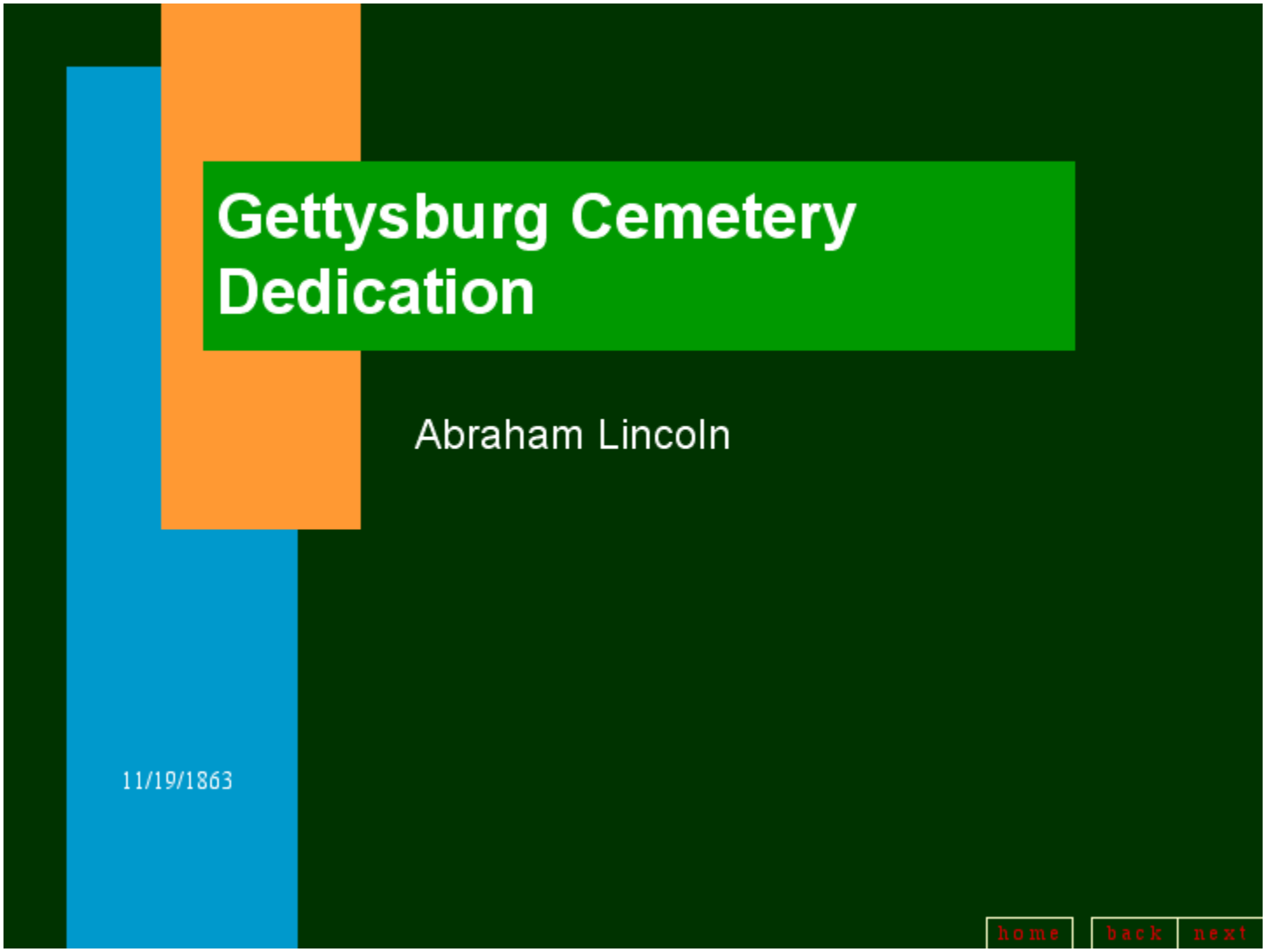

Peter Norvig, "The Gettysburg PowerPoint Presentation," October 12, 2011, norvig.com/Gettysburg/.

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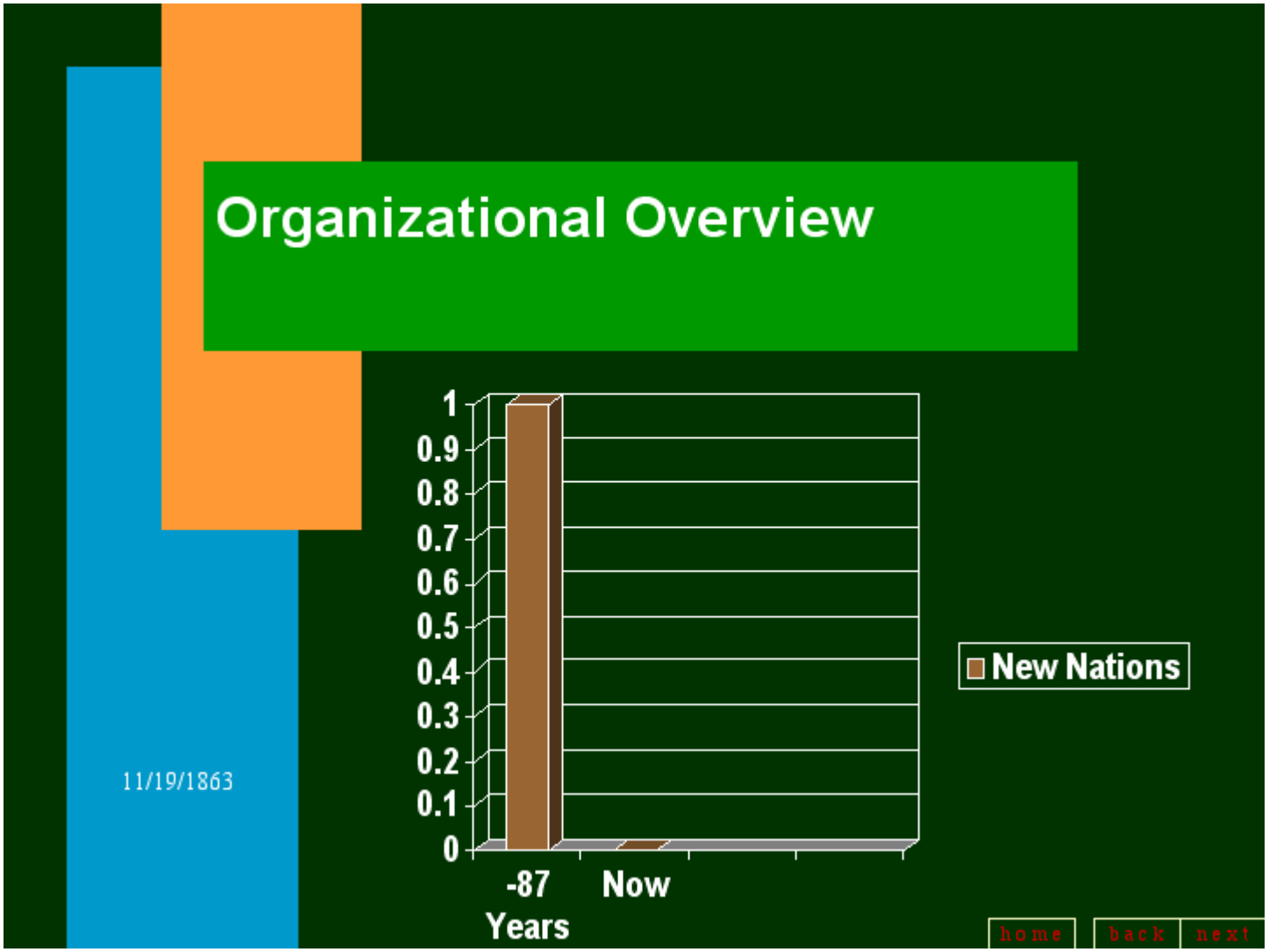

