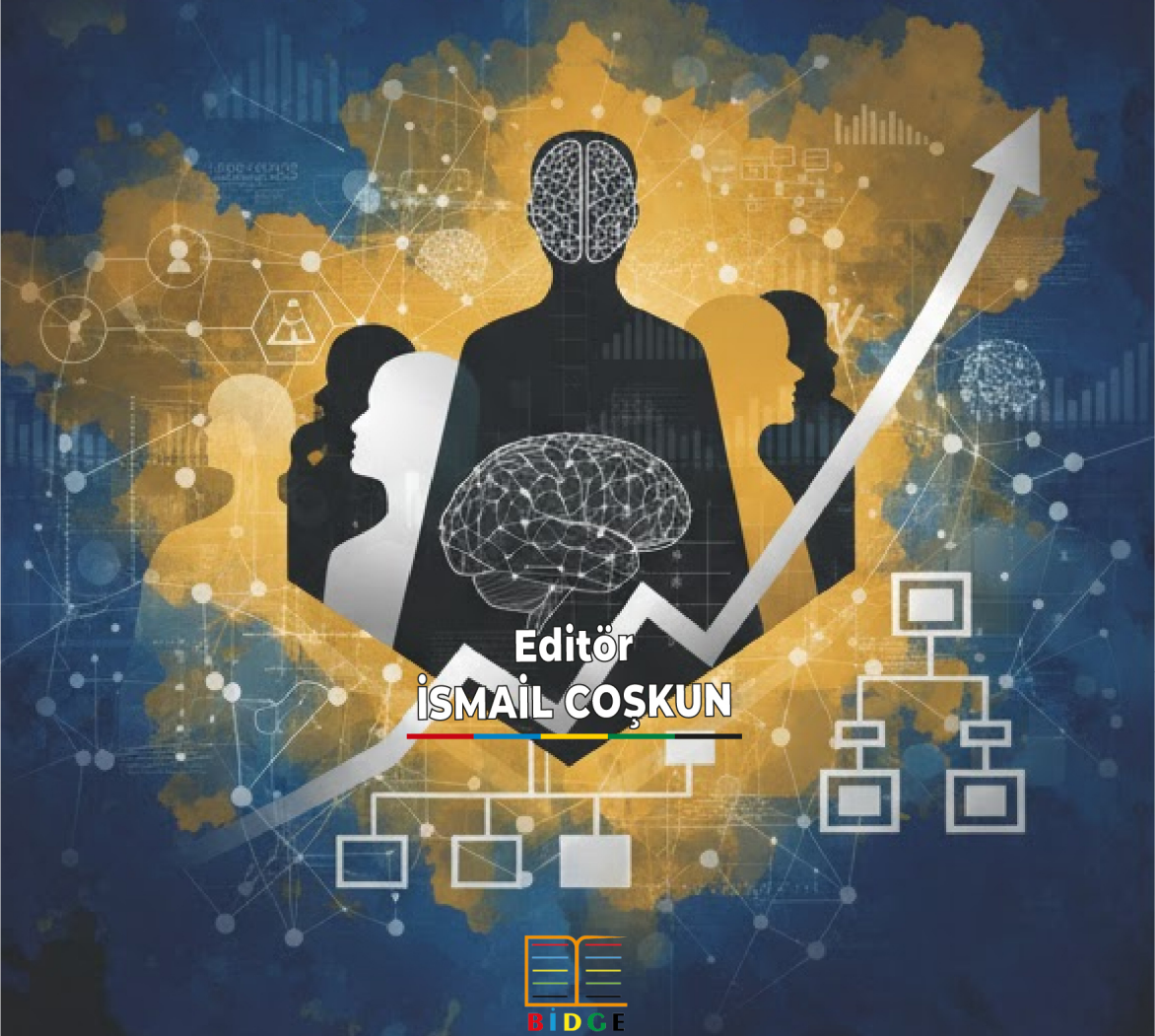
Entrepreneurship and the Human Factor

From A Management And Organizational Perspective



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FOREWORD

Entrepreneurs bring together the factors of production to enable the production of goods and services. Although entrepreneurship is defined in terms of innovative ideas, capital, technology, and market opportunities, people are always at the center of this process. This is because it is people who generate new ideas, take risks, cope with uncertainty, establish, develop, and sustain organizations. Therefore, entrepreneurship cannot be evaluated solely as an economic activity. Entrepreneurship must be approached by including human behavior and management concepts. This book, entitled “Entrepreneurship and the Human Factor: A Management and Organizational Perspective,” has been prepared to examine the phenomenon of entrepreneurship from a holistic perspective.

Today's business world is characterized by global competition, changing market conditions, uncertainties, and digitalization. Therefore, entrepreneurs must possess management skills in addition to technical knowledge. For this reason, the book addresses the multidimensional structure of the human element in the entrepreneurial process in light of current theoretical approaches and practical examples.

I would like to thank all our authors who contributed to the creation of this valuable work for their scientific knowledge, contributions, time, and effort. I would also like to express my gratitude to the publishing house team and all individuals and organizations who provided their support at every stage of the publication process.

