The Space Shuttle Challenger Disaster
A Study in Organizational Ethics

(See related Group Think references:
http://pirate.shu.edu/~mckenndo/ethics-GroupThink.htm
http://pirate.shu.edu/~mckenndo/ethics-Groupthink-Janus%20article.htm
http://pirate.shu.edu/~mckenndo/ethics-Groupthink%20examples.htm)

The Space Shuttle Challenger, with school teacher Christa McAuliffe aboard, exploded in flames on live television on January 28, 1986. Because of the intense public interest in the explosion and the fiery death of the astronauts, the Challenger case has been fully publicized.

The direct cause of the Challenger explosion was technical - faulty O-rings. But the Challenger also presented a case study in organizational communication and ethics, including the ethics of organizational structure and culture as it promotes or discourages necessary communication, the ethics of whistle blowing, and an excellent study of group think.

We will examine at least two aspects of this case: the ethics of organizational structure and culture, and the ethics of group think. And, as our discussions develop, perhaps some of the other related issues as well.

Refer to the Presidential Commission on the Space Shuttle Challenger Accident (the Rogers Commission) report for the official version of the Challenger explosion:

http://science.ksc.nasa.gov/shuttle/missions/51-l/docs/rogers-commission/table-of-contents.html.

Note especially the chapters on Other Contributing Causes of the Accident and The Silent Safety Program . There is a general clearinghouse on Challenger accident web references at: http://www.fas.org/spp/51L.html. (These sites may not link from this text. You can search for Space Shuttle Challenger Accident , Rogers Commission or cut and paste the addresses.)

The following is a significantly abridged version of perhaps the best communication-oriented article on the Challenger: Ethics in Organizations: The Challenger Explosion by Ronald C. Kramer in Communication Ethics: Methods of Analysis by James A. Jaska and Michael S. Pritchard, second edition, 1994, Wadsworth Publishing. This book is strongly recommended to all students in the MASCL program.

A System Breaks Down

On January 28, 1986, the space shuttle Challenger exploded in midair, sending six astronauts and schoolteacher Christa McAuliffe to their deaths. The initial public reaction was shock and disbelief. Americans had come to expect routine flights from NASA. Well before the shock had eased, the public wanted to know why the accident took place. Some of the reasons surfaced almost immediately, and they were disturbing.

The press reported that engineers at Morton Thiokol, the contractor responsible for building the solid rocket booster, had vigorously opposed the launching of Challenger, but their warning had not been heeded by management. These engineers suspected what the Rogers Commission would later support, that the immediate cause of the explosion was a burn through of the solid rocket booster joint O-rings - the same O-rings that engineers had been concerned about for more than eight years.

Despite this concern, top NASA decision makers (at levels I and II) told the Rogers Commission that they had no knowledge on January 27 that these matters had been the subject of intense controversy within Thiokol and between Thiokol and the Marshall Space Flight Center (levels IV and II in the decision-making chain). These officials added that they would not have given the final approval to launch if they had heard the views of the Thiokol engineers.

After a careful study of the variables contributing to the Challenger explosion, the Rogers Commission concluded that although the O-ring failure was the immediate cause, a flawed decision-making process was an equal, if not more important factor. The major findings of the commission:

1. The Commission concluded that there was a serious flaw in the decision-making process leading up to the launch of flight 51-L (the Challenger flight). A well structured and managed system emphasizing safety would have flagged the rising doubts about the Solid Rocket Booster joint seal. Had these maters been clearly stated and emphasized in the flight readiness process in terms reflecting the views of most of the Thiokol engineers and at least some of the Marshall engineers, it seems likely that this launch of 51-L might not have occurred when it did.

2. The waiving of launch constraints appears to have been at the expense of flight safety. There was no system which made it imperative that launch constraints and waivers of launch constraints be considered by all levels of management.

3. The Commission is troubled by what appears to be a propensity of management at Marshall to contain potentially serious problems and to attempt to resolve them internally rather than communicate them forward. This tendency is altogether at odds with the need for Marshall to function as part of a system working towards successful flight missions, interfacing and communicating with the other parts of the system that work to the same end.

4. The Commission concluded that the Thiokol management reversed its position and recommended the launch of 51-L, at the urging of Marshall and contrary to the views of its engineers in order to accommodate a major customer.

NASA Goals

In March 1970, President Nixon made an important political choice. For budgetary reasons, he scrapped the Mars project and the space platform, but he ordered the development of the shuttle vehicle. As the Rogers Commission points out: “ Thus the reusable space shuttle, earlier considered only the transport element of a broad, multi-objective space plan, became the focus of NASA s near-term future.”