Peter Norvig, "The Gettysburg PowerPoint Presentation," October 12, 2011, norvig.com/Gettysburg/.

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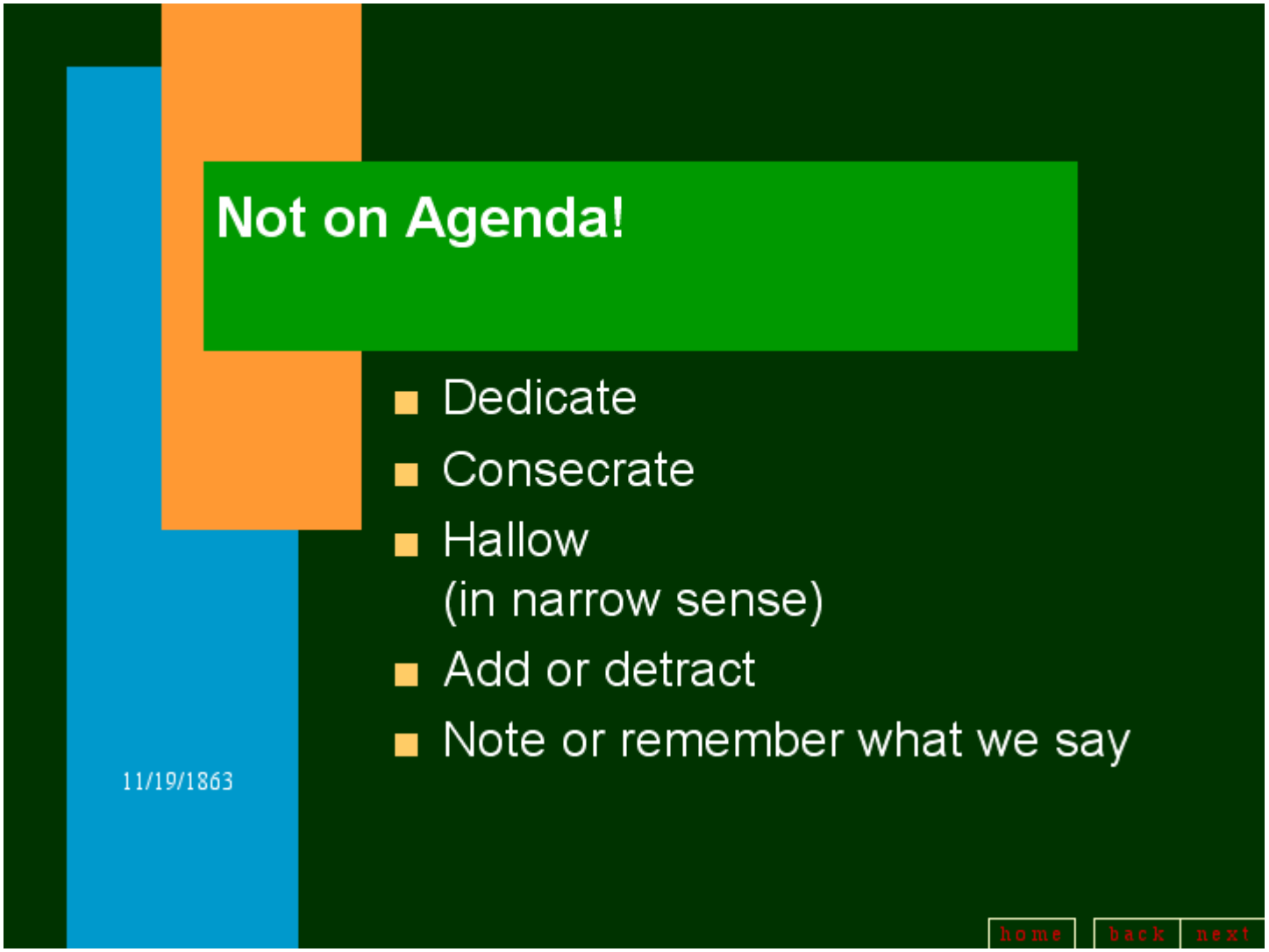

Peter Norvig, "The Gettysburg PowerPoint Presentation," October 12, 2011, norvig.com/Gettysburg/.

