first have to understand why the slides were ineffective.

**Let's break down one
of the Columbia slides
in detail to find out.**



~~Readability~~

~~Highlighting~~

~~Legibility~~

~~Hierarchy~~

title is misleadingly reassuring.

qualitative wording is ambiguous in this situation.

bad bullet point hierarchy.



6 levels of hierarchy.

Review of Test Data Indicates Conservatism for Tile Penetration

- The existing SOFI on tile test data used to create Crater was reviewed along with STS-87 Southwest Research data
 - Crater overpredicted penetration of tile coating significantly
 - Initial penetration to be described by normal velocity
 - Varies with volume/mass of projectile (e.g. 200ft/sec for 3cu. Ln)
 - Significant energy is required for the softer SOFI particle to penetrate the relatively hard tile coating
 - Test results do show that it is possible at sufficient mass and velocity
 - Conversely, once tile is penetrated SOFI can cause significant damage
 - Minor variations in total energy (above penetration level) can cause significant tile damage
 - Flight condition is significantly outside of test database
 - Volume of ramp is 1920cu in vs 3 cu in for test

Slide retrieved from the Columbia Accident Investigation Board

what does "significantly" actually mean?

the 4 core messages are lost.

the most important point was written in the smallest font size.

“ *...it is easy to understand how a senior manager might read this PowerPoint slide and not realize that it addresses a life-threatening situation.* **”**

— the Columbia Accident Investigation Board

What principles were violated?

Hierarchy.

Hierarchical organisation is the best way to visualise and understand complex problems and information. The Columbia slides show a very poor understanding of hierarchy, and ultimately led to misinterpretation of importance by the audience (Tufte, 2003).

Legibility.

Legibility refers to the visual clarity of text, based on size, typeface contrast, text blocks and spacing of characters used. Lots of information on the Columbia slides is bunched closely together, making reading a strenuous process.

Readability.

Sentences need to be concise to be effective. Run-on and conjoined sentences, such as those in the Columbia slides, can impact readability and, in turn, information can be lost in translation to the audience.

Interference effects.

Mental processing can be made slower and less accurate through competing mental processes; known as interference effects. The incoherent use of qualitative and quantitative data on the Columbia slides creates ambiguity.

Highlighting.

Highlighting information ranks it as more critical. There is little to no use of highlighting in the Columbia slides, all information incorrectly represented as of the same level of importance.

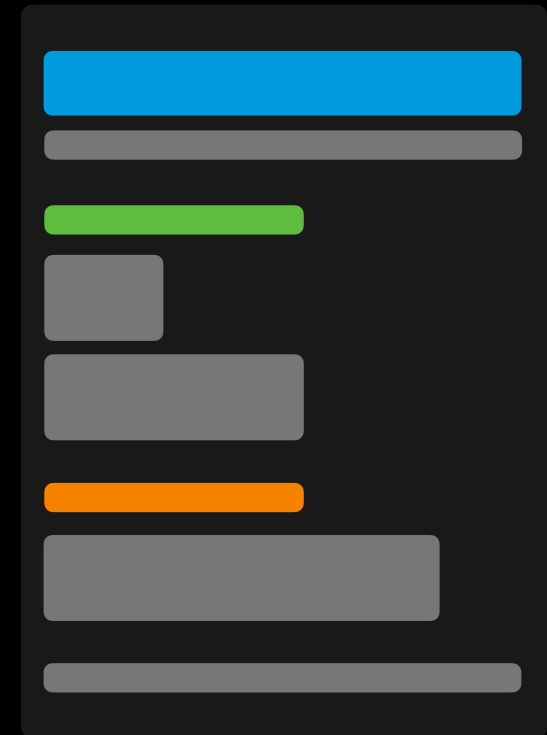
How do we prevent this from happening again? A framework. ---

We need to build a framework that prevents misunderstanding, miscommunication, and room for error when presenting information.

Visual communication is always important.

However, when in the context of life threatening information, there is no room for misinterpretation.