This decision forced NASA to put all its eggs in one basket; it significantly shaped NASA’s goals for the future. From this point on, to prove that the shuttle could be used as a universal launch vehicle, NASA tried to create an operational shuttle system by instituting a heavy schedule of flights.

President Ronald Reagan, in an important policy speech on the national space policy on July 5, 1982, increased the pressure on NASA when he declared that the shuttle was “fully operational”. The Reagan administration was eager for the shuttle system to become operational because it had developed some rather ambitious commercial and military goals for NASA. One of these goals was for NASA to become an economically self-sufficient cargo hauler, primarily of communication satellites. Thus NASA found itself in the business of launching satellites for a wide variety of customers.

According to the Rogers Commission, pressures in NASA increased as a result, perhaps at the expenses of engineering considerations

Pressures developed because of the need to meet customers commitments, which translated into a requirement to launch a certain number of flights per year and to launch them on time. Such considerations may occasionally have obscured engineering concerns. Managers may have forgotten-partly because of past success, partly because of their own well-nurtured image of the program-that the shuttle was still in a research and development phase.

It is evident, then that NASA was subjected to strong external pressures to accept very ambitious goals. These goals were internalized within the organizational structure of NASA. The agency committed itself to a frenetic pace of launchings in the 1980s, at one point proposing 714 flights between 1978 and 1990.

This pressure was undoubtedly felt by individuals at NASA. It was this launch pressure that led Marshall Space Flight Center solid rocket booster project manager Lawrence Mulloy to comment, on hearing the Thiokol engineers’ objections to the Challenger launch, “My God, Thiokol, when do you want me to launch, next April?” Thus external pressures were internalized as organizational goals by NASA, zeroing in on individual decision makers and setting the stage for the Challenger explosion.

Structural Strains Within NASA

As NASA attempted to meet the increasing flight schedule of the space shuttle and achieve the commercial and military goals that had been laid out for it, the agency encountered a number of constraints and operating problems. These constraints made it increasingly difficult for NASA to reach its goals in an acceptable way-that is, with the high level of safety expected of it. The disjunction between the organizational goals of NASA and acceptable means available to meet these goals created structural strains within the agency. Apparently NASA attempted to resolve these strains by resorting to means that were less safe, rather than by changing its goals and proceeding more cautiously.

The first source of structural strains directly related to the Challenger disaster was the faulty seal design of the joint on the solid rocket motor. The faulty design, of course, was the responsibility of Morton Thiokol, the contractor for the solid rocket motors. The Rogers Commission, however, also assigns fault to NASA, for failing to act on information concerning the flaw:

"The genesis of the Challenger accident-the failure of the joint of the right solid rocket motor-began with decisions mad in the design of the joint and in the failure by both Thiokol and NASA s solid booster project office to understand and respond to facts obtained during testing. The Commission has concluded that neither Thiokol nor NASA responded adequately to internal warnings about the faulty seal design. Furthermore, Thiokol and NASA did not make a timely attempt to develop and verify a new seal after the initial design was shown to be deficient."

The Rogers Commission found written objections to the design as early as October 1977. In addition, the commission discovered that the O-ring seal had been designated a Criticality 1 feature of the solid rocket booster design in 1982. Criticality 1 meant that the O-rings had been identified as a failure point-without backup-that could cause the loss of life or vehicle if the component were to fail. On the day before the launch, a delay because of the weather was debated. The weather was expected to be much colder than any conditions in which the O-rings had been tested. More than 30 people were in at least 25 communication situations during this period discussing the O-ring problem. Yet none of the concerns reached levels I or II.

So while NASA worked on solving the problem, it continued to fly, and it defined the risk as “acceptable” and “unavoidable.” Dr. Alex Roland, a former NASA official, commented:

They had put the whole future of the space program on the shuttle. There was no way out. Overwhelming problems were just denied. It wasn’t conscious deception. They were kidding themselves as much as anybody else.

In its report, the Rogers Commission devotes an entire chapter to what it calls the silent safety program at NASA. They found that the safety, reliability, and quality-assurance workforce at NASA had been reduced, and that this reduction had seriously limited NASA s capability in these vital functions. As the commission notes:

"The unrelenting pressure to meet the demands of an accelerating flight schedule might have been adequately handled by NASA if it had insisted upon the exactingly thorough procedures that were its hallmark during the Apollo program. An extensive and redundant safety program comprising interdependent safety, reliability, and quality-assurance functions existed during and after the lunar program to discover any potential safety problems. Between that period and 1986, however, the program became ineffective. This loss of effectiveness serious degraded the checks and balances essential for maintaining flight safety."

