Research Article
Academic Platform Journal of Natural Hazards and Disaster Management
6(1) 2025: 36-45, DOI: 10.52114/apjhad.1541468

A Look at the Leadership Management of Chernobyl and Fukushima Nuclear Accidents

Serap Duman[1*], Müge Ensari Özay[1]

[1]Department of Occupational Health and Safety, Institute of Health Science, Uskudar University, Istanbul, Türkiye

Received: / Accepted: 31-August-2024 / 24-May-2025

Abstract

This article aims to analyze the role of leadership in the context of the Chernobyl and Fukushima nuclear accidents. The study begins with the definition of basic concepts such as nuclear energy, nuclear accidents and leadership. It also attempts to examine how leaders behaved in managing disasters and crises in these two major nuclear accidents and their behaviors such as effective communication, decisive action and adaptation to rapidly changing situations during crises. It also attempts to understand the behavioral patterns and effects of different types of leadership on individuals in crisis management. The study also aims to provide insight into the critical role of leadership in managing complex emergencies and preventing similar disasters in the future, while trying to understand which type of leadership is more effective in reducing the impact of disasters, especially in the context of nuclear accidents. The study attempted to synthesize previous studies in these areas using the literature review method. Finally, the research concluded that strong leadership is necessary in ensuring safety and security

Key words: Chernobyl, Fukushima, Nuclear accident, Leadership

1. Introduction

"Nuclear energy" is high energy generated by the splitting of atoms. This energy is produced in a controlled manner in nuclear power plants. When nuclear energy or its waste goes out of control and harms the facility workers, the public and the environment, this is called a "nuclear accident" [1]. As seen in the Fukushima nuclear accident; natural disasters such as earthquakes, floods, storms and forest fires pose serious risks to nuclear power plants [2]. Both the Chernobyl and Fukushima accidents were classified as Level-7, the worst level on the International Nuclear Event Scale (INES) [3]. The Chernobyl nuclear accident occurred on April 26, 1986, at the Chernobyl Nuclear Power Plant near the town of Pripyat in the Ukrainian Soviet Socialist Republic. The radiation leak caused by this accident is one of the worst nuclear accidents in history [4]. The Fukushima Daiichi nuclear disaster occurred in Japan on March 11, 2011, and is one of the major events following a nuclear disaster such as the Chernobyl disaster. In Fukushima (March 2011, Japan), an earthquake occurred, followed by tsunami. When the coolant pumps were submerged in water and did not work, the reactors overheated, leading to hydrogen explosions in the spent fuel pool, which caused fires. Tons of water contaminated with radiation were released into the sea [5].

* Corresponding Author e-mail: serapduman1771@gmail.com

Table 1. General Comparison of Fukushima and Chernobyl Accidents [5]

Accident Features	Fukushima Accident	Chernobyl Accident
Accident Date	March 11, 2011	April 26, 1986
Accident Level According to Ines Scale	7. Level- Important Accident	7. Level- Important Accident
Number of Reactors	There are six reactors, three reactors are in use	There are four reactors and the accident occurred in a reactor.
Reactor Type	It is a boiling water reactor (BWR).	It is a boiling water reactor with graphite moderator.
Summary of Accidents	The 8.9 magnitude earthquake and tsunami damaged the power plant's electrical system, collapsed the cooling system, causing a hydrogen haze explosion.	As a result of the sudden power fluctuation that occurred during the system test of the reactor, the reactor pressure vessel was damaged and this was followed by a series of explosions. The fire in the reactor lasted for 10 days.
Affected Area	60 km in the northwest direction of the power plant and 40 km in the south-southwest direction, the radiation limit was measured above the values.	According to the UN notification, radiation emissions have reached 500 km away from the power plant.
Evacuated Area	It is a region where 20-30 km of people were voluntarily evacuated, and people from five different regions were evacuated.	30 km area has been evacuated.
Number of People Evacuated	78,000 people have been evacuated from the region.	In 1986, 115 thousand people were evacuated, then about 220 thousand people were transported from various regions.
Accidental Deaths	No deaths caused by radiation were found	In the UN report, 64 cases of death due to radiation were reported as of 2008.
Current Status	Protective structures are being built around the reactors to prevent radioactive leakage. The reactors are still cooling.	The damaged reactor was completely covered with a concrete coating sarcophagus to prevent leakage.