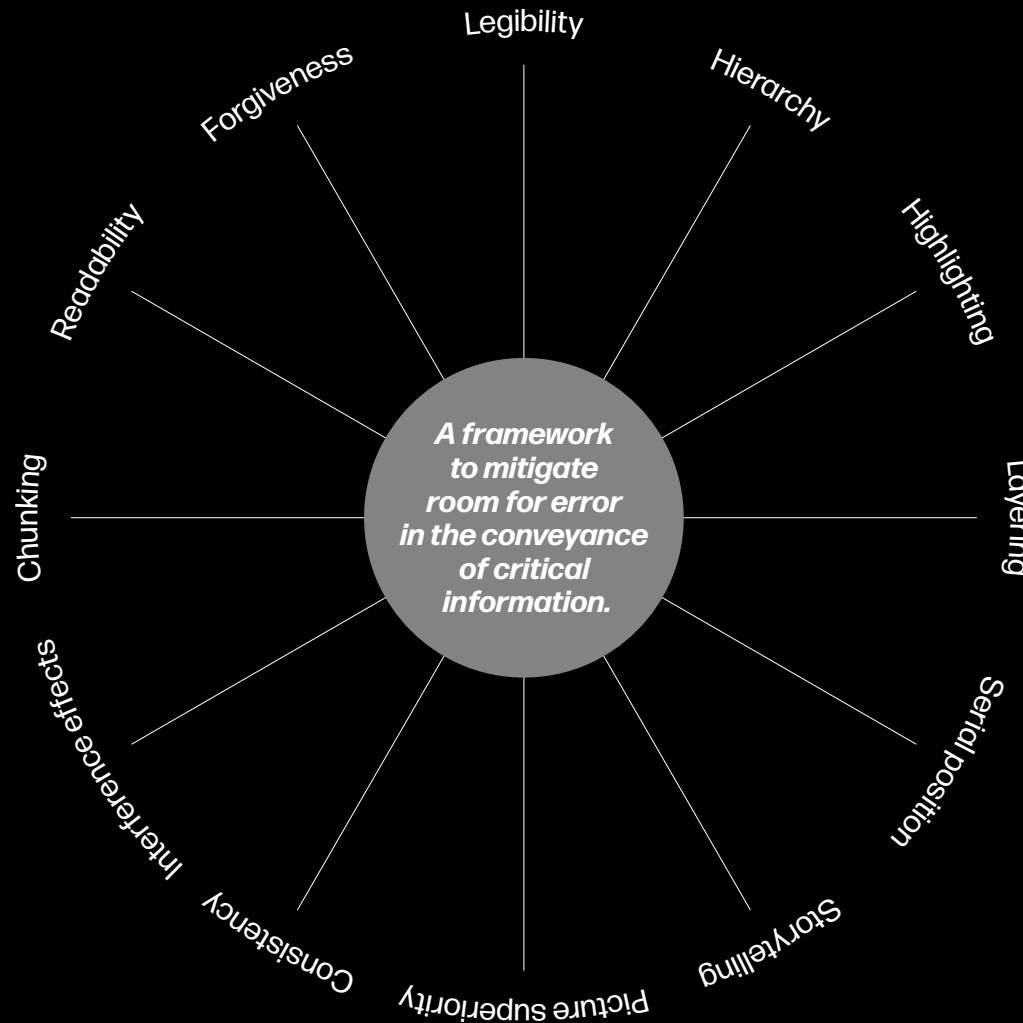
All presentations of information, regardless of medium, need to follow a strict set of guidelines, or rather a framework, in order to be as effective and risk-avoiding as possible; mitigating room for error in the conveyance of critical information.



What makes up the framework? ———

These design principles are core to the framework.

The framework is designed to apply to scenarios involving



These principles must all be considered when applying the framework to different disciplinary areas and contexts.

The framework. Workplace culture.

Clarity and care needs to be paramount within every workplace, especially ones concerning such operations as space travel.

Operant conditioning.

It was determined that by the time of the Columbia disaster “inadequate concern over deviations from expected performance, a silent safety program, and schedule pressure”(CAIB) was the culture at NASA. By reinforcing safety-focused behaviour throughout the company, unsafe scenarios should not exist in future.

Development cycle.

