Book Review

The Challenger Launch Decision:

Risky Technology, Culture, and Deviance at NASA

Author: Diane Vaughan
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In her book ***The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA***, author Diane Vaughan investigates the series of events leading to the ill-fated *Challenger* launch decision from a new perspective. She rejects the prevalent explanations of the cause of the accident and presents an alternative sociological explanation that explores much deeper root cause of the failure, and warns us of the risks involved in the complex technical systems.

She has succeeded in her effort to take the reader beyond the conventional fault finding exercise, deeper into the cause of the accident. Her background and training as a sociologist clearly dictates the framework she uses to examine the tragedy. However, notwithstanding this disciplinary bias, she has been able to allude to some fundamental issues pertaining to the behavior of organizations and how the environmental and cultural context shapes the actions taken by individuals.

Reference Frame and Methodology

Professor Vaughan is a sociologist, and she uses her disciplinary lens to examine the chronology of events leading to the Challenger accident and attempts to reconstruct the cultural and sociological context of the events and decisions that culminated in the disaster. She uses construction of historical ethnography, as a methodology, to systematically examine the evidence and uncovers a deep cause embedded in the "institutional banalities", where "deviance" from the norm becomes institutionalized, and "…an incremental descent into poor judgment" finally leads to the decision to launch that resulted in the disaster.

In chapter Two of the book, she explains how her training as a researcher in sociology, who looks at the critical interactions between the individuals and the institutions, and her previous work on organizational misconduct shapes her interpretation of the accident.

Diane Vaughan claims to unveil a "revisionist history" and a "sociological explanation" of cause of the Challenger accident, as opposed to the commonly accepted "technical failure", flawed decision making process, and managerial wrongdoing theory.

Many accounts of enquiry into the cause of the accident pose both, a challenge and an opportunity for her. On the one hand, she has made a conscious effort to avoid falling in the trap of accepting the conventional explanation, on the other hand she has extensively used the information dug up by previous enquiries, and supplemented the available information by conducting personal interviews with many of the important players, whose role was not taken into cognizance previously.

Teacher in the Space and the O-ring Problem

In chapter one *The Eve of the Launch*, Diane Vaughan first describes the NASA's space shuttle Challenger's launch schedule, which was originally scheduled to launch on January 22, 1986, and outlines how inclusion of an elementary school teacher, Christa McAuliffe, made it a special mission. She also discusses the four-tier launch decision team of NASA, and vividly describes the various communications on the eve of launch that took place between NASA and the engineers and managers of Thiokol, the contractor responsible for manufacturing the Solid Rocket Motor (SRM). She described the discussion where Thiokol's decision to object to the launch of the shuttle, due to abnormally low temperatures and fear of malfunction of the O-ring, which is designed to seal the joints between the SRM case segments of the Solid Rocket Booster (SRB), is reversed by replacing engineering judgment based on technical rationale with "management hat".

Diane Vaughan presents her thesis in following order. First she describes the chronology of the events and delineates the conventional explanation of the accident and findings by the Rogers commission, the House of Representatives committee, and the media. Next, she explains the theoretical framework of her undertaking, and explains the work group culture in the NASA, and how normalization of deviance becomes a part of the culture. Next she discusses factors leading to scarcity of funds and competition, resulting in evolution of a culture of production, where production pressure gets institutionalized. Chapter seven discusses structural secrecy and its impact. In chapter eight, she brings all the pieces of the puzzle together, and presents the eve of the launch events in the light of her theoretical framework, and arguments developed so far. In Chapter nine she explains how conformity to the rules, and the work culture, led to the disaster, and not the violation of any rules, as thought by many of the investigators. She concludes her book with a chapter on lessons learned.

The Conventional Explanations

In the aftermath of the accident, president Regan appointed Rogers commission to investigate the cause of the accident. Most prominent and a detailed enquiry into the cause of the incident was initiated by the presidential commission (also known as Rogers commission), who attributed the cause of accident to a technical failure of the O-ring - which seals a critical joint of the solid rocket booster (SRB) - and also implicated NASA for its flawed decision making

process. The presidential commission identified O-ring as technical cause of failure and concluded that the design failure interacted with the temperature and other physical characteristics leading to the failure. Commission also held NASA, as an organization, responsible for contributing to the failure by adopting “a flawed decision-making process”.

U.S. House of Representatives Committee on Science and Technology published its report in October 1986, where it agreed with many findings of the presidential commission, but offered a different explanation. It placed the blame on people making poor judgment. It suggested that the launch decision was a result of incompetence of managers.