Nuclear accidents are complex and potentially destructive events that create significant challenges for leadership. Leaders in nuclear energy facilities must make decisions during a crisis, inform the public, take emergency measures and effectively manage the effects of the disaster. Conceptually, it was seen that leadership began to attract attention and research in the early 1800s [6]. After the middle of the 19th century, the concept of leadership was discussed more theoretically and today, with its emergence in many fields, it has become a subject that has attracted the attention of both management and organizational theorists and practitioners [7]. Leadership is one of the most complex and multifaceted phenomena. Leadership has ancient origins, evolving from authoritarian styles focused on tasks to participative styles centered on people. This shift has created more supportive and empowering work environments. Today, leadership continues to advance, with a particular focus on service leadership, reflecting ongoing progress in personal and professional development within organizations [8].

The study of leadership has been extensive over the years and has become even more critical in today's fast-paced and increasingly globalized world. However, leadership continues to create fascinating and confusing discussions due to the complexity of the subject. Bennis stated that "leadership is the most studied and least understood topic in social sciences" and that "never have so many worked so long to say so little." Leadership is fundamentally a social influence process involving both leaders and followers [9].

In this study, 3 types of leadership theories will be discussed; such as Transformational Leadership, Transactional Leadership, or Complexity Leadership. These theories were explained in relation to crisis management and tried to be associated with the behaviors observed in both accidents. The types of leadership mentioned are:

1. Transformational Leader: When we look at the dictionary meaning of transformation, we see that it is written "to transform into a different form, change shape, transformation, revolution, change", but it can also be expressed as increasing or decreasing the level of something, that is, to bring it to a different level [10]. James V. Downtown's mentioned the concept of transformational leadership for the first time in book "Rebel Leadership". It was James McGregor Burns in 1978 with his book "Leadership" who brought this concept to the literature. The concept of transformational leadership has also been included in Turkish sources as a reformist, transformational, transformative leader [11].

2. Transactional Leadership: The transactional leader focuses on the subordinate-superior relationship with the employees, formal reward system and control based on structure and performance attaches importance to its activities, influences its employees by using official authority, He is a person who avoids risks and leads and guides communication. Transactional leadership, characterized by a strong emphasis on protocols, rules, and predefined roles, could have contributed to the rigid adherence to procedures that limited flexibility during the crises [12]. To protect his own interests and current situation, the leader fulfills the material and physical needs of his followers. Conditional reward, which is clearly communicated by the leader what is the reward, appreciation and promise to receive in the face of the audience's effort, is an important dimension of the interactive leader [13].

It is important to determine the objectives, business standards and the machinery and equipment to be used in the work to be done in this form of leadership. Active management with exceptions, which is the second dimension of interactive leadership, is the way the leader controls the performance of the audience and takes the right action in the mistakes formed by comparing it with the standards [14].

3. Complexity Leadership: Given the dynamic and unpredictable nature of nuclear accidents, illustrate how this leadership style, which focuses on adaptability and emergent problem-solving, could have helped manage the crises more effectively [12]. The nuclear accidents at Chernobyl and Fukushima nuclear disasters underscore the paramount importance of strong and effective leadership during crises. These incidents highlight several vital lessons, including the necessity of timely decision-making, the value of transparent and clear communication, and the role of international collaboration in managing such complex events. For leaders, the focus must be on prioritizing emergency preparedness, fostering transparency, and building and maintaining public trust. By doing so, they can significantly enhance safety measures and more efficiently mitigate the risks associated with nuclear energy, ensuring better outcomes in future crises.

Additionally, when the literature is scanned, many studies are found about the Fukushima and Chernobyl nuclear accidents. Likewise, many studies have been conducted on leadership and leadership types. However, no study combining these two topics has been found. After describing the previous studies on this subject, the article explains the gap in the literature and aims to contribute by filling this gap.

2. Materials and Method

The Fukushima nuclear power plant accident is a natural disaster, caused by a tsunami caused by a magnitude 9.0 earthquake. The Chernobyl nuclear power plant accident, on the other hand, can be considered a disaster, although it is not natural, although it is caused by human error. As stated in the Disaster and Emergency Regulation of the Ministry of Internal Affairs of the Republic of Turkey, disasters are “natural, technological or human-induced events that cause physical, economic and social losses for the whole society or certain segments of society, stop or interrupt normal life and human activities, and for which the affected society does not have sufficient capacity to cope” [15]. Leadership and relationships are difficult concepts. In fact, it has been stated that there are more than 650 definitions of leadership in the literature [16]. Leadership can generally be achieved through long and difficult work. Leadership requires having certain characteristics. Although there is a lot of research on effective leaders and their specific qualities, there is no common list of their characteristics. However, it is suggested that all successful leaders have three basic characteristics. These are; character, management and experience [17].