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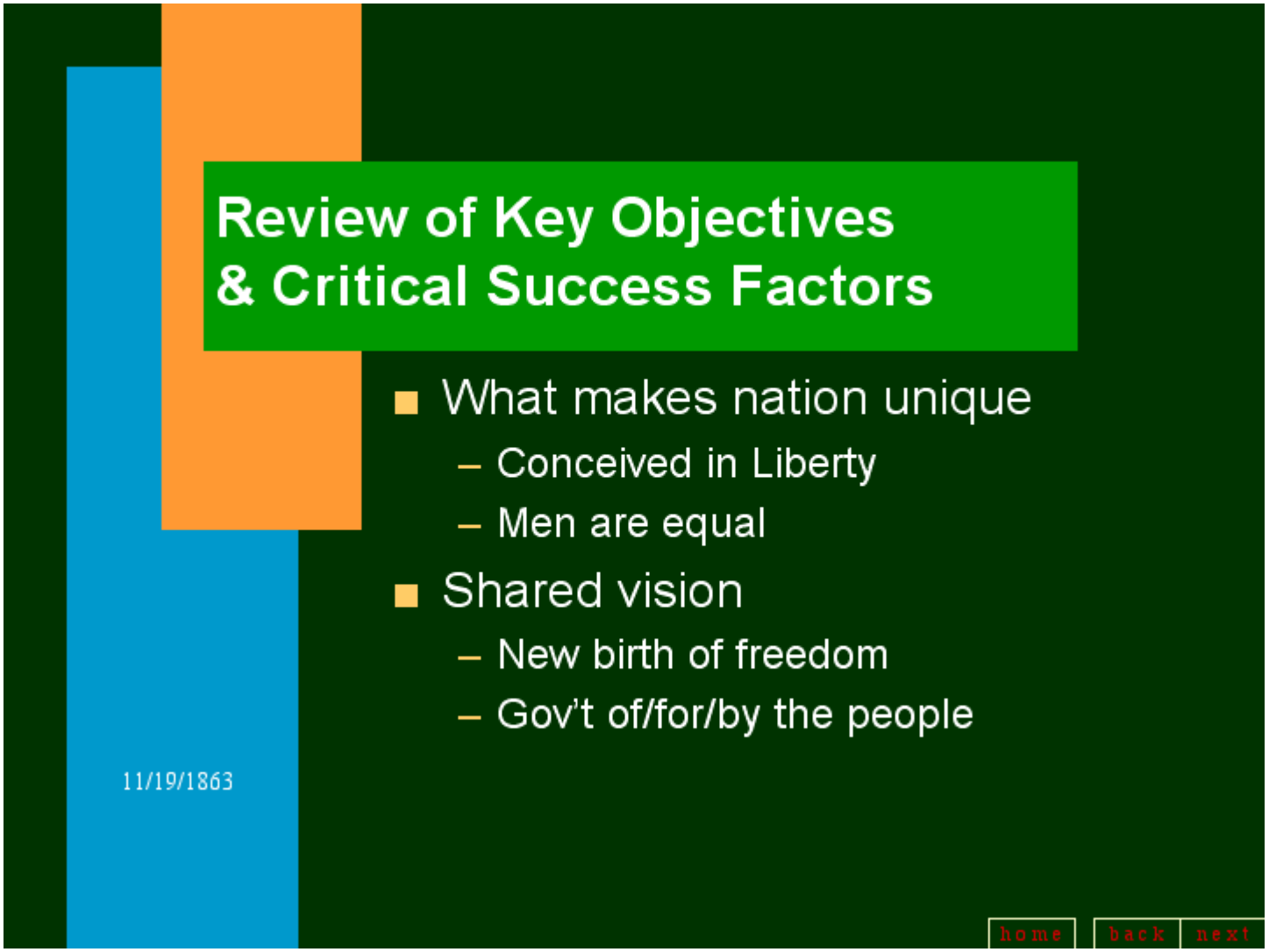

Peter Norvig, "The Gettysburg PowerPoint Presentation," October 12, 2011, norvig.com/Gettysburg/.

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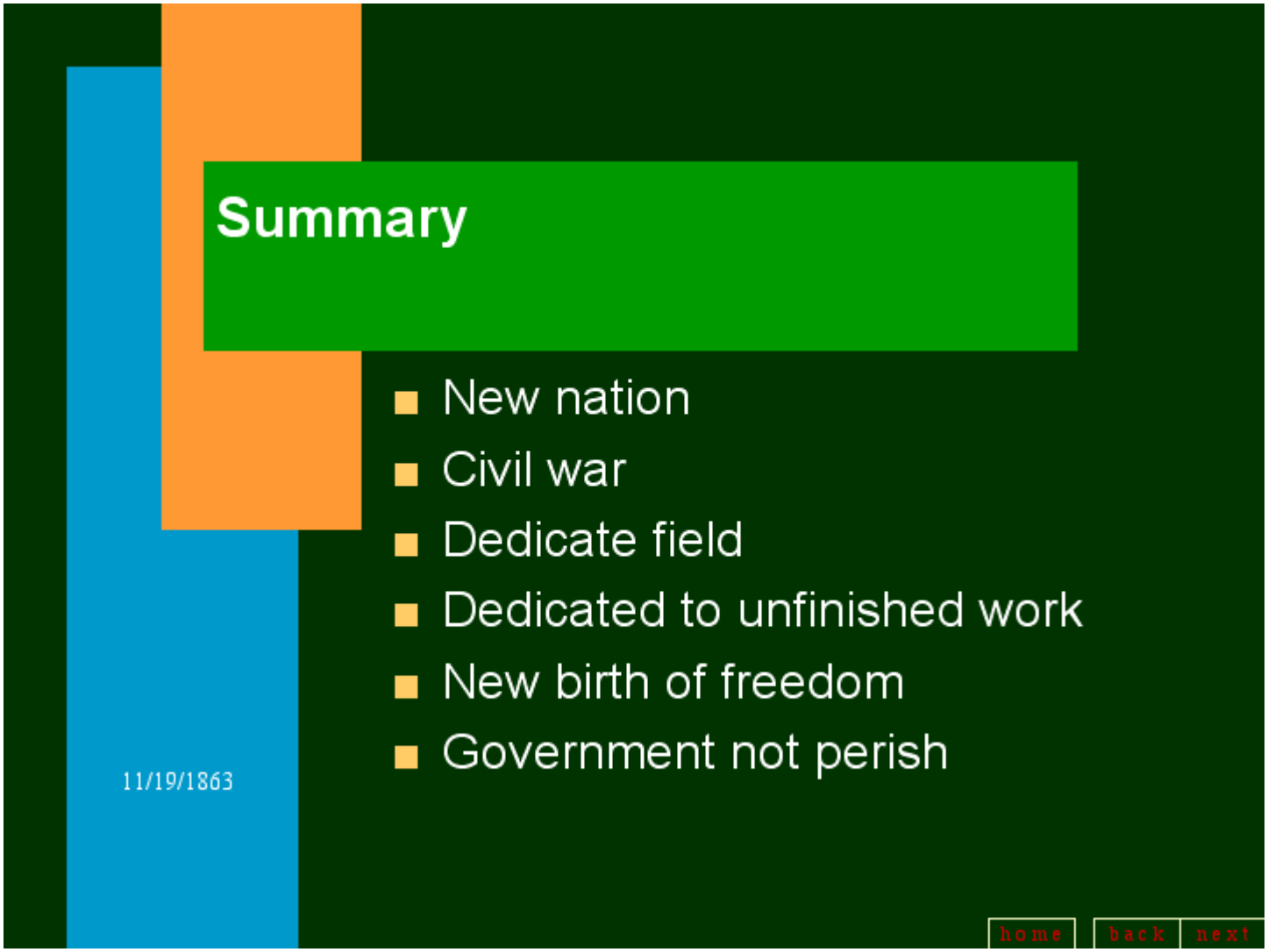

Peter Norvig, "The Gettysburg PowerPoint Presentation," October 12, 2011, norvig.com/Gettysburg/.