The Space Shuttle program as a whole was less efficient, more expensive, and more dangerous (Schwartz, 2003) than prior programs at NASA. “Go fever”, a term that refers to NASA being in a rush to meet deadlines while overlooking mistakes, could be mitigated by a more stringent and thorough development cycle with more iterating and achievable deadlines.

Hierarchy of needs.

By establishing a hierarchy of needs within a company, a tone of safety and transparency can be set amongst the workplace, filtering down through the ranks. Within NASA, setting the tone of safety would draw the company away from it’s “get-home-itis” attitude; achieving goals no matter the human cost (Woods).

The framework. Presentation protocol.

The five rules to effective conveyance of critical information:

- ◆ Never overload users or audiences with more than 3 chunks of information at a time. Our minds can't process more than this, and we don't want information to be missed; **interference effects.**
- ◆ Use visual representations when appropriate. Based on the idea of the **picture superiority effect**, visuals can very simply communicate important ideas effectively and with ease.
- ◆ Critical information should always be more prominent than regular copy. Users and audiences need to know this information in particular, and as such it should be **hierarchically** above regular information.
- ◆ Understand hierarchy and stick to it. Don't use sub bullets, you shouldn't have to. Find a way to present information that is relevant, clear and easy to understand.
- ◆ Engage audiences. Use rhetorical questions, statements, and keep it succinct. Don't just leave prose on your slides, make it fun to listen to, make it engaging, whatever the purpose. Create a narrative; use **storytelling.**

Let's apply the framework to the Columbia slide from earlier.

The title should surmise the key points on the slide.

Misleading titles like the one for the Columbia slides can lead to jumping to conclusions and missing the point of the information.

Too many ideas on one slide can lead to confusion.

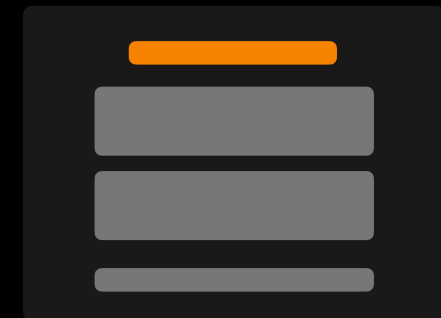
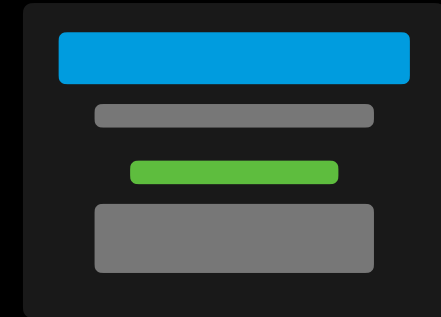
The Columbia presentation had too much info on each slide, our working memory is not able to process this much.

Bullet points can be good, but sub-bullets can be confusing.

Information gets lost, and information hierarchy becomes too complex to handle. The Columbia slides have 6 levels of hierarchy, at which point it becomes useless.

Pictures really do 'tell a thousand words'.

With critical information like that on the Columbia slides, an annotated image would have told the best and worst case scenario clearly and effortlessly.