This study focuses on the behavior of leaders in the Chernobyl and Fukushima nuclear accidents in disaster situations, focusing on their effects on risk management, which has been studied in various academic platforms. While conducting the research, keywords such as "Chernobyl", "Fukushima", "nuclear accident" and "leadership" were used extensively in Web of Science, Cambridge Core, Project Muse, Pub Med, Dergi Park and Research Gate. The research used mostly academic articles and, in some cases, relevant research sections published in books. Initially, article titles and abstracts were scanned, excluding those that were irrelevant or lacking in depth. Then, the selected studies were examined in detail. While the review included peer-reviewed journal articles and relevant books, these and other comprehensive documents were excluded due to their broad scope. The study also took into account factors such as national and international security regulations. A total of approximately 800 research articles were found during the keyword search. The most cited and directly related to the subject and content were selected and used, and their languages were English and Turkish.

In this study where the examinations were made, answers were sought to the following three questions;

1- How did the Fukushima and Chernobyl nuclear power plant accidents occur?
2- How were the crisis environment that resulted from the Fukushima and Chernobyl nuclear power plant accidents managed?
3- What are the definitions and types of leadership?
4- What are the crisis management styles of leaders in large-scale disasters?

3. Results

Actionable strategies that leaders in the nuclear industry or other high-risk sectors can adopt based on the lessons learned from these two accidents may be:

3.1. Lessons learned in the Chernobyl nuclear disaster and their practical effects:

1. The first prominent problem about leadership in the Chernobyl accident is communication errors. In such major disasters, it is very important that the leaders correctly convey the seriousness of the event and its potential effects to the public and other leaders. Thus, the necessary precautions can be taken faster.
2. Leaders responsible for managing the event must be willing to take responsibility. The authorities should not underestimate the scale and danger of the incident and should not cause delays in taking the necessary emergency measures.
3. Information about the disaster should be shared transparently and honestly with the public and employees, and trust should be provided.
4. Personnel should receive all the necessary training and have the competence related to their work. Training the personnel working in the reactor on emergency plans and procedures will make it easier to control the disaster.
5. Effective cooperation and coordination between different organizations and levels of leadership will ensure effective use of the resources and expertise necessary for better crisis management.

Leadership management in Chernobyl has enabled various courses to be taken not only in the nuclear energy industry, but also in leadership and crisis management in general.

3.2. Lessons learned in the Fukushima nuclear disaster and their practical effects:

1. The first notable leadership lesson in Fukushima was about communication. We have understood how important it is to fully convey the seriousness of the disaster to the public and other leaders.
2. The importance of taking responsibility has emerged. It is very important to take responsibility and convey the real situation to the public by considering the principle of transparency and quickly.
3. Long-term preparation for such disasters should be made. Nuclear facilities must be made sufficiently resistant to earthquakes and tsunamis. This long-term preparation will allow to control and reduce disaster.
4. Making emergency plans in the right ways and paying attention to the completeness of trainings in this area will facilitate crisis management. Emergency measures should be implemented quickly and effectively.

Finally, we can say that the most important actionable strategies that leaders in the nuclear industry or other high-risk sectors can adopt based on the lessons learned from these two accidents are proactive crisis communication and emergency preparedness training. It has been seen that the importance of transparent communication and the fact that leaders communicate correctly with the public and employees during a crisis will be of great benefit. It may also be recommended that leaders focus on regular training and simulation exercises to better prepare for possible disasters. The following two tables show the successful aspects of leadership theories and their role in managing crises.

Table 2. Comparison of Achievements Aspects of Leadership Theories and Their Role in Crisis Management [7], [12], [18]

Leadership Theories	Core Achievements	Crisis Management Roles
Transformational Leadership	**Long-term trust-building** through consistent communication and accountability. **Visionary planning** for post-crisis recovery (e.g., community resettlement, radiation monitoring). **Stakeholder alignment** among government scientists and NGOs.	**Motivating teams** under extreme stress (e.g., keeping workers engaged during prolonged containment efforts). **Transparency** in risk communication (critical for public compliance with safety measures). **Ethical responsibility** (owning mistakes to rebuild trust, as seen in post-Fukushima apologies).
Transactional Leadership:	**Short-term order** via clear chains of command (e.g., Chernobyl firefighters ' immediate response). **Task efficiency** through rewards/punishments (e.g., bonuses for risk-taking liquidators). **Structured protocols** (e.g., Fukushima's initial evacuation drills).	**Rapid decisions** under time pressure (e.g., Chernobyl's sand-dropping helicopter missions). **Procedural compliance** (e.g., enforcing radiation exposure limits). **Accountability enforcement** (e.g., disciplining TEPCO for negligence).
Complexity Leadership:	**Adaptive learning** (e.g., real-time adjustments to radiation thresholds). **Networked collaboration** (e.g., integrating IAEA experts post-Chernobyl). **Innovative problem-solving** (e.g., Fukushima's improvised cooling methods).	**Decentralized decision-making** (e.g., local teams prioritizing evacuation routes). **Cross-sector coordination** (e.g., joint government-private sector task forces). **Resilience-building** (e.g., redundant systems for future disasters).