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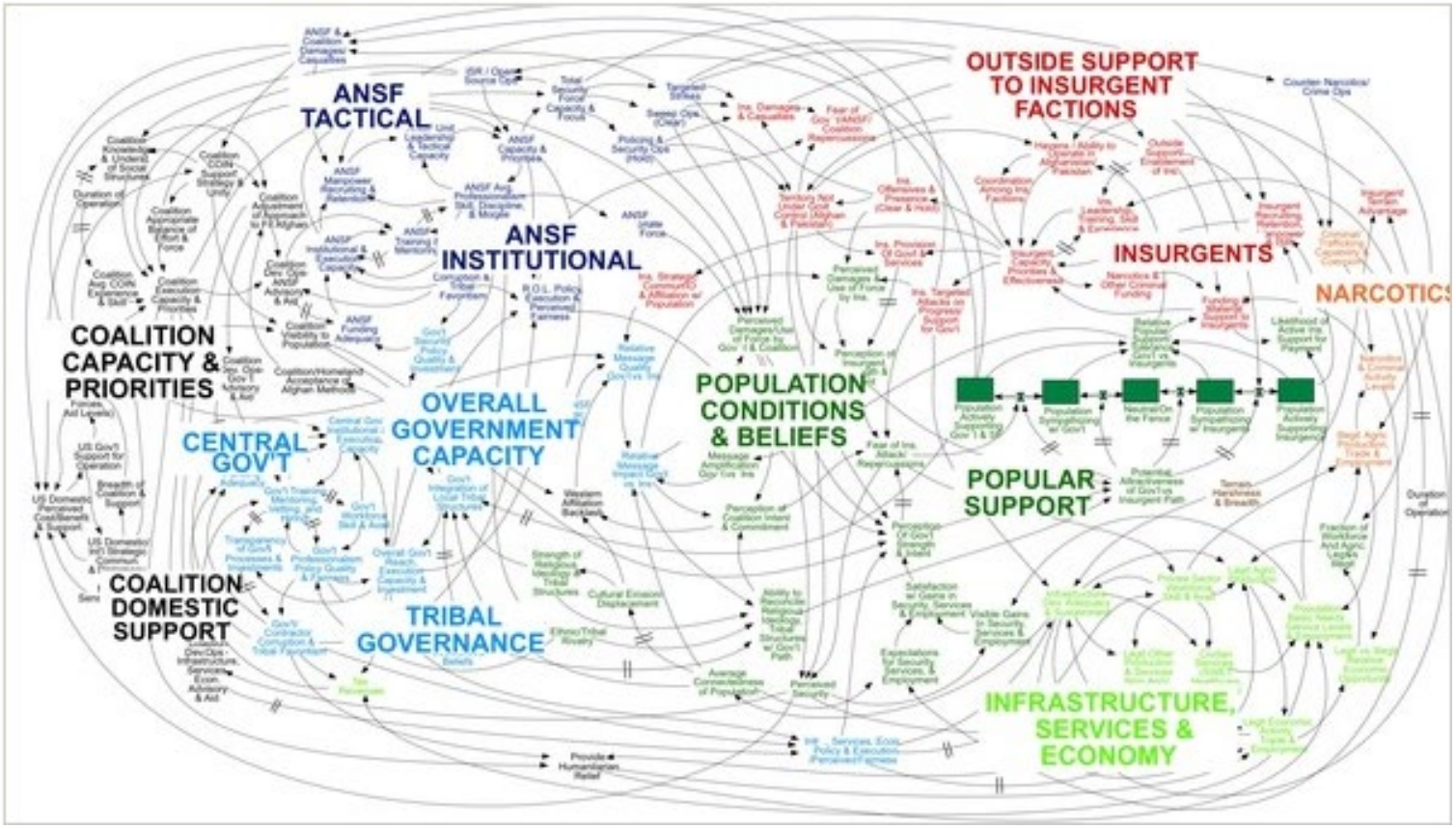


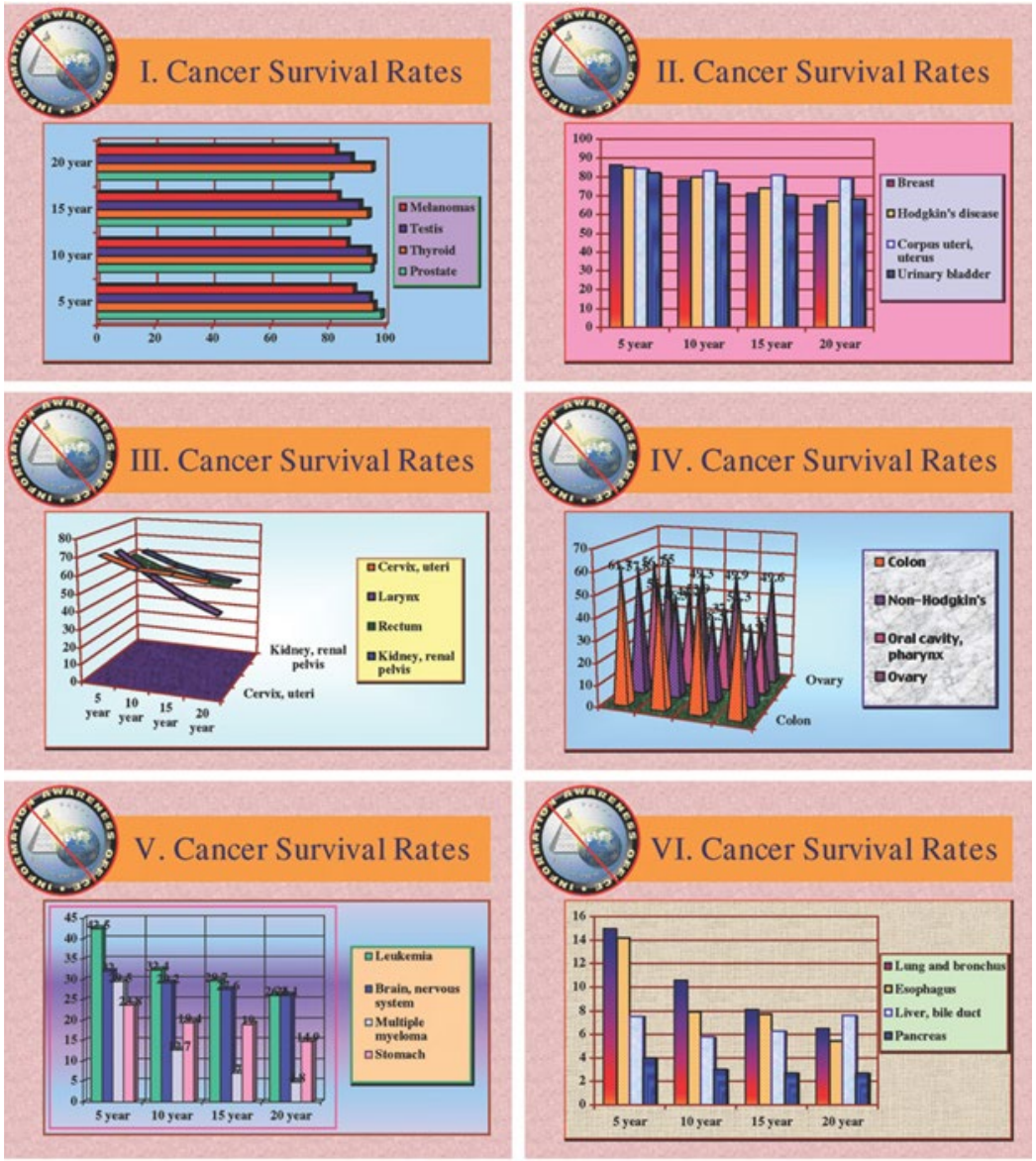
A military PowerPoint diagram meant to portray the complexity of American strategy in Afghanistan. Source: Elisabeth Bumiller, "We Have Met the Enemy and He is PowerPoint," New York Times, April 26, 2010. [We Have Met the Enemy and He Is PowerPoint].