An alternative interpretation, based on many accounts published in the popular media suggests that political, financial and social (media) pressures on NASA, played a key role in the *Challenger* launch decision.

In summary, the alternative explanations of the launch decision are focused on (i) Pressure on NASA to launch, (ii) incompetence of NASA management, and (iii) a flawed decision making process.

Vaughan examines the pressure theory, and rejects it. She argues that pressure from media theory seem to have little credibility, and is counterintuitive. The Presidential commission found no evidence of any political pressure from the White House. She contends that NASA’s political environment forced the space agency to compete for scarce financial resources, which led to “production pressure”, leading to the risky launch decision. She mainly emphasizes on the long-term impact of institutionalization of the political pressure and economic factors, that results in a “culture of production”.

In a move to save cost, NASA decided to cut cost on safety testing, this was divergence from the earlier Apollo Program. The Covert report (Eugene Covert, Department of Aeronautics, MIT) concluded that the key components may not have been tested sufficiently and certification of components required more time than that given by NASA, leading to problems with the main engine. Due to economic constraints, success of the program was heavily dependent on success of its business model, which was based on maintaining high frequency of launch to meet financial goals.

Organizational Misconduct: Amoral Calculator at Work?

Presidential commission indicates that NASA personnel violated both industry rules and internal rules designed to assure safety. Since these people violated the rules to achieve organizational goals, there misconduct is “organizational misconduct”. Moreover, the traditionally accepted characteristics associated with organizational misconduct are exhibited in the *Challenger* case, viz., Competitive pressure and scarcity of resources, organizational characteristic that facilitate wrongdoing, and ineffectiveness of the regulatory mechanism.

Often organizational interests are given priority over human safety, and risk taking is routine in most organizations. To compete for scare resources, all organizations engage in misconduct (P.35). While assessing risk at the workplace, managers only pay attentions to a few key parameters, and do not engage in a systematic risk assessment and often do not foresee full implications of their actions.

She examines the conventional explanation that the environmental pressures at NASA, created by scares resources and production pressure forced managers to do amoral calculations that resulted in the launch decision. Then she elaborates, on basis of her research and discovery, that the aforementioned explanation is inaccurate.

Middle management did not inform the senior managers of the teleconference with the Thiokol, and potential problems with the O-ring. NASA had a history of decision-making where economics weighted heavy against the risk in decision-making (P.42). They deiced to solve the SRB joint problems by tinkering with the existing design, rather than redesigning the joint.

Amoral calculator hypothesis is often used to explain the organizational misconduct, when managers take a calculated risk, while weighing its cost-benefit implications. She refutes the hypothesis that amoral calculator was at work in shaping the *Challenger* launch decision. She argues that the cost of failure, or risk was so high that the decision makers could not have decided to go ahead with the launch, as failure would jeopardize their organizational goals that were competing with safety of the mission.

Risk and the Work Group Culture

After she systematically rejects the hypothesis that in managerial decision making, any amoral calculators was at play, she turns her attention to recreating the work group culture and the environment in which NASA engineers and managers worked, negotiated risk and took decisions under uncertainty. She attempts to create a “native view” of the workgroup culture in NASA. There was always a “residual risk” present in all the flights, due to unique design of the shuttle, and a large number of uncertainties associated with such a large complex technical system, which did not have any prior experience, therefore “work groups were calculating risk…where it was fundamentally incalculable”(P. 79). The concept of “acceptable risk”, which was a formal status conferred upon a component by following a prescribed procedure based on a documented engineering analysis and technical rationale, is key to estimating the flight risk. Whereas other enquiry commissions expressed their surprise at the use of “acceptable risk”, it was a norm to fly in NASA culture with a known residual risk. The decision to assess risk and to categorize it as “acceptable risk” was based on scientific method and engineering judgment based on tests and data, and was often negotiated in the work groups.

Normalization of Deviance

Normalization of the deviance in performance of O-ring incrementally increased the "acceptable risk" criteria. Also, the (strong) belief in redundancy (there were two O-rings in shuttle design, one primary, and one backup, as opposed to the Air force's Titan III solid rocket, which had only one O-ring) led to the construction of risk, which was normalized when test performance deviated from design predictions (p.110). The early decision to accept the risk became a precedent and part of the workgroup culture, which led to repeated normalization of the deviance. Diana Vaughan explores the normalization of deviance in chapter five and also revisits and revises the post-accident accounts of controversial NASA actions to continue to fly after observing extensive erosion on the STS-2, declaring the space shuttle operational, and failing to report the joint performance during the Flight Readiness Review to the upper-level NASA administrators. After fourth flight of the shuttle, it was declared operational, which resulted in reducing the testing of vehicles and its components, and requirement for reporting problems. This decision had serious structural impacts that affected the work group's decision-making process.