4. Discussion

As a result of the study, it was seen that the Chernobyl and Fukushima nuclear accidents contained a number of similarities and differences in terms of leadership. These nuclear accidents provide various global learning opportunities related to nuclear accident management, crisis communication and energy policies. These events underline the importance of leaders being prepared for crisis situations, communicating effectively and gaining public trust. To summarize the factors that affect leadership in nuclear accidents: first, the ability to make quick and accurate decisions is crucial because nuclear accidents require immediate intervention. Leaders must be well organized, understand the scope of the event, and make quick and effective decisions. Second, effective communication is vital. It is critical to communicate openly and transparently with the public, staff and other authorities. Immediate sharing of reliable information can prevent panic and gain people's trust. Third, international cooperation is important. Nuclear accidents often have cross-border effects. Leaders should collaborate with the international community to use experts and resources effectively. Necessary attention should be given to the effectiveness of emergency plans. Leaders in nuclear power plants should create emergency plans for possible accidents and test them regularly. The effectiveness of these plans provides a quick response in a crisis. In addition, community participation and awareness are important. Leaders must educate and inform the public living near nuclear power

plants. Public awareness and preparedness in crisis situations is very important to minimize the impact of disasters. Leaders should also regularly review and improve safety standards to ensure the long-term security of nuclear power facilities. Finally, in this context, facility personnel and crisis management teams should be trained regularly and exercises that simulate crisis situations should be carried out.

This study has also limitations due to the lack of sufficient articles and research on the management of nuclear accidents. I hope that new studies will be carried out in this matter in the future.

5. Conclusions

The comparative analysis of the Chernobyl and Fukushima accidents reveals a critical paradigm: effective crisis leadership is not about rigid adherence to a single theory, but about adaptive integration of transactional, transformational, and complexity approaches across disaster phases. Three universal lessons emerge: Transactional leadership's structured protocols proved vital for Chernobyl's initial firefighting (saving lives) but failed in Fukushima's cascading failures due to inflexibility. Transformational leadership's trust-building was absent in both cases when most needed (Chernobyl's secrecy; Fukushima's delayed transparency), exacerbating long-term consequences. Complexity leadership's adaptive capacity—though theoretically ideal for unprecedented scenarios—was hindered by cultural and institutional rigidities. As Table 3 illustrates, organizational culture dictated leadership effectiveness more than theoretical models: The Soviet "zero-mistakes" culture suppressed early warnings at Chernobyl, while Japan's "safety myth" blinded TEPCO to station blackout risks. Hierarchical structures in both contexts delayed bottom-up innovation, underscoring the need for decentralized decision-making in complex crises. The Chernobyl-Fukushima comparison reveals a critical institutional paradox: the very leadership models most capable of preventing catastrophic failures—namely, transformational and complexity-based approaches—are systematically disregarded until crises become inevitable. To break this cycle, adaptive leadership must be embedded into the core of nuclear safety governance, not as a reactive measure but as an intrinsic design principle that shapes organizational culture and decision-making processes from the outset. The following table provides a summary of the topic.

Table 3. Leadership in Crisis Management: Chernobyl vs. Fukushima Nuclear Accidents

Aspect	Chernobyl (1986)	Fukushima (2011)	Key Lessons for Crisis Leadership
Initial Response	- Heroic but disorganized liquidator efforts - Military-style command structure - Immediate denial then delayed disclosure	-Protocol-driven but slow response - Over-reliance on emergency manuals - Early evacuation but poor communication	Transactional leadership works for immediate response but requires flexibility
Communication	-State secrecy and misinformation - Delayed international notification (3 days) - Downplayed radiation risks	- Corporate hesitancy (TEPCO) - Conflicting government messages - Delayed severity acknowledgment	Transformational leadership's transparency is crucial for public trust
Decision- Making	-Centralized Soviet bureaucracy - Local commanders improvising solutions - Scientific input ignored initially	- Hierarchical Japanese culture hindered quick decisions - Excessive procedural adherence - Late expert consultation	Complexity leadership enables adaptive solutions in unprecedented crises
Long-Term Management	-600,000+ liquidators with inadequate protection - Permanent sarcophagus took 8 months - Lasting environmental impact	- 30km exclusion zone established quickly - Ongoing decommissioning (30-40-year estimate) - Water contamination issues	Mixed leadership approach needed for different crisis phases
Cultural Factors	-Soviet "no mistakes" culture prevented early admission - Priority on saving face internationally	- Japanese hierarchical norms slowed local initiatives - "Safety myth" blinded risk preparedness	Organizational culture shapes crisis response effectiveness
International Impact	-Accelerated Glasnost reforms - Created IAEA emergency protocols - Changed global nuclear safety standards	- Revised "defense in depth" requirements - New focus on station blackout scenarios - Stricter regulatory independence	Effective crisis leadership has global safety implications