	Relative survival rate, % (SE)			
	5 years	10 years	15 years	20 years
Cancer site				
Oral cavity and pharynx	56·7 (1·3)	44·2 (1·4)	37·5 (1·6)	33·0 (1·8)
Oesophagus	14·2 (1·4)	7·9 (1·3)	7·7 (1·6)	5·4 (2·0)
Stomach	23·8 (1·3)	19·4 (1·4)	19·0 (1·7)	14·9 (1·9)
Colon	61·7 (0·8)	55·4 (1·0)	53·9 (1·2)	52·3 (1·6)
Rectum	62·6 (1·2)	55·2 (1·4)	51·8 (1·8)	49·2 (2·3)
Liver and intrahepatic bile duct	7·5 (1·1)	5·8 (1·2)	6·3 (1·5)	7·6 (2·0)
Pancreas	4·0 (0·5)	3·0 (0·5)	2·7 (0·6)	2·7 (0·8)
Larynx	68·8 (2·1)	56·7 (2·5)	45·8 (2·8)	37·8 (3·1)
Lung and bronchus	15·0 (0·4)	10·6 (0·4)	8·1 (0·4)	6·5 (0·4)
Melanomas	89·0 (0·8)	86·7 (1·1)	83·5 (1·5)	82·8 (1·9)
Breast	86·4 (0·4)	78·3 (0·6)	71·3 (0·7)	65·0 (1·0)
Cervix uteri	70·5 (1·6)	64·1 (1·8)	62·8 (2·1)	60·0 (2·4)
Corpus uteri and uterus, NOS	84·3 (1·0)	83·2 (1·3)	80·8 (1·7)	79·2 (2·0)
Ovary	55·0 (1·3)	49·3 (1·6)	49·9 (1·9)	49·6 (2·4)
Prostate	98·8 (0·4)	95·2 (0·9)	87·1 (1·7)	81·1 (3·0)
Testis	94·7 (1·1)	94·0 (1·3)	91·1 (1·8)	88·2 (2·3)
Urinary bladder	82·1 (1·0)	76·2 (1·4)	70·3 (1·9)	67·9 (2·4)
Kidney and renal pelvis	61·8 (1·3)	54·4 (1·6)	49·8 (2·0)	47·3 (2·6)
Brain and other nervous system	32·0 (1·4)	29·2 (1·5)	27·6 (1·6)	26·1 (1·9)
Thyroid	96·0 (0·8)	95·8 (1·2)	94·0 (1·6)	95·4 (2·1)
Hodgkin's disease	85·1 (1·7)	79·8 (2·0)	73·8 (2·4)	67·1 (2·8)
Non-Hodgkin lymphomas	57·8 (1·0)	46·3 (1·2)	38·3 (1·4)	34·3 (1·7)
Multiple myeloma	29·5 (1·6)	12·7 (1·5)	7·0 (1·3)	4·8 (1·5)
Leukaemias	42·5 (1·2)	32·4 (1·3)	29·7 (1·5)	26·2 (1·7)

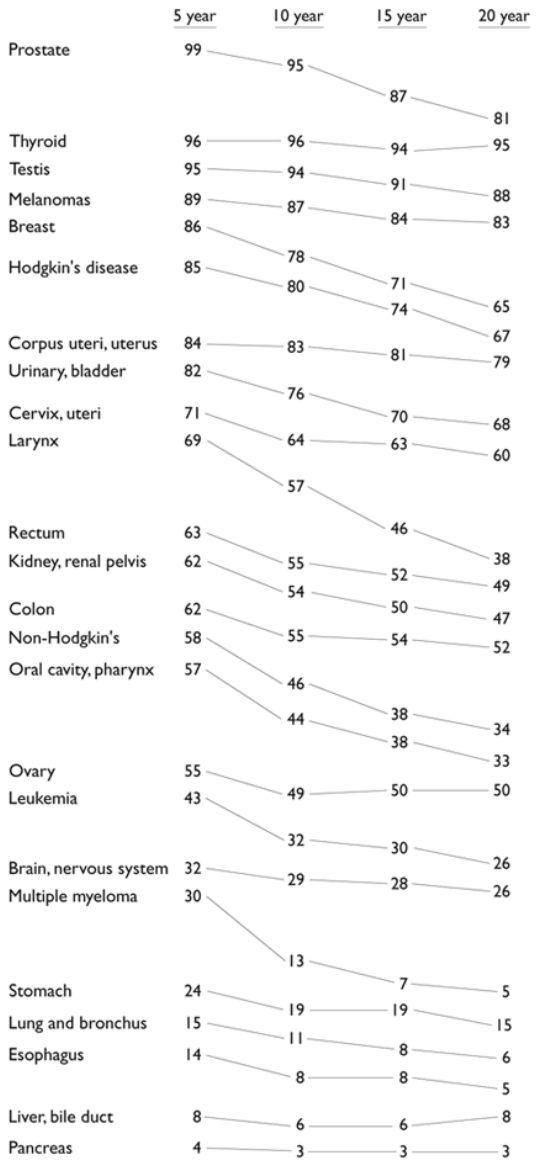
Rates derived from SEER 1973–98 database (both sexes, all ethnic groups).[12]
NOS=not otherwise specified.

Table 4: **Most recent period estimates of relative survival rates, by cancer site**

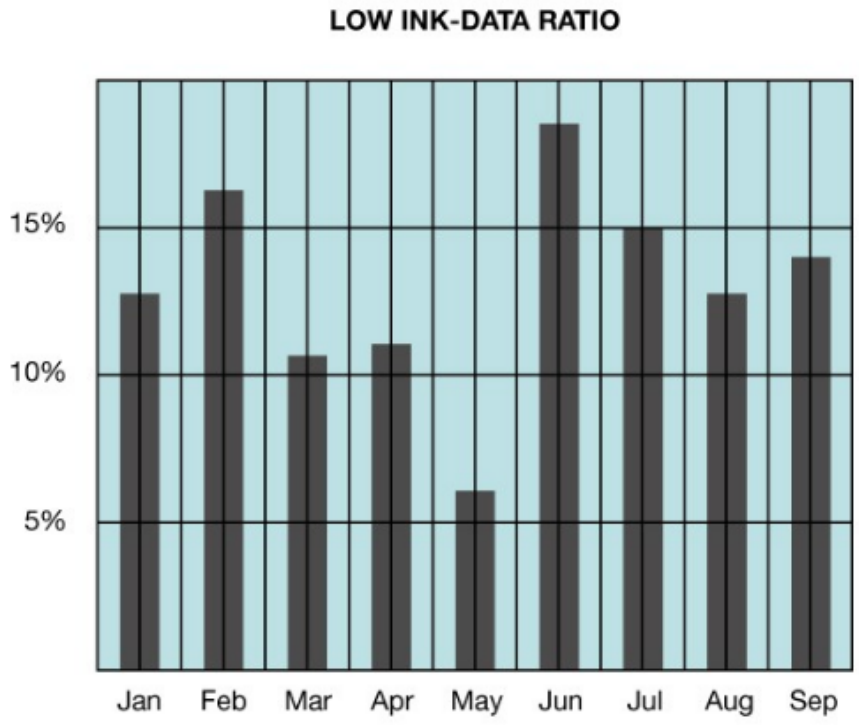
Hermann Brenner, "Long-term survival rates of cancer patients achieved by the end of the 20th century: a period analysis," *The Lancet*, 360 (October 12, 2002), pp. 1131-1135.

