

Understanding organizational tragedies: The case of the Hubble Space Telescope

Robert E. Quinn and James P. Walsh

Executive Overview

In the last issue of AME we published the Pulitzer Prize-winning article "Hubble Error: Time, Money and Millionths of an Inch" and invited some top scholars in the field of management to comment. What follows is a perceptive analysis of the events that led to what the authors call a "dramatic tragedy."

Editor

The Hubble story makes for a wonderful and instructive case study. This marvelous reporting job does something very unusual. It captures the complexity of organizational life. In trying to make sense of our organizational and managerial worlds, we have a tendency to focus on a few factors that fit together in some kind of cohesive, disciplinary story. When we apply our disciplinary lenses to this case, however, we find no simple answers. We conservatively identified 42 factors that contributed to the eventual problem with the mirror. They range from a consideration of our political system to the workings of the human mind. These factors are listed in the order of their chronological appearance in the article:

Project Design: NASA uses unrealistic schedule and funding.

Scapegoating: Rigby and his crew are blamed for the "fundamental error."

Safety Procedures: Burch falls through the wooden slats.

Technological Processes: The outside band fuses to the inside slats.

Project Management: 9 months are lost in the early phases.

Interorganizational Pressures: Bottlenecks create ripple effects.

Political Pressure: NASA encourages contract underbidding.

Contracts: Perkin-Elmer is caught in a "winner's curse."

Public Policy: Congress tightens funds, eliminates overruns and puts Perkin-Elmer in a cost squeeze.

Morale: People begin to feel that their project is "snake-bitten."

Quality: As they begin to cut corners, quality bows to cost.

Corporate Image: The company cuts realistic time estimates.

Fatigue: Long hours take their toll on health and performance.

Error: Geissler pushes the wrong button and cuts a groove in the mirror.

Training: The technician reacts instantly to limit the impact of Geissler's error.

Cognitive Limitations: It is impossible to detect the missing spot of paint.

Bad Luck: The laser bounces off the worn spot of paint.

Quality Management: A reliance on inspecting for quality.

Judgment: The lens is shimmed with 20¢ washers.

Legitimacy: Scott is defined as a relic and a bother.

Organization Culture: Values shift from science to management.

Staffing: Nimitz relies on the external, not internal labor market.

Management Development: The company embraces the business schools' "crash courses."

Organization Design: Matrix management breeds conflict.
Negotiation: NASA compromises before seeking integrative project decisions.
Project Control: Fuller ordered to ignore the mirror's quality.
Stakeholder Management: The Defense Department wants secrecy.
Communication: Johnson never gets the message on quality control.
Compromise: Quality office ignores the lack of a sign-off by Fuller.
Management Style: Lucas dislikes bad news.
Turnover: Burch leaves after two heart attacks.
Profit Pressure: Funds are diverted to Micralign Division.
Resistance To Challenge: Scott is kept out of work area.
Paradigms: Revelations of flaw are explained away.
Personality: Montagnino takes questions as an affront.
Expertise: Rigby could not question opinions on metrology.
Provincialism: Kodak test proposal idea earns Scott a "traitor" label.
Conflict: Fight occurs over the issue of final review.
Strategy: Perkin-Elmer follows a trendy diversification/divestiture path.
External Events: The space shuttle Challenger explodes.
Denials: Initial reports on the flaw are denied.
Guilt: Some individuals blame themselves.

Given the presence of so many factors, how does one learn from this case? How do we make sense of such complexity? Do we turn to the tools of economics, political science, sociology, or psychology? Obviously, the case implicates all of these disciplines. What we need is a broad frame that brings an understanding to this highly conflicted human drama. Our proposal is to see this case from the cross-disciplinary frame of dramatic tragedy.

The Tragic Frame

A tragedy is a serious story that focuses on problems of the central character. These problems usually result in an unhappy or disastrous ending. In ancient tragedies, the problems were usually brought on by fate and a tragic flaw in the central character. In more modern tragedies, the problems are brought on by moral weakness, psychological maladjustment or social pressures. The effects of a well-told tragedy are often cathartic. Tragedy raises in the audience not the will to punish, but the understanding of the conflict, empathy for the human pain, and the desire to make things right.

The Hubble case is a well-told tragedy. The central characters are both organizations and people. All are flawed and the flaws lead to disaster. In the end, everyone—the public, NASA, science, Perkin-Elmer Corporation, and a long list of people—is injured. In reading the story, we gain insight into their conflicts and come to understand the decisions that led to the unfortunate outcomes.

