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# The Space Shuttle Disaster: Bencana Kapal Angkasa

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**Abstract**: This research investigates the events surrounding the space shuttle Challenger's ill-fated Mission 51-L on January 28, 1986. Carrying seven individuals, including the notable "Teacher in Space" Christa McAuliffe, the Challenger met a catastrophic end just 75 seconds after liftoff. The study involved issues of risk management, communication management, integration management, human resource management, and quality management. The results indicate how the project manager handle the issues and what caused the explosion. The consequences of the Challenger disaster highlight a perceived lack of direction within NASA, emphasizing the necessity for organizational improvements to enhance safety and prevent future incidents.

**Keywords**: Challenger disaster, Mission 51-L, Space shuttle Challenger, Risk management, Communication management, Integration management, Human resource management, Quality management, Explosion, NASA

## 1. Introduction

On January 28, 1986, the space shuttle Challenger took off for Mission 51-L, carrying seven brave people: Commander Francis R. (Dick) Scobee, Pilot Michael John Smith, Mission Specialists Ellison S. Onizuka, Judith Arlene Resnik, and Ronald Erwin McNair, along with Payload Specialists S. Christa McAuliffe and Gregory Bruce Jarvis. Sadly, just 75 seconds into the flight, something went terribly wrong. The Challenger exploded in a big fire, and all communication and tracking were lost. It turned out a faulty seal, called an O-ring on one of the rocket boosters, caused the disaster.

After the accident, people wanted to know if it could have been predicted. They argued about who was to blame, some said it was because of bad management, especially in handling risks, while others

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thought it was a technical problem. Because this was a big deal, the White House decided to set up a special group to investigate, instead of NASA doing it on their own. The decision was made because NASA was in a bit of a mess at the time. They didn't have a permanent boss, and lots of people in charge were leaving, making things feel chaotic.

Mission 51-L was extra important because it was called the "Teacher in Space" mission. Christa McAuliffe, a teacher from New Hampshire, was chosen from a huge group of applicants. The mission got a lot of attention, especially because McAuliffe was supposed to teach students from the Challenger on the fourth day of the mission. The sad events of that day not only took the lives of the crew but also made people notice the problems inside NASA. It led to NASA looking at how they were being run and making changes to do things better.

## 2. Related Work

### 2.1 Risk Management

One knowledge area of the PMBOK includes risk management. Risk management emphasises the importance of risk assessment and analysis in a project. Risk identification is the first step in the risk management process. This step identifies and describes the risks that may occur during project implementation and the relationship between the risks [1]. Unfortunately, this area of knowledge became one of the core factors of the space shuttle disaster. The main cause of the incident is said to be the flaw of the O-ring design. Although the error has been identified and known for years, there were no immediate responses or action taken to improves the errors. As the design of the O-rings are not capable of withstanding the harsh cold weather and temperature, it is extremely dangerous for the launch to proceed. However, this concern has been ignored due to the management fear of public's bad impression toward NASA capabilities and reputation making them subsequently accepting the risk which then results in the fatal incident [2]. This show that the potential risks were not properly assess and analyses throughout the decision-making process. The policy to plan and implement safety policy of inherently safer design was lacking at the technical as well as management levels of NASA and its contractor organisation as well [3]. Hence, this incident underlines the importance of thorough risk analysis and the significant role of project manager in ensuring the project safety is prioritized over anything else.

### 2.2 Communication Management Issue

Other than that, one of the knowledge areas of the Project Management Body of Knowledge (PMBOK) is Communication Management. The leaders and team members must work together, share, compile, and integrate information and knowledge in order to achieve project objectives. Therefore, enhancing the flow of information is by allowing the team members to take responsibility for their work and improve communication to lead to successful feedback [4]. Researchers studying crisis communication examine how organisations react to, rationalise, and explain crisis events; what steps they take to look into the origins of the crisis; how they inform the public about these steps; and how they use various media to mend their damaged reputation [5]. The communication failure within the reporting structure at both NASA and engineers (Thiokol) which they supposed to report everything to managers then supervisors to voicing their concerns. But some of the information was modified or silenced so there was no alternate path to reach the higher-ups. During the Rogers Commission testimony, they did not reach a consensus regarding the O-ring and the temperature. They did not have accurate data as informed, and the temperature often changed according to the situation. The launch's temperature was much lower than the last launches. Although there was some heat effect, there was no measurable erosion observed on the secondary O-ring. Since blow-by and erosion had now occurred at a higher launch temperature, the original premise that launches under cold temperatures were a problem was now being questioned. They failed to convince the decision makers involved of any strong connection between temperature at launch and the malfunction of a particular crucial part [6].