The Engineers Speak

How strongly did the Thiokel engineers speak out? The Rogers Commission provides considerable testimony regarding this issue. Robert Ebeline, manager of the ignition system and final assembly for the solid rocket motors project at Thiokol, told the commission that when it was learned that cold weather could be a problem, he convened a meeting of engineers. The meeting began at 2:30 p.m. on January 27. During the one-hour meeting, according to Ebeline, several engineers expressed serious concern bout the low temperature for which the O-rings had been tested.

Engineer Roger Boisjoly offered the commission a reconstruction of his and Arnold Thompson s attempt to convince the Thiokol mangers of the potentially dangerous effects of cold on the O-rings seal:

"Arnie actually got up from his position which was down the table, and walked up the table and put a quarter pad down in front of the table, in front of the management folks, and tried to sketch out once again what his concern was with the (O-ring seal) joint, and when he realized he wasn't getting through, he just stopped."

"I tried one more time with the photos. I grabbed the photos and I went up and discussed the photos once again and tried to make the point that it was my opinion from actual observations that temperature was indeed a discriminator and we should not ignore the physical evidence that we had observed& .I also stopped when it was apparent that I couldn't get anybody to listen."

"After Arnie and I had our last say, Mr. Mason said we have to make a management decision. He turned to Bob Lund and asked him to take off his engineering hat and put on his management hat. From this point on, management formulated the points to base their decision on. There was never one comment in favor, as I have said, of launching by an engineer or other non-management person in the room before or after the caucus. I was not even asked to participate in giving any input to the final decision charts& ."

"I must emphasize, I had my say, and I never (would) take (away) any management right to take the input of an engineer and then make a decision based upon that input, and I truly believe that& .So there was no point in me doing anything any further than I had already attempted to do& ."

"I left the room feeling badly defeated, but I felt I really did all I could to stop the launch."

Preventive Measures Improving Communication

The structural flaw at NASA seems to have been the lack of an effective communication system. Information flow was limited and barriers blocked a free and open exchange of vital information about matters of safety. Passing the Thiokol engineers' concerns on to Levels 1 and II need not have compromised the decision-making powers of management. If the Level III managers' recommendation to go ahead with the launch was justifiable, the Thiokol engineers' dissent should hot have swayed level I managers or level II either. Yet only level III managers were given the opportunity to evaluate the concerns of the engineers.

Is there any reason to believe that level I and II managers would have viewed matters differently than those at level III? In a dramatic moment at the Rogers Commission hearings, Chairman William P. Rogers asked the four key NASA officials to respond to a critical question:

CHAIRMAN ROGERS: " By way of a question, could I ask, did any of you gentlemen, prior to launch, know about the objections of Thiokol to the launch?"

MR. SMITH (Kennedy Space Director):" I did not."

MR. THOMAS (Launch Director):" No sir."

MR ALDRICH (Space Program Director):" I did not."

MR. MOORE (Associate Administrator for Space Flight):" I did not."

Thomas was asked what would have happened if the Thiokol concerns had been made known to him. He replied: "I can assure you that if we had had that information, we wouldn't have launched if it hadn't been 53 degrees."

It may be tempting to place full responsibility on the level III mangers at the Marshall Space Center for failing to pass the concerns of the Thiokol engineers on to level II. However, this is to overlook the structural strains associated with the project that may have discouraged the upward transmission of bad news. A basic finding of specialists in organizational communication is that bad news seldom flows up in an organization. Top-level manages need to be aware of this fact and take steps to create a climate n which all critical information-good or bad-is communicated upward.

The tendency to management isolation at the Marshall Space Flight Center is cited by the Rogers Commission as a major factor in the breakdown of communications at NASA.

Would the Level I managers, those in whose hands the final decision rested, want to know about the engineers' concerns about approving the launch?& .Did the astronauts and Christa McAuliffe know that their risk taking might include launching under conditions for which critical features of the space craft had not been tested - and about which engineers were extremely concerned?

Nothing in the Rogers Commission report suggests that questions like these were posed by the managers at level III. Again, however, top-level manages need to let those at lower levels know that they are expected to ask such questions. Interviews with top corporate executives and middle manages indicate that both groups believe that top management sets the ethical tone for the organizations. So top management has the main responsibility for establishing an internal environment that supports the safest possible means to achieve organizational goals, despite the structural strains that arise.

The Challenger accident is not a story of moral villains. No one has suggested that any individuals whose actions causally contributed to the accident had evil intentions, or that they were callously indifferent to human life. Perhaps some individuals could have (heroically) prevented the disaster. But we cannot rely only on moral individuals to make proper decisions in the use of technologies that carry enormous risks. As we have seen, these individuals are subjected to tremendous organizational pressures and constraints. A variety of external controls and monitoring mechanisms must be used if we wish to minimize the likelihood of future disasters in areas of technological risk.