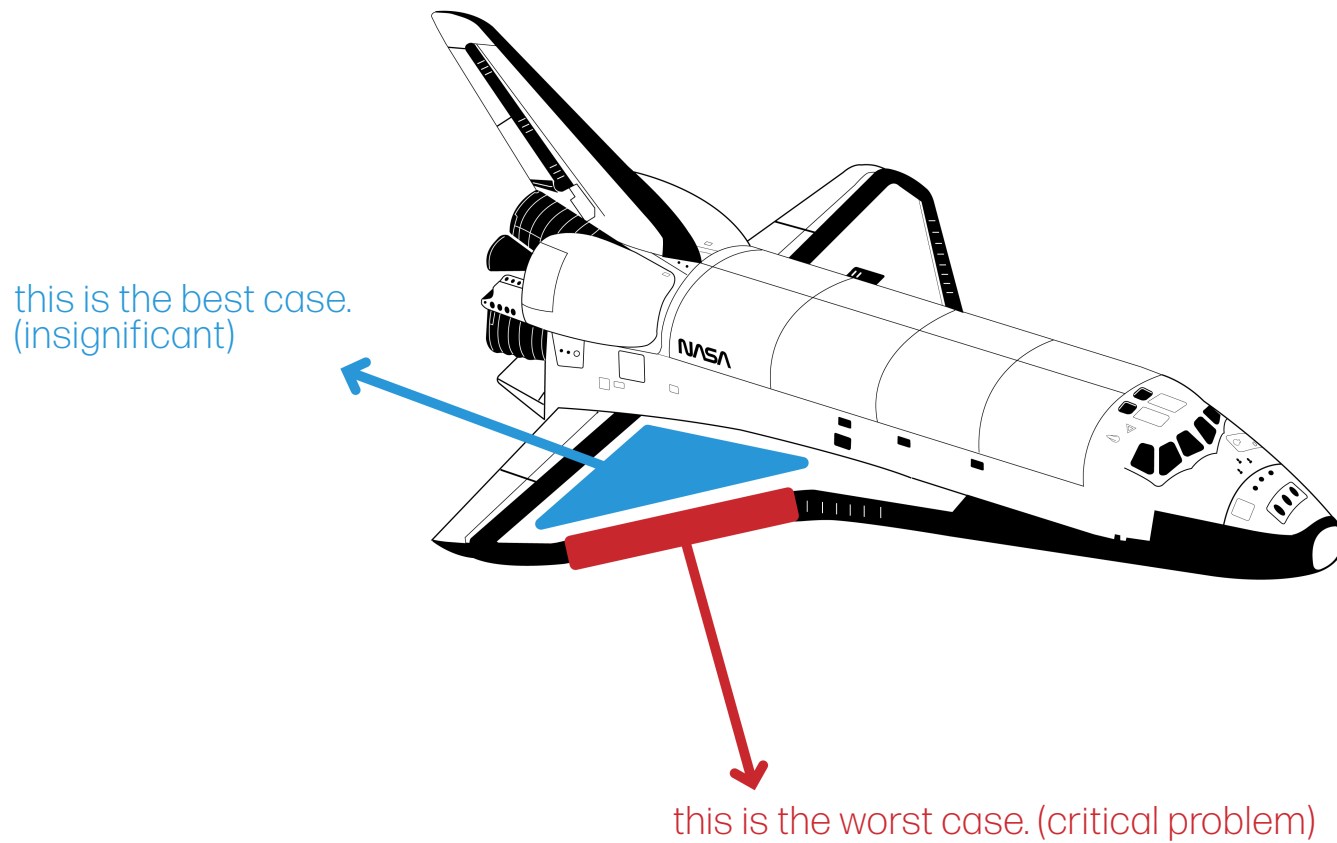
Let's see what the slide would look like.

We need to determine if the wing has been damaged before proceeding.

- The simulations predicted the foam strike completely penetrated through to the wing's frame.
- However, the results are inconclusive as the foam strike was 600 times larger than anything previously recorded in the database.
- The damage would be insignificant if the heat tiles were hit.
- If the wing was struck, we have a critical problem.

We need in-orbit photos of the wing.

We need to check these two coloured areas for damage:



Applying the framework. Medicine.

Applications in medicine.

Between 44,000 and 98,000 people die every year because of medication errors (Institute of Medicine, 2000).

Current medicinal packaging templates “do not differentiate between medicines, users, actions, languages, and contexts.” (Van de Waarde, 2005). Templates don’t always accommodate for the “most relevant information” for users, in direct conflict with the EU guidelines.

Instead of a template based approach, medicinal packaging would benefit from adhering to the framework, designing for each individual case instead of blanket-designing for all medicine types.

There were 121 cases of ingestion of this product in the year 2010.

A “for skin use only” was added, however a “DO NOT DRINK” label would be more concise.



Marketing terms distract from critical information concerning users health. Instead, directions and dosage should be front and centre.



Applying the framework. Instruction.

This information is not critical, and unnecessary in an instruction booklet.

Applications in giving directions.

Operation manuals are ancillary means of support. Almost in a state of “existential limbo” (Ballard, 2018), operation manuals should ideally *not exist*; products should be well-designed enough to be used without their aid, however in reality they are still necessary in many cases.