Production of Culture and the Structural Factors

After examining the detailed historical evidence pertaining to the normalization of deviance being part of the NASA culture, Diana Vaughan furthers her thesis by introducing two structural factors. First, culture of production, and second, structural secrecy, essential to understand the environment in which NASA engineers and managers were operating. The formative years of NASA culture were shaped by pure technical culture, where "can do" attitude was a part of the self-image. Slowly, it became structurally more complex and bureaucratic, and later budgetary constrains transformed it into a *technical production system*. Author summarizes her argument by saying that decision-making was affected when initial technical culture of NASA became amalgamated with the bureaucratic and political accountability, leading to structural source of the disaster. Decisions made by the work group in this culture may look "deviant" and "inappropriate", but to the work group, construction of the risk in wake of engineering tests, mathematical models and previous flight experience were normal. They were conforming to the set of cultural beliefs - in using the paradigm of acceptable risk, belief in redundancy, and in need to continue production in spite of evidence suggesting problems - that they had formed, and continuing to recommend launch. This conduct was culturally approved and conforming to the established norms and practice.

By structural secrecy, author means "the way that patterns of information, organizational structure, processes, and transactions, and the structure of regulatory relations systematically undermines the attempt to know" and take decisions, in an organization. She examines the sources of structural secrecy and traces their effect on information and its interpretation. Information that reached higher levels was filtered, and people high up in the line of command were, more often than not, unaware of the nitty-gritty of the details and

discussions that went on pertaining to several technical issues which were dealt with and resolved or categorized as “acceptable risk” by engineers.

In the chapter eight *Eve of the Launch Revisited,* she repeats the conventional account of the eve of the *Challenger* launch, juxtaposed against another version that restores the social and complex cultural context in which the launch decision was taken. The reality was much more complex, she argues, than that reflected in the conventional accounts. The picture that emerges defies the existence of “schedule minded, amoral calculator middle managers who violated safety norm under the production pressure (P. 334). She concludes that manager’s decision making was rule based, and the launch decision resulted not from managerial wrongdoing, but from structural factors that were deep rooted. These structural factors impinged upon the decision-making and resulted in the tragic mistake (P.345).

Lessons Learned

In the final chapter of the book author delves into the *Challenger* case to see what lessons can be learned from this tragedy. She claims that in the *Challenger* case there are lessons embedded, both theoretical and practical. She also highlights the significance of a new territory it introduces which is how organizations normalize the deviance, and what are its implications for mistakes, mishaps and disasters. The *Challenger* accident resulted from the mistake, which was socially organized and systematically produced. The normalization of deviance was the outcome of the social forces shaping the culture of the SRB workgroup, the culture of production and the structural secrecy. When we take all the three elements together they constitute a theory of normalization of deviance in organizations.

The lessons that can be learned from this case fall in three broad categories, first, science technology and risk, second, decision-making in organizations, and third, organizational deviance and misconduct. The case elaborates that the social and technical factors are important in understanding scientific practice of engineers and also in determining the construction of risk that results from this practice. It highlights the fact that culture is supreme element in shaping the risk assessment in workplace. It also shows that the scarce resources, political commitments, bureaucratic procedures and routine in organizations result in a bounded rationality. Attention is focused on one aspect of the problem at the expense of some other aspects. The case also suggests how “conformity to rules and norms, incrementalism, precedent, patterns of information, organizational structure, and environmental conditions” come together to produce a change-resistant worldview that neutralizes deviance and makes them acceptable and nondeviant.

Conclusion

The book is a scholarly piece of work and looks at the Challenger accident from a new angle using sociological framework and goes deep into the structural

and sociological causes of the failure of mission STS 51-L. It also raises some important issues about the social construction of risk by work group of engineers and managers. Diana has successfully refuted many of the conventional explanations, as propagated by the findings of the Rogers commission, the House Committee, and media. Although, it touches upon the problem of communication as part of the factor called as structural secrecy, it fails to take into account the ambiguities associated with the language responsible for creating an impression of “everything is fine”. Many other people, such as Dorothy Wilson in her paper *Communication Failures Contributing to the Challenger Accident: An Example for Technical Communicators*, have attributed the cause of accident to be a communication failure. Also, the question of dealing with a very complex technological system in the wake of uncertainty and (often unquantifiable) risk remains unanswered.