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To simply say that the Hubble case is a tragedy, however, provides little insight. To learn from the Hubble case, we must understand something more about the nature of tragedy. Hampden-Turner argues that tragedy is a form of learning, a way of encountering moral choices in the realm of imagination, a way of preparing one's self to face real crises with emotional resilience and moral courage.¹ Tragedy makes clear the relationship between values: The finest human ideals are linked in dynamic oppositions; the single-minded pursuit of any value will transform it into its opposite; disaster results from excess. He writes:

Human folly is thus less a consequence of badness in people or values than of misjudgment in combining values. The tragic hero triumphs, over-learns the winning value combination, and employs it in new circumstances with disastrous results (p. 18).

In most tragedies, a single element in the overall set of values is selected and pursued. The value grows like a cancer, eventually killing the whole.

A second function of tragedy is to teach the necessity of creative response and the value of facing uncertainty courageously, of living with faith in the crucible of anxiety. Pursuing a value to excess creates a vicious cycle. The mother seeking control drives the daughter to anorexia. The illness causes the mother to increase control and thus provokes the daughter to a greater manifestation of the illness. The mother sees no other choice. The father, clearly seeing the problem, tries to tell the mother to reduce control. The mother rejects the father as a foolish meddler who does not understand her love for her daughter. And so, the tragic tale continues. Unless the underlying cognitive frame can be broken, unless the mother can be led to exercise faith and move from control to trust, no change can occur. The situation can only worsen. Life is filled with such problems. Today it is fashionable in management circles to call them paradigm problems. Without faith, risk and a creative response, complex systems disintegrate.

Tragedy teaches us that the ideal state is the interpenetration of positive opposites. For humans the problem is both seeing, valuing and obtaining positive opposites and then recognizing the rhythmic ebb and flow between them. The best artistic efforts are both free and structured; the best relationships are both loving and disciplined; the best organizations are both integrated and differentiated.

The Limits of Excess

If the Hubble case study is a tragedy, then where is the excess? Is there a value whose pursuit lies at the heart of this tragedy? Absent a villain who embodies some kind of manifest evil, it is difficult to tell. Perhaps if we waded through the 42 factors we identified earlier, we can discover a few root causes. We found a number of possibilities.

The most obvious diagnosis focuses on the actions of the technicians who inserted three 20¢ washers into the \$1 million null corrector. In a rush, they moved the lens 1.3mm closer to the mirror than prescribed. As a result, all of the subsequent measurements using the null corrector were based on "a 13-inch ruler thought to be a foot long." While these technicians are clearly culpable, it is a shallow exercise to focus solely on them in this instance. Clearly, others are involved.

If Rigby and his crew were to use a faulty null corrector for eleven months, clearly someone would point out an abnormal reading some time. It turns out that Perkin-Elmer had many chances to catch the problem. Unfortunately, the company missed all of them. As a result, we might point to the self-sealing character of this organization as another fundamental root cause of the problem. The company was just not poised to view negative feedback as a stimulus for learning. Fuller, NASA's quality-assurance specialist, was told to focus on safety and not construction matters. Lucas, the director of the Marshall Space Flight Center, did not like to hear bad news. Slomba, the senior optical

engineer, finds spherical aberrations in the interferograms and works with Montagnino to explain them away. Scott, the resident skeptic, suggests that Kodak conduct an independent test of their mirror only to be ridiculed for his idea. Rehnberg, the head of the division that held the space telescope contract, does not act on his scientists' recommendation to conduct an independent test near the end of the project. And finally, Meserve and Jones, the project manager and his deputy, deny the final review of the mirror that Rigby and Montagnino both wanted. If the company had either sought disconfirming evidence about their mirror or tried to explain rather than explain away the discrepant evidence that they did have, we suspect that we wouldn't be reading this tale today. Having said this, we are still sympathetic to Meserve's concern at the end about time and money. This leads us to a third, and perhaps more significant root cause of the mirror's imperfections.