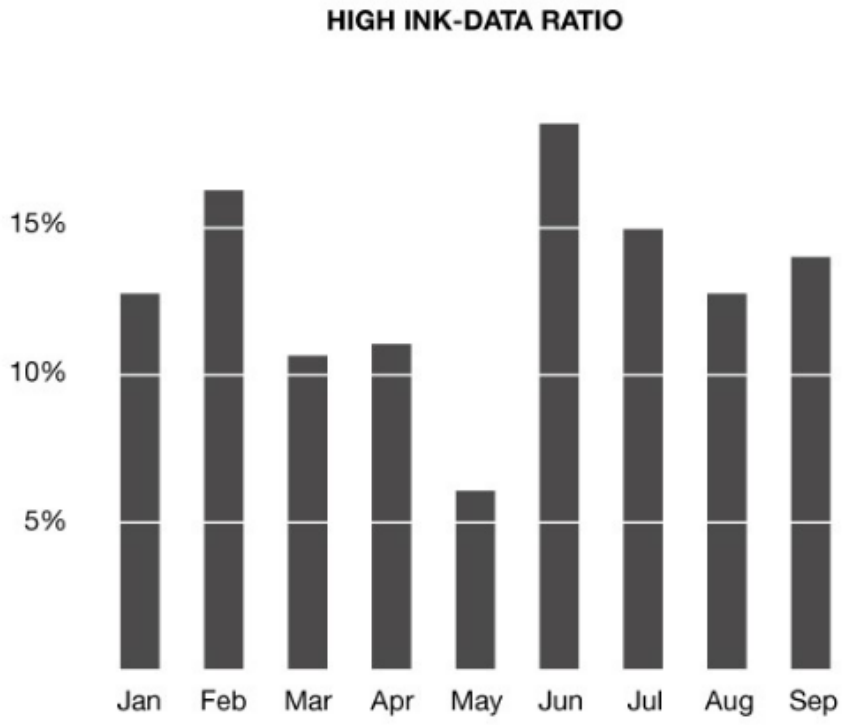


Cancer survival rates chart from the Information Awareness Office of Defense Advanced Research Projects Agency (DARPA), 2002. Source: Edward Tufte, "The Cognitive Style of PowerPoint," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 175.



Revised cancer survival rates chart by Edward Tufte. Source: Edward Tufte, "The Cognitive Style of PowerPoint," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 176.





WinWire Technologies, “Principles for Creating Effective Data Visualization,” https://www.winwire.com/data-visualization.

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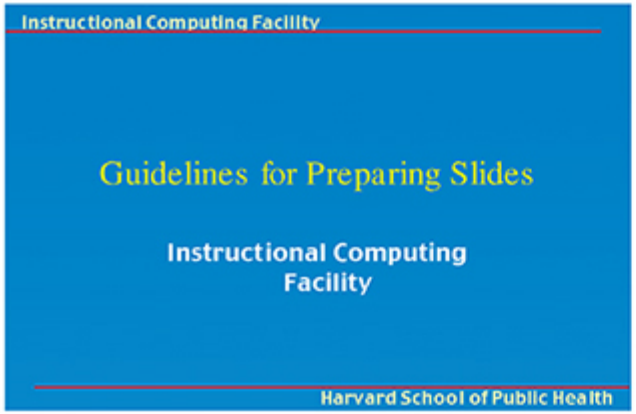
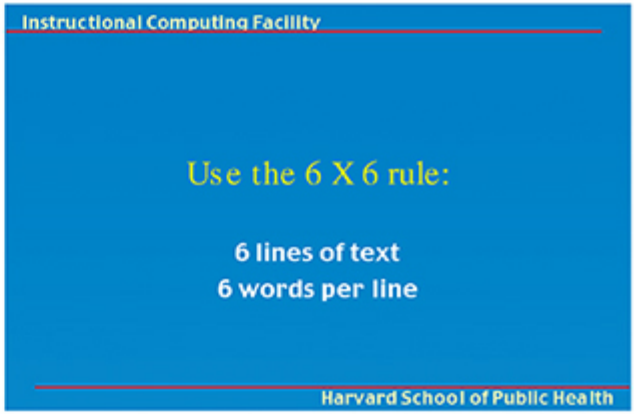
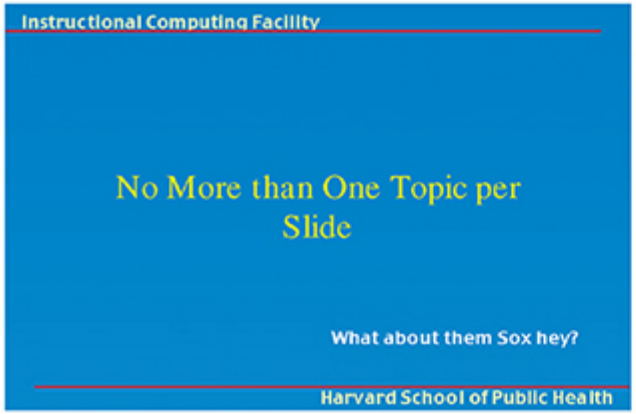


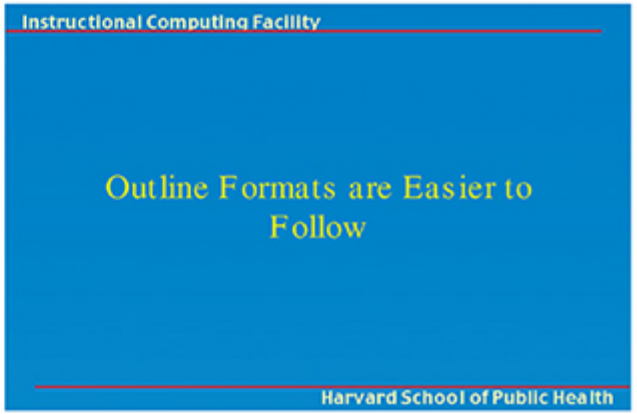
Stylesheet-makers often seek to leave *their* name on *your* show; "branding," as they say in the Marketing Department. In case you didn't notice, this presentation is from the "Instructional Computing Facility." But where are the names of the people responsible for this? No names appear on any of the 21 slides.