Optimal operation manuals, that abide by the framework, should be easy to navigate and understand. This is important in terms of findability; referring to the ease at which information can be discovered by a user.

planet bike protege 8.0 and 9.0 Instructions

1. Parts List

1. Mounting Bracket
2. Wheel Sensor
3. Computer Case
4. Rubber Shims
5. Wheel Magnet
6. Quick Ties

1 mm
2 mm

Congratulations and thank you for your purchase of the Planet Bike Protege Bicycle Computer. The Protege represents a breakthrough in bicycle computer design and function. The MacroMonitor LCD display, "buttonless" design, and overall compact size offer advantages to the cyclist that no other computer can match. In recognition, Planet Bike will donate 25% of our profits from purchases of any other Planet Bike product you buy, to non-profit bicycle advocacy groups to further benefit your cycling experience. Enjoy your new Protege Bicycle Computer and thank you for making a difference!

2. Mounting Instructions

STEP 1: Attach the wheel sensor to the right or left fork using two quick ties (diagram #1). Note: Do not fully tighten quick ties until final placement is determined. We recommend a sensor placement of 1-2 inches up from hub axle (diagram #1). Position sensor and wire on backside (toward rider) of fork blade to offer protection from debris while riding.

STEP 2: Attach magnet to spoke using screwdriver (diagram #2) so magnet lines up directly across from one of the flat round dots at the lower or upper portion of wheel sensor with a distance of 1/2 mm between sensor and magnet (diagram #3). Caution: Do not over-tighten magnet screw.

STEP 3: Attach the wire harness to the fork using quick ties (diagram #4). Excess wire can be wrapped around brake cable before securing bracket to handlebars. Note: Allow slight wire slack between fork and brake cable for turning handlebars.

STEP 4: Attach the computer bracket to the handlebars near the stem (diagram #4). Use any combination of rubber shims to fit different diameter handlebars. Tighten the screw so the bracket will not rotate on the handlebars. Slide the computer head into the bracket until it "snaps" into place.

STEP 5: TEST. Install computer head into bracket and rotate front wheel to test for proper function of magnet/wheel sensor alignment. The mph/kph indicator will flash if the sensor and magnet are properly aligned. Tighten quick ties on sensor when correct alignment is achieved.

TO REMOVE COMPUTER HEAD FROM BRACKET: Push the computer in the opposite direction you would to mount it (diagram #5). The computer head will "snap" out. Note: You may have to push hard, do not be afraid of breaking it. It will pop out.

3. Functions & Specifications

LINE : LCD Specification : Line 1, 2 and 3 modes do not change

- 1 CURRENT SPEED • Miles or Kilometers per hour • 0-99.9 mph/Kph • Increments of 0.1 mph/Kph
- 2 RIDE TIME, "RTM" • Up to 9:59:59 • Increments of 1 second
- 3 RIDE DISTANCE, "DST" • Up to 999.99 M or K • Increments of 0.01 M or K
- 4 ODOMETER, "ODO" • Up to 999.99 M or K • Increments of 0.01 M or K (ODO= Cumulative distance for BIKE 1 and BIKE 2)

OR CHANGE MODE TO SCREEN 2-4 BY PUSHING COMPUTER FORWARD IN BRACKET TO ACCESS:

- AVERAGE SPEED, "AVS" • 0-99.9 mph/Kph • Increments of 0.1 mph/Kph
- MAXIMUM SPEED, "MAX" • 0-99.9 mph/Kph • Increments of 0.1 mph/Kph
- TEMPERATURE • -19° to 120 F / -19° to 50 C (Protege 9.0 ONLY)
- CLOCK • 12 Hr format • Indicated by flashing colon ":"
- BIKE ODOMETER, "BIKE ODO" • Up to 99,999 M or K • Increments of 0.1 M or K (This is the distance for the wheel size currently being used. It only appears when distance is registered on both BIKE 1 and BIKE 2.)

PUSH AND RELEASE FOR MODE CHANGE. CAUTION: HOLD FOR LESS THAN ONE SECOND OR YOU WILL RESET ALL OF THE RIDE DATA.

This is FAR too complex.

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