The Explosion of the Columbia Space Shuttle

Adrian Kosmaczewski

2007-08-10

The explosion of the Columbia Space Shuttle uncovered several internal problems in the National Aeronautics and Space Administration (NASA). This paper will summarize the reasons of the accident, highlighting the organizational issues, and provide an overview of the roles played by the different stakeholders of the project.

The Columbia Accident

The Columbia Space Shuttle, in its mission "STS-107", exploded over Texas on February 1st, 2003, killing all of its seven crew members. Its tremendous explosion, seen and heard from the ground while the shuttle was on its way to Florida, led to the complete interruption of the USA space program. The Columbia Accident Investigation Board (CAIB) was formed immediately after the event to provide much needed answers, such as the one to the question of the origin of the accident.

The CAIB issued a report in August 2003, freely distributed on the CAIB website, that provides a twofold answer to the explosion:

1. A technical answer:
   "The physical cause of the loss of Columbia and its crew was a breach in the Thermal Protection System on the leading edge of the left wing." (CAIB, "Report Volume I", page 49)
2. An organizational answer:
   "The Board found that there is a"broken safety culture" at NASA (pp. 184-189). Schedule pressure (pp. 131-139) related to construction of the International Space Station, budget constraints (pp. 102-105), and workforce reductions (pp. 106-110) also were factors. The Board concluded that the shuttle program "has operated in a challenging and often turbulent environment…." (p. 118) "It is to the credit of Space Shuttle managers and the Shuttle workforce that the vehicle was able to achieve its program objectives for as long as it did." (p. 119)"

(Marcia S. Smith, "Synopsis", page 2; the page numbers reference CAIB, "Report Volume I").

In pages 192 and 193 of the Report, the CAIB enumerates its findings from the perspective of the organizational point of view, and proposes key modifications.

It is interesting to see how CAIB's Report stresses the organizational answer for the explosion of the Columbia Space Shuttle, and this is particularly obvious in chapter 8 (pages 195 to 204) where the Report compares the tragedy of the Columbia to that of the Challenger, in 1986.

The impact of such an accident is clearly put into light when enumerating the major stakeholders of USA's space program:

1. The USA Government: Both the White House and the Congress are deeply influenced by the success or failure of the space program, but in different ways:
    1. There is a great sense of pride of the American people regarding the space program; as such, the popularity of the President of the United States has historically been greatly influenced by its results; the desire and objective of the White House is then to have a greater, better space program each year (see for example this link)
    2. The Congress has the hard task of deciding the amount of money that will be given to NASA every year, and historically, the budget for the space program has been eroded sinde the mid seventies, after the Apollo 17 mission, the last one sent to the Moon (Source). The position of the Congress is then to try to reduce this amount of money, every year, to compensate with the enormous public debt of 64.7% of GDP (CIA World Factbook, 2006), which clearly demands a reduction of public expenses. This is currently provoking much turmoil in the NASA scientist community (see for example this link)
2. NASA's staff: CAIB's Report clearly identifies two different kinds of stakeholders; on one side the upper management, and on the other the technical teams (engineers, astronauts, scientists in general). Both have different and, lately, opposed objectives:
    1. The upper management targets recognition and political success (the NASA is an extremely big budget with high visibility) while they not always have the technical skills needed to understand the day-to-day jobs of their reportees. At the same time, facing a reduction of budget, they have to fight against the technical staffs to reduce their size, salaries or otherwise overall capacity, leading to internal struggles:

The subcommittee asked that we discuss the four major management challenges we identified at NASA in our latest Performance and Accountability Series report. These include: (1) strengthening human capital; (2) controlling International Space Station costs; (3) implementing a faster, better, cheaper approach to space exploration; and (4) correcting weaknesses in contract management.

(United States General Accounting Office, 2002)

2. On the other side, the engineering staff directs its actions towards the achievement of c

3. The public: There is great interest in the public to know the results of the space program, to follow its discoveries, and this somehow "feeds" the pride that the American people has about its space program (by far the biggest on Earth). Furthermore, NASA being a public entity, funded by taxes, the public has a great interest in knowing how the funds are spent and invested.

Conclusion

The organizational problems of the NASA are due to the extreme complexity of the space program (by far the most complex project ever undertaken), and by the diversity of nature and interests of the stakeholders from inside and outside the organization. The (second) explosion of the space shuttle is a warning sign calling for a major internal restructuration.

This extreme example shows clearly how the internal structure of an organization can greatly impact a project, and how the stakeholders must interact and behave in order to help the project. I can only recommend reading the CAIB Report, since it provides a deep understanding of the current situation of the space program.

Finally, I would like to point out that while this is not an IT specific example, it constitutes a clear and extreme one of how organizational issues can affect the outcome of a project. Nevertheless, it must be said that the NASA has historically been one of the major software organizations; its Software Engineering Laboratory (SEL) has the mission

to lead and facilitate the improvement of software engineering practices in the Information Systems Center (ISC), within Goddard and NASA, and in the wider software development industry

(NASA SEL, 2006).

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