Ultimately, how is it possible for one person to possess complete knowledge about such a complex technical achievement and yet be bold enough to make decisions on their own? One individual cannot and should not make informed decisions by themselves especially when it involves the experiences of each team members that represents multiple competencies [7]. Although they were aware of the issue, the engineers chose to test the seals at high pressure in spite of the blowhole creation rather than run the chance of a launch with a malfunctioning primary seal. The Rogers Commission then concluded that there was a breakdown in communication between the engineers and the Top NASA and faulted the management structure for not allowing important information about The Space Shuttle Solid Rocket Booster (SRB)'s. When there was an early sign of SRB, the managers refused to accept the recommendations from engineers not to launch. The failure related directly to faults including problem reporting requirements, misrepresentation of critically, and lack of involvement in critical discussion.

### 2.3 Integration Management

Effective integration management is crucial in complex projects, especially in the Space Shuttle program, where the tragedies of Challenger and Columbia highlighted the disastrous consequences of failing to align specialized knowledge with overall project objectives [8]. Integration management is pivotal in fostering collaboration, interdisciplinary communication, and seamless alignment of safety considerations with design, operation, and decision-making processes. This sets the foundation for exploring how integration management can prevent the normalization of deviance, mitigate risks, and promote a culture of High-Reliability Organization (HRO).

In intricate projects like the Space Shuttle program, the importance of integration management cannot be overstated. Its crucial role lies in aligning specialized knowledge with overarching project goals, ensuring effective utilization of expertise, and preventing silos of information and oversight. As was witnessed in the tragedies of Challenger and Columbia, the breakdown in communication and collaboration among various technical disciplines within NASA underscored the need for a culture of collaboration and interdisciplinary communication, which integration management fosters [9].

In the Space Shuttle program context, integration management ensures the seamless connection between technical insights and mission objectives, integrating safety considerations into the design, operation, and decision-making processes. This prevents the normalization of deviance, where risks become accepted rather than mitigated. Integration management practices are crucial in preventing such normalization by creating transparent communication channels and aligning safety goals with broader organizational objectives.

Moreover, integration management promotes a holistic view of projects, reinstating a High-Reliability Organization (HRO) culture [8]. This involves cross-functional integration, where various technical disciplines collaborate in decision-making, preventing flawed judgments. Integration management oversees training programs that instill a high-reliability mindset at all levels, emphasizing the importance of learning from past mistakes. By systematically integrating lessons learned into future projects, integration management ensures that the organization evolves and continuously improves, reducing the likelihood of catastrophic failures caused by a lack of integration between technical expertise and mission objectives.

In conclusion, the significance of integration management must be balanced in complex projects such as the Space Shuttle program. It is a vital safeguard against normalizing deviance, a remedy for accepting known risks, and an architect of a High-Reliability Organization (HRO) culture. Integration management fosters collaboration, interdisciplinary communication, and learning from past mistakes, guiding organizations toward continuous improvement. As we contemplate the lessons learned from Challenger and Columbia, the imperative to seamlessly integrate technical expertise with mission objectives remains a poignant mandate, ensuring that future endeavors take flight with the wisdom gained from the past.

### 2.4 Human Resource Management

One knowledge area of the PMBOK includes a Human Resource Management (HRM). Human resource management is importance for the project to be succeed in safety situation for the employees. Poor Human Resource Management (HRM) practices can contribute to workplace accidents or incidents [10]. For example, if an organization does not provide adequate training or safety protocols for its employees, it can lead to accidents or injuries. Additionally, if an organization does not have a culture of safety or does not prioritize employee well-being, it can lead to negative outcomes [11].

In the case of the challenger tragedy, the root cause was a failure in the design of the Space Shuttle's O-ring seals, which led to a catastrophic failure during launch. The decision to launch the Space Shuttle despite warnings from engineers about the potential risks was made by NASA's management, including the Human Resource Management (HRM) department. The Human Resource Management (HRM) department was responsible for ensuring that the organization had the necessary personnel and resources to carry out its mission, including the Space Shuttle program.

However, the investigation into the tragedy revealed that there were issues with NASA's Human Resource Management (HRM) practices, including a lack of communication and transparency between management and engineers, as well as a culture that prioritized meeting deadlines over safety concerns. These factors contributed to the decision to launch the challenger despite warnings from engineers about the potential risks.

Therefore, it can be argued that the Human Resource Management (HRM) department, along with other management departments, contributed to the tragedy by failing to prioritize safety concerns and by not providing adequate communication channels between engineers and management. Many perspectives that Human Resource Management (HRM) need to consider before continuing the project for worker safety.

### 2.5 Project Quality Management

Project quality management, a cornerstone within the Project Management Body of Knowledge (PMBOK) framework, stands as a pivotal tenet in orchestrating successful project execution. This knowledge domain is not merely a procedural checklist; rather, it serves as the orchestrator of organizational procedures and actions. These actions, rooted in PMBOK, are designed to establish comprehensive quality policies, delineate achievable goals, and assign specific duties that collectively ensure the project meets and surpasses stipulated requirements. Within the intricate tapestry of project quality management, PMBOK outlines three primary procedures: Plan Quality Management, Perform Quality Assurance, and Control Quality. These procedures intricately weave together, forming the very fabric of what is colloquially referred to as Project Quality Management, a critical facet within the expansive domain of project management. Its overarching mission is not just compliance with rules and standards but the perpetual pursuit of improvement through a feedback loop and iterative adjustments.

