

To: Sharon Ahlers

From: Anubhav Jain

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Subject: Ethics in technical presentations: BART case study

The Bay Area Rapid Transit (BART) incident is sometimes seen as a case of three ethical engineers trying to protect the public in the face of unresponsive managers. In this interpretation, the engineers identify an important and real flaw in BART's Automatic Train Control (ATC) system, and BART management fires the engineers instead of listening to their concerns[1]. However, while a possibly hostile management may have contributed to BART's problems [2], this explanation fails to address one of the most basic conflicts in the story: the conflict between technical and non-technical information. Under BART's management system, technical decisions were made by non-technical staff. In converting technical information for managers, details could be covered and false impressions created. Ethics in this case regards how to build the bridge between the regions of technical and non-technical information. There is evidence that Westinghouse may not have acted ethically in its presentation of information to the BART board of directors, but no guidelines are in place dictating ethical transformation of technical information.

BART: Introduction and Aftermath to the Westinghouse Presentation

The BART project is a public transportation system serving San Francisco, Alameda, and Contra Costa counties. Construction began around 1963 [3]; organization of design responsibilities were somewhat complicated. The BART Board of Directors and Local Government made high-level decisions, relying on public funding; the system would be put in place by Parsons-Brinckerhoff-Tudor-Bechtel (PBTB), a consulting firm; PBTB in turn subcontracted the Automatic Train Control (ATC) system to Westinghouse[4].

The Board of Directors had the task of making decisions about technical issues implementing BART; however, because BART was publicly funded, Board members were chosen for their good public relations skills rather than their technical expertise [4]. This meant BART design decisions were made by an unspecialized group of people.

Around 1971, three engineers working for BART - Holger Hsortsvang, Max Blakenzee, and Robert Bruder - saw problems in Westinghouse's ATC design [3]. Growing discontent with management responses to their concerns, and under the recommendation of a Board member, Daniel Helix, the three hired an

outside consultant, William Burfine, to present their issues anonymously to the Board of Directors.

At the ensuing meeting, both Westinghouse and Burfine presented their case. The Board put their support in Westinghouse - in the words of Blackenzee, Burfine was "slaughtered" [4]. The three engineers were later fired after unsuccessfully trying to arrange another meeting.

In the aftermath, BART was plagued with controversial problems due to Westinghouse's design. The California State legislature's "Post report" found train-control deficiencies, a three-man panel found the BART ATC to not provide adequate passenger safety under full-scale operation, and perhaps most vividly in 1972 the lead car in a BART train operating under ATC crashed into a sandpile [5].

Analysis

Since BART decision-makers, specifically the Board of Directors and General Manager B.R. Stokes, were not trained in engineering, they could not look at technical information directly. Instead, they were forced to make decisions based on the most convincing non-technical presentation of information. Given this, is not surprising that BART's Board of Directors voted in favor of Westinghouse's design and rejected Burfine's report. When Westinghouse and Burfine presented their argument to the Board, it is clear that Westinghouse had the more convincing presentation. Blankenzee describes the Westinghouse presentation as "beautiful", while Burfine's was underprepared and did not stand up to Westinghouse's rebuttals [4]. Unable to see the technical entanglements behind Westinghouse's presentation, the Board had to make a decision, and it cannot be blamed for putting its trust in the more effective non-technical argument.

The focus, then, should not be on the engineers or management, because it is quite likely that both were fulfilling their professional duties competently. Instead, the question to ask is this: To what extent was the Westinghouse's presentation and status reports a fair representation of their actual problems and progress? Flaws in the ATC design were still not fixed by the time BART was operational, as evidenced in October of 1972 when a train operating under Westinghouse's ATC overshot its terminal, causing the lead car to crash into a sandpile [5]. While it may be true that Westinghouse intended for these problems to be fixed, it seems that the nature and number of problems were most likely suppressed from the Board, given the confidence with which the Board voted in favor of Westinghouse (either 10-2 or 8-2)[3]. This false impression of assurance would then prevent the Board from making the right decision and compromise public safety.

So did Westinghouse unethically present their technical information to the Board? A look at the "suggested guidelines for use with the fundamental canons of engineering ethics", section 3b, states:

Engineers shall be completely objective and truthful in all professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports, statements, or testimony [6].

While this seems to incriminate Westinghouse, is it even possible to follow? A "completely objective" report of technical information would be nothing other than a list of data points, which is hardly a report. To make information useful, an opinion is needed interpreting the data. Furthermore, the next sentence dictating that "all relevant and pertinent information" be included in reports makes objectivity impossible because it involves the inherently subjective decision of what data is important. Therefore, these guidelines would be a poor way to judge Westinghouse, as any recommendation they made would involve their personal opinions.

Instead, a new code is needed to guide an engineer's transformation of technical information into recommendations for unspecialized decision-makers. It is important to realize that this problem is not unique to the BART case or to decades past. Some accounts of the recent Columbia disaster, in which the shuttle was lost in re-entry, attribute the tragedy to a faulty PowerPoint slide [7]. The slide placed critical information about wing damage from management in a maze of nested bullets. It was easy to see how this disaster can be seen not as the result of poor decision-making, but the presentation of technical information in a hidden and complex way.

References

1. Kline, Ronald R. Using History and Sociology to teach Engineering ethics. IEEE Technology and Society Magazine; 2001/2002. p15.
See also Bruder's account in [3], p142.
2. Friedlander, G. The case of the three engineers vs. BART. IEEE Spectrum; Oct 1974. pp.69-76.
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4. Anderson et al. Divided Loyalties. pp12-13, 143-145.
5. Friedlander, G. Bigger Bugs in Bart? IEEE Spectrum; March 1973. p32,35,37.

6. Code of Ethics of Engineers.

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7. Thompson, C. Powerpoint makes you dumb. The New York Times; December 14, 2003.