This must be the Haiku Rule for formatting scientific lectures. At least we're not limited to 17 syllables per slide. Above this slide, the rule can be seen in action—in a first-grade reading primer. The stylesheet typography, distinctly unscientific, uses a capital X instead of a multiplication sign.

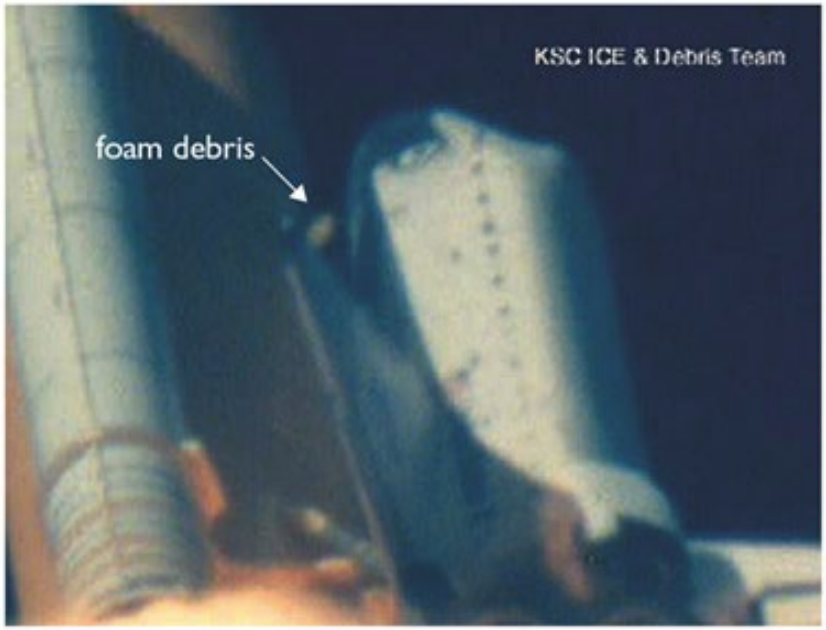


But this breaks up the evidence into arbitrary fragments. Why aren't we seeing examples from actual scientific reports? What are the Sox (a rather parochial reference) doing here? The inept PP typography persists: strange over-active indents, oddly chosen initial caps, typographic orphans on 3 of 4 slides.



Why is this relevant to scientific presentations? Are there other principles than ease of following? Didn't the *Harvard Business Review* article indicate that bullet outlines corrupt thought? Text, imaging, and data for scientific presentations should be at the level of scientific journals, much *higher* resolution than speech.

Slides prepared by the Instruction Computing Facility at the Harvard School of Public Health. Source: Edward Tufte, "The Cognitive Style of PowerPoint," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 177.



The rapidly accelerating Columbia in effect ran into the foam debris. Post-accident frame-by-frame analysis yields the impact velocity of the foam, 600 miles or 970 km per hour, the speed of sound. Since kinetic energy = $\frac{1}{2}mv^2$, the velocity-squared contribution is substantial.

In the video, 2 relevant variables are indeterminate: impact *angle of incidence* and impact *location*. Did the debris hit the insulation tiles on the left wing, or the reinforced carbon-carbon (RCC) on the leading edge of the wing? Post-accident investigation established that the foam hit the especially vulnerable RCC.

Photos of the debris impact on the Columbia space shuttle's wing shortly after launch. Source: Edward Tufte, "PowerPoint Does Rocket Science: Assessing the Quality and Credibility of Technical Reports," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 162. https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0001yB&topic_id=1&topic=Ask+E%2eT%2e.

On this one Columbia slide, a PowerPoint festival of bureaucratic hyper-rationalism, 6 different levels of hierarchy are used to display, classify, and arrange 11 phrases:

Level 1 Title of Slide
Level 2 ● Very Big Bullet
Level 3 – big dash
Level 4 ◆ medium-small diamond
Level 5 • tiny square bullet
Level 6 ( ) parentheses ending level 5

The analysis begins with the dreaded Executive Summary, with a conclusion presented as a headline: "Test Data Indicates Conservatism for Tile Penetration." This turns out to be unmerited reassurance. Executives, at least those who don't want to get fooled, had better read far beyond the title.

The "conservatism" concerns the *choice of models* used to predict damage. But why, after 112 flights, are foam-debris models being calibrated during a crisis? How can "conservatism" be inferred from a loose comparison of a spreadsheet model and some thin data? Divergent evidence means divergent evidence, not inferential security. Claims of analytic "conservatism" should be viewed with skepticism by presentation consumers. Such claims are often a rhetorical tactic that substitutes verbal fudge factors for quantitative assessments.

As the bullet points march on, the seemingly reassuring headline fades away. Lower-level bullets at the end of the slide undermine the executive summary. This third-level point notes that "Flight condition [that is, the debris hit on the Columbia] is significantly outside of test database." How far outside? The final bullet will tell us.

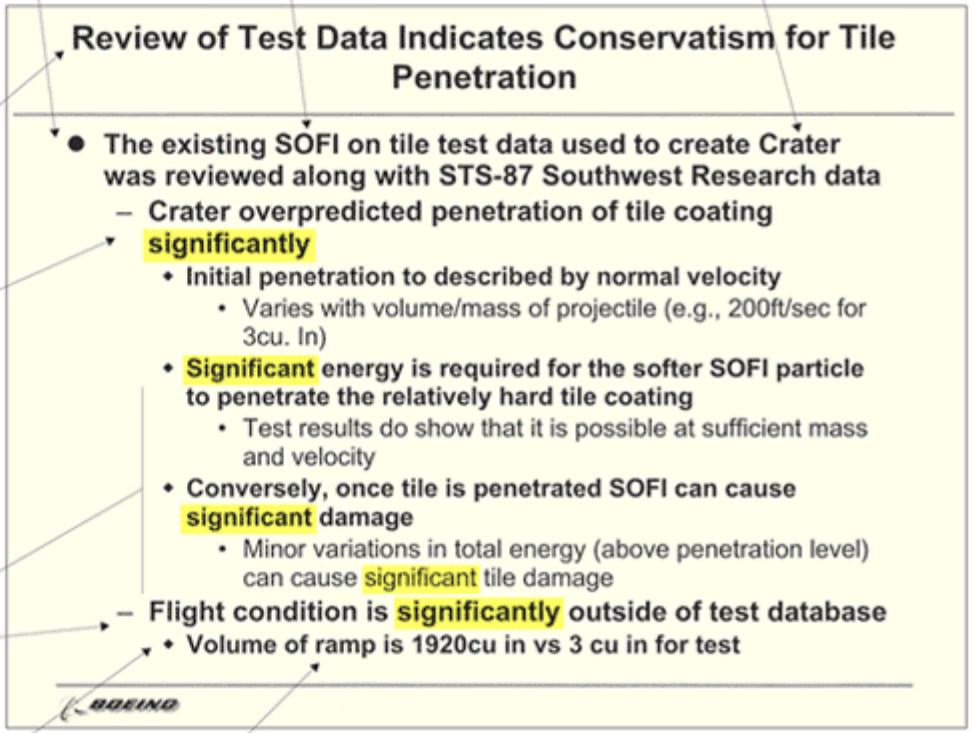
This fourth-level bullet concluding the slide reports that the debris hitting the Columbia is estimated to be 1920/3 = 640 times larger than data used in the tests of the model! The correct headline should be "Review of Test Data Indicates Irrelevance of Two Models." This is a powerful conclusion, indicating that pre-launch safety standards no longer hold. The original optimistic headline has been eviscerated by the lower-level bullets.