Conflict of Interest

Authors declare no conflict of interest.

Author Contribution

S.D. led the research design, data collection, analysis, and manuscript writing. M.E.Ö. supervised the study, provided critical feedback throughout the research process, and contributed to the refinement of the manuscript.

References

[1] T. Güler, *Accidents, Nuclear Waste and Environmental Problems in the Nuclear Energy Production Process*, Unpublished Master's Thesis, Gazi University, Institute of Social Sciences, Public Administration, Ankara, 2006.

[2] P. Gunter, *Natural Disasters and Safety Risks at Nuclear Power Stations*, NIRS (Nuclear Information and Resource Service), Washington, DC, USA, 2004. [Online]. Available: http://www.nirs.org/factsheets/naturaldisaster&nuclearpower.pdf [Accessed: Dec. 4, 2023].

[3] UCS, *Nuclear Accident ABCs*, Union of Concerned Scientists, 2011. [Online]. Available: http://www.ucsusa.org/assets/documents/nuclear_power/explaining-japan-nuclear-reactor-disaster.pdf [Accessed: Dec. 6, 2016].

[4] K. Baverstock, *Guidelines for Iodine Prophylaxis following Nuclear Accidents – Update 1999*, World Health Organization, Geneva, Belgium, 1999.

[5] Z. Başar and N. Türkan, "A Comparative Examination of Chernobyl and Fukushima Nuclear Power Plant Accident from the Occupational Health and Safety Perspective," *OHS Academy*, vol. 6, no. 2, pp. 116–130, 2023. doi: 10.38213/ohsacademy.1145057.

[6] B. Kırmaz, "Leader of the Information Age," *Journal of Ankara Bar Association*, vol. 3, pp. 207–222, 2010.

[7] T. Bolat and O. A. Seymen, "An assessment of the effects of transformative leadership style on the placement of business ethics in organizations," *Balıkesir University Journal of Social Sciences*, vol. 6, no. 9, pp. 59–85, 2003.

[8] R. N. Lussier and A. F. Christoper, *Leadership: Theory, Application and Skill Development*, 4th ed., Ohio, USA: South-Western Cengage Learning, 2009.

[9] B. M. Bass, "From transactional to transformational leadership: Learning to share the vision," *Organizational Dynamics*, vol. 18, no. 3, pp. 19–31, 1990.

[10] Turkish Language Institution, *Türk Dil Kurumu Sözlüğü*, 2019.

[11] T. Koçel, *Business Administration*, Beta Printing, İstanbul, 2011 and 2018 editions.

[12] R. N. Kanungo, "Ethical values of transactional and transformational leaders," *Canadian Journal of Administrative Sciences*, vol. 18, no. 4, pp. 257–265, 2001.

[13] B. M. Bass, "Two decades of research and development in transformational leadership," *European Journal of Work and Organizational Psychology*, vol. 8, no. 1, pp. 9–32, 1999. doi: 10.1080/135943299398410.

[14] G. Yukl, "An evaluation of conceptual weakness in transformational and charismatic leadership theories," *Leadership Quarterly*, vol. 10, no. 2, pp. 285–305, 1999.

[15] AFAD, *Annotated Disaster Terms Dictionary*. [Online]. Available: https://www.afad.gov.tr/Explanatory-disaster-management-terms-dictionary [Accessed: May 11, 2022].

[16] A. Silva, "What is leadership?" *Journal of Business Studies Quarterly*, vol. 8, no. 1, pp. 1–5, 2016.

[17] A. Gini and R. M. Green, "Three critical characteristics of leadership: Character, stewardship, experience," *Business and Society Review*, vol. 119, no. 4, pp. 435–446, 2014.

[18] R. Marion, "Complexity Leadership in Bureaucratic Forms of Organizing: A Meso Model," *The Leadership Quarterly*, 2009.