Drawing profound lessons from the Space Shuttle disasters, a paradigm shift is evident in the approach to project quality management. The spotlight is on the meticulous role of component designers, who are not merely tasked with design but are integral custodians of the project's success. They are entrusted with conducting a thorough and comprehensive analysis utilizing the principles of probability-based physics, a methodology particularly vital for decoding complex failure modes. This analysis, far from being a perfunctory step, is elevated to a recognized and strategically planned initiative. It is seamlessly integrated into the broader program schedule, with a key stipulation that this analytical rigor is not confined solely to the design phase but is revisited, when necessary, across various program phases. The end goal is clear — to reduce overall system risk systematically and proactively, a mission-critical aspect that cannot be relegated to happenstance. Complementing this strategic analysis, the emphasis on quality control measures, woven into the fabric of each project phase, emerges as an indispensable element. This comprehensive integration ensures a consistent alignment of components and processes with specified standards, forming an intricate safety net that contributes decisively to the ongoing reduction of system risk throughout the project's dynamic lifecycle [12].

Shifting focus to the software dimension, the meticulous evaluation of software quality metrics within the context of space shuttle projects unfolds as a nuanced narrative. The article illuminates the critical distinction between quality factors, with a clear customer-centric focus exemplified by discrepancy reports, and metrics, designed to cater more to the specific needs of developers, as embodied by indicators like the number of nodes in a program control graph. This dichotomy emphasizes the inherent complexity of managing quality in software development, where end-user expectations align with the need for efficient and reliable software solutions. Importantly, the article advances a strategic prescription: the utilization of validated metrics as precursors to formal quality factors. This approach positions metrics as proactive sentinels, adept at identifying potential quality issues before formal inspections commence. In essence, it's a prescient maneuver, aligning with the overarching ethos of project quality management — the foresighted anticipation and resolution of potential issues before they escalate into critical concerns [13].

In summation, the amalgamation of PMBOK principles, experiential wisdom gleaned from space exploration endeavors, and a nuanced approach to software quality metrics crystallize into a comprehensive framework for project quality management. Embracing this multifaceted tapestry is not merely a theoretical exercise but a pragmatic guide for project managers and teams navigating the complex landscapes of high-stakes, high-complexity projects. This inclusive approach ensures not only compliance with standards but also a proactive, adaptive stance that is attuned to mitigating risks and optimizing project outcomes across the spectrum of challenges presented in today's dynamic project environments.

## 4. Conclusion

In conclusion, the Space Shuttle Challenger disaster stands as a stark illustration of the critical importance of various project management facets in complex and high-stakes endeavors. The tragic events of January 28, 1986, were not only a technological failure but a glaring breakdown in multiple areas of project management within NASA. The analysis has highlighted five issues regarding project management that contributed to this tragic failure. The first one is the neglect of warnings and potential dangers raised by engineers that was a pivotal failure in risk management. Careful evaluation of recognised dangers was overshadowed by the rush to fulfil deadlines and external expectations. By learning from the mistakes of the past, we can pave the way for a future where the lessons of risk management failures contribute to safer and more successful projects. Secondly, a clear breakdown in communication management was revealed by the decision to move on with the Challenger launch in spite of objections expressed by engineers. In project management, communication management is both a procedural and a cultural requirement. It is imperative for organisations to give top priority to a transparent and inclusive communication strategy that empowers all team members to express issues without fear of retaliation. Thirdly, the failure of Challenger revealed a lack of integration between technical insights and the broader mission objectives. A more thorough approach to project integration may have ensured that all components were working towards the same goal by giving equal weight to mission success and safety. Next, a serious shortcoming in human resource management was shown by the unwillingness to prioritise and respond to the issues brought forth by engineers.

The denial of opposing opinions and the absence of a secure forum for raising issues brought to light how important it is to create a work environment that values the expertise and viewpoints of all team members. Last but not least, the choice to launch the Challenger in spite of known technical problems exposed a serious flaw in quality control. The aftermath of this tragic event served as a crystal-clear illustration of the terrible long-term effects that can result from compromising quality for reputation. Subsequent research ought to investigate strategies for fostering an attitude that prioritises quality and stresses the significance of following set rules and guidelines. A comprehensive strategy that includes risk management, communication management, integration management, human resource management, and quality management is needed to address these problems. Future project management techniques must be based on the lessons learnt from this tragic incident, with a focus on the comprehensive integration of all knowledge domains to guarantee the success and security of large-scale projects.

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