Note how close readings can help consumers of presentations evaluate the presenter's reasoning and credibility.

The Very-Big-Bullet phrase fragment does not seem to make sense. No other VBB's appear in the rest of the slide, so this VBB is not necessary.

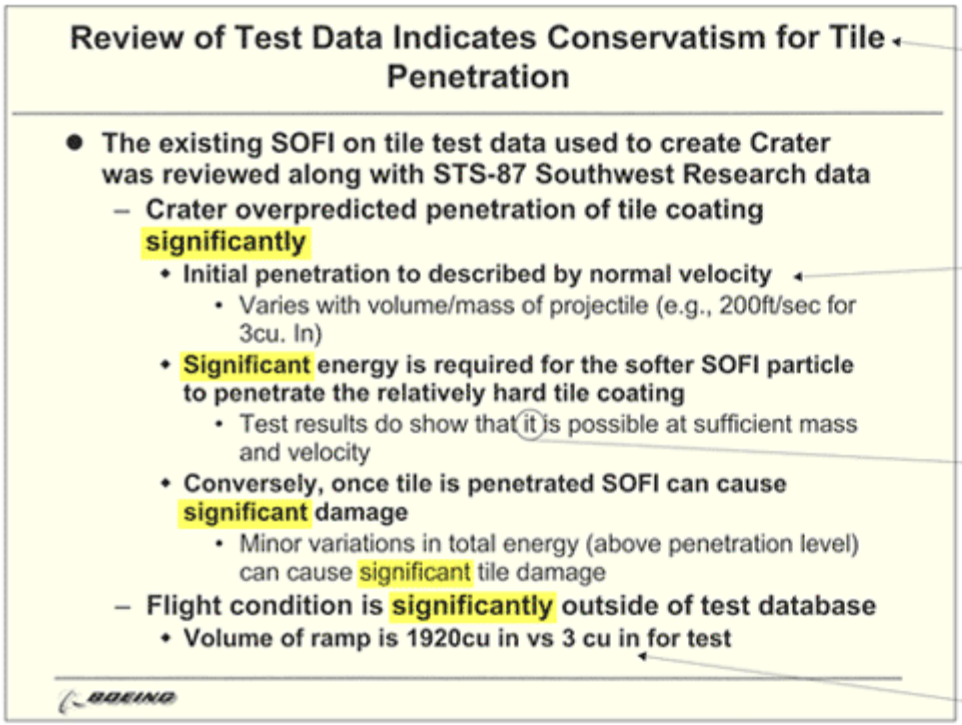
Spray On Foam Insulation, a fragment of which caused the hole in the wing

A model to estimate damage to the tiles protecting flat surfaces of the wing



Here "ramp" refers to foam debris (from the bipod ramp) that hit Columbia. Instead of the cryptic "Volume of ramp," say "estimated volume of foam debris that hit the wing." Such clarifying phrases, which may help upper level executives understand what is going on, are too long to fit on low-resolution bullet outline formats. PP demands the shorthand of acronyms, phrase fragments, and clipped jargon in order to get at least some information into the tight format.

Edward Tufte's analysis of a Boeing PowerPoint slide for the Columbia Accident Investigation Board. Source: Edward Tufte, "PowerPoint Does Rocket Science: Assessing the Quality and Credibility of Technical Reports," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 164. https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0001yB&topic_id=1&topic=Ask+E%2eT%2e.



The vigorous, vaguely quantitative, words "significant" and "significantly" are used 5 times on this slide, with meanings ranging from "detectable in a perhaps irrelevant calibration case study" to "an amount of damage so that everyone dies" to "a difference of 640-fold." None of the 5 "significants" refer to "statistical significance;" such wordplay may suggest that a formal statistical analysis has been done.

Note the analysis is about *tile* penetration. But what about RCC penetration? As investigators later demonstrated, the foam did not hit the tiles on the wing surface, but instead the delicate reinforced-carbon-carbon (RCC) protecting the wing leading edge. Alert consumers should carefully watch how presenters delineate *the scope of their analysis*, a profound and sometimes decisive matter.

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Slideville's low resolution and large type generate space-wasting typographic orphans, lonely words dangling on 4 separate lines:

Penetration **significantly** 3cu. In and velocity

The really vague pronoun reference "it" alludes to *damage to the left wing*, which ultimately destroyed the Columbia (although the slide here deals with tile not RCC damage). Low-resolution formats may encourage vague pronoun references because there isn't enough space for specific and precise phrases.

The same unit of measurement for volume (cubic inches) is shown in a slightly different way every time

3cu. In **1920cu in** **3 cu in**

rather than in clear and tidy exponential form $1920\ in^3$. Shakiness in conventions for units of measurement should always provoke concern, as it does in grading the problem sets of sophomore engineering students.* PowerPoint is not good at math and science; here at NASA, engineers are using a presentation tool that makes it difficult to write scientific notation. The pitch-style typography of PP is hopeless for science and engineering, yet this important analysis relied on PP. Technical articles are not published in PP; why then should PP be used for serious technical analysis, such as diagnosing the threat to Columbia?

*The Columbia Accident Investigation Board (final report, p. 191) referred to this point about units of measurement: "While such inconsistencies might seem minor, in highly technical fields like aerospace engineering a misplaced decimal point or mistaken unit of measurement can easily engender inconsistencies and inaccuracies." The phrase "mistaken unit of measurement" is an unkind veiled reference to a government agency that had crashed $250 million of spacecraft into Mars because of mix-up between metric and non-metric units of measurement.

Edward Tufte's analysis of a Boeing PowerPoint slide for the Columbia Accident Investigation Board. Source: Edward Tufte, "PowerPoint Does Rocket Science: Assessing the Quality and Credibility of Technical Reports," *Beautiful Evidence* (Cheshire, CT: Graphics Press LLC, 2006) p. 165. https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0001yB&topic_id=1&topic=Ask+E%2eT%2e.

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*This list does not contain the script's visual aid references. See the figure captions in the printed handout for source information on those references.