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Both the technicians' rush to set up the null corrector and the company's managers' obsession about time and money can be traced to "the game" Babish described. The former Perkin-Elmer technical director tells how U.S. officials coached the company on how to win a government contract. The game, of course, is to vastly underbid the original contract, secure the job, and later expose the "unforeseen technical challenges" that justify paying the "overruns" which may actually reflect the true cost of the job. It is in this light that many called the company's initial bid "a partnership in deception." Indeed, early on and according to script, Perkin-Elmer went to NASA to ask for \$272 million instead of the \$70 million they originally estimated. The only problem was that Congress changed the rules of the game once the project was underway. They apparently told NASA to stick to their original budgets. As a result, NASA told Perkin-Elmer to abide by their contract or risk losing the entire project. And so, Perkin-Elmer, who no doubt suffered a "winner's curse" in their original bidding war with Kodak, saw themselves caught in a terrible cost squeeze (even though we later learn that their contract increased first to \$160.6 million and ultimately to \$350.8 million). While these cost pressures seem to account for the technicians' original error as well as the scientists' and managers' later inability to find it, cost pressures themselves do not create tragedies. The real source of the tragedy lies elsewhere.

We have traced the mirror's problem from the technician's rushed and crude adjustments to the company's self-sealing character and then to the deceptive bidding practices that began the project. The attribution chain brings us closer to the fundamental issue. We are told by Hampden-Turner that "the ideal is both the attainment of heroic extremes and the realization that harmony requires one extreme to yield to its opposite, in the rhythm of verse, plot and music."² Is there an unyielding extreme here? Has some value been over-learned to the point where it sows the seeds of disaster? We must consider the historical development of the company to find the answer.

Richard Perkin and Charles Elmer founded their company on \$10,000 and a handshake in 1937. By 1969, the Perkin-Elmer Corporation employed more than 3,000 people and was a leading manufacturer of advanced optics and scientific instruments. It had also buried its two founders. Ten years later, outside observers might have been impressed by the company's ability to weather the death of its founding entrepreneurs, its established professional management, its growing Micralign business, and its new contract with NASA. The problem was that notwithstanding its new blend of management sophistication (a corporate diversification strategy supported by a matrix structure and a variety

of executive development programs) and moxie (outbidding Kodak with its street-smart sense of how to conduct business with the government), the company sustained a tragic loss of its soul.

The tragic irony is that deception, denial and self-sealing behavior come to fold back, in an invisible but poisonous loop, on to control itself.

When Perkin and Elmer died, the new management team could replace if not improve upon their ability to coordinate and control the firm. The problems with the mirror, however, suggest that the founders carried their passion for science to their graves. Somehow, this passion was lost in the company's quest to meet their myriad budgets and schedules and in the end, sustain their hard won competitive advantage. The unchecked value that explains all of these core diagnoses might be called management. In our view, the company has slowly drifted to a place where management coordination and control have become something of a fetish. While Capers and Lipton conclude that "profit had become an end in itself," we are drawn to Scott's observation that the company "paid too much attention to management and too little to science." We worry that it is management and not profits per se that had become an end in itself.

The tragic irony is that deception, denial and self-sealing behavior come to fold back, in an invisible but poisonous loop, on to control itself. That is, the sophisticated control systems that spark the deception become undermined by the deception. Control without trust destroys both control and trust. The organization becomes a system of tyranny in which deception flourishes. Unable to confront real problems, the system fails.

The Lessons

If tragedy raises in the audience the will to understand conflict, empathy for human pain and the desire to make things right, then we need to learn from the Hubble Case. This is particularly true because the Hubble Case is so relevant to what is happening in so many organizations today. In a time of hyperchange, executives tend to see their organizations as if they are frozen in a photograph. But organizations evolve. In young organizations, passionate purpose dies unless it is blended with dispassionate analysis and control. Once they are joined, control is often allowed to conquer passion. When this happens, routinization brings stagnation, deception brings chaos, and the organization withers and sometimes dies. And so, our story here moved to its tragic conclusion.

An antidote to the organizational tragedy might be found in the story of the organizational hero who brings revitalization to a dying system. In today's terms, the hero might be called a transformational leader. Such a person brings stability through change and commitment through purpose. A revitalization brings new vision, transformation, empowerment and other manifestations of an organization built on passion, trust, relationships and purpose. The contribution of the transformational leader in this instance is to restore balance and the harmony of extremes.

The key lesson of the Hubble Case cannot be found in the list of the 42 surface factors we listed early on. Rather, it is buried in the structure of human thought and our tendency to enshrine the single answer, the linear solution, and the greatest value. It is in the understanding that excellence and failure both emerge from judgment in combining values. Managerial leadership requires cognitive and behavioral complexity. It sustains the harmony of purpose and process, trust and control, challenge and support, and truth and power.

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Endnotes

¹ Hampden-Turner, C.M. *Maps of the Mind* (New York, NY: Macmillan, 1981). ² *Ibid.*

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