Assoc. Prof. Dr. POLAT YÜCEKAYA

ÇANAKKALE ONSEKİZ MART UNIVERSİTY

İÇİNDEKİLER

BÖLÜM 1

THE TURKİYE MODEL IN TERMS OF ENTREPRENEURSHIP ECOSYSTEM FOR CENTRAL ASIAN COUNTRIES[1]

Oğuzhan AYTAR[2]

Introduction

Entrepreneurship ecosystems have become one of the most important elements of countries' economic growth, job creation and innovation capacities (Cansız, Kurnaz, & Yavan, 2018: 2). In recent years, rapidly changing economic dynamics on a global scale, digital

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transformation, and knowledge-based production processes have led to entrepreneurship taking a central place in national development strategies (Ballı, 2022: 253). For developing countries in particular, entrepreneurship is considered one of the most effective tools for ensuring economic diversity, increasing competitiveness, and integrating into global markets.

Thanks to its young and dynamic population, strategic geographical location, state-supported incentive mechanisms, and rapidly developing digital infrastructure, Türkiye has become a regional hub for entrepreneurship in recent years (Kurtuluş & Büyükbalcı, 2025, s. 123). The emergence of unicorn startups such as Getir, Trendyol, and Insider demonstrates that Türkiye can produce startups that are competitive not only locally but also in global markets. The growth of investment funds and angel investor networks, supported by institutions such as universities, technology parks, KOSGEB, and TÜBİTAK, has accelerated the institutionalisation of the ecosystem.

Entrepreneurship ecosystems play a decisive role in the economic development of different countries around the world. The United States maintains its global leadership thanks to Silicon Valley, with its concentration of venture capital funds, university-industry collaboration, and culture of innovation (Çelik, 2023, s. 22). Israel, known as the "Start-up Nation," stands out for its R&D experience in the defence industry and state support. China has created global brands such as Alibaba, Tencent, and ByteDance through its vast domestic market, digitalisation initiatives, and state investments in entrepreneurship. India has rapidly risen in software and IT-focused ventures with its young, English-speaking population, producing successful examples such as Flipkart, Ola, and Zomato. In Europe, Germany stands out with its engineering infrastructure and EU funding, while innovative companies like BioNTech have achieved global success. The United Kingdom is a

pioneer, particularly in FinTech, with its strong London-based financial infrastructure. Singapore, with its low tax policies and status as a financial centre, has become an active player in Asia with ventures such as Grab; South Korea, with its technology investments and young population advantage, has hosted ventures such as Coupang and Kakao. These examples demonstrate that the common features of successful entrepreneurial ecosystems are state support, the sophistication of investment funds, university-industry collaboration, and the capacity for integration into global markets.

On the other hand, Central Asian countries consist of young and developing economies such as Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan, and Tajikistan. Despite their rich natural resources, they are still in the development phase in terms of economic diversity, entrepreneurial culture, and innovation ecosystems (Karaoğlu, 2023, s. 146). Although digitalisation processes have gained momentum, limited financing sources, inadequate entrepreneurship education, and insufficient institutional structures remain significant challenges.

At this point, Türkiye's entrepreneurial experience can be considered a role model for Central Asian countries. Common history, cultural and linguistic ties, along with political and economic cooperation efforts, are seen as factors that could facilitate the transfer of Türkiye's experience to Central Asia. This paper aims to examine Türkiye's entrepreneurial ecosystem and discuss the extent to which this ecosystem can serve as an example for Central Asian countries.

The Development of Türkiye's Entrepreneurship Ecosystem

The development of the entrepreneurial ecosystem in Türkiye has gained momentum, particularly since the 2000s, driven by government policies, contributions from universities and research institutions, private sector investments, and the impact of global

economic dynamics. The young and dynamic population structure, increasing internet and mobile usage rates, and the widespread digitalisation in social and economic areas have made significant contributions to the growth of the ecosystem (Aka & Özdemirci, 2022, s. 199). Since the 2010s, incentives and grants provided by the state through institutions such as KOSGEB, TÜBİTAK, and the Ministry of Industry and Technology have paved the way for the institutionalisation of the entrepreneurial culture. Furthermore, the proliferation of technology parks, incubators, and accelerator programmes has enabled entrepreneurs to refine and commercialise their business ideas (Akça, 2024, s. 138).

Another noteworthy element in Türkiye's entrepreneurial ecosystem is the development of investor networks and venture capital funds (Altundal, 2024, s. 115-117). Angel investor networks and venture capital funds play a critical role, particularly in the growth of technology-based ventures. In this context, the unicorn ventures emerging from Türkiye clearly demonstrate the ecosystem's current status. Getir's rapid growth, Trendyol's leadership in e-commerce, and Insider's success in global markets with its artificial intelligence-based marketing solutions demonstrate that Türkiye's entrepreneurial ecosystem has reached a level where it can compete on a global scale.

Furthermore, the contribution of universities and research centres to the development of Türkiye's entrepreneurial ecosystem is noteworthy. Start-ups within technology parks produce innovative solutions by combining academic knowledge with the needs of the private sector. In particular, the qualified workforce trained in engineering and information technology provides a strategic advantage for the sustainability of the ecosystem. Furthermore, entrepreneurship competitions, hackathons, and student communities are raising awareness of entrepreneurship among

young people and contributing to the emergence of new business ideas.

As a result, Türkiye's entrepreneurial ecosystem has shown significant development in recent years, driven by government policies, private sector investments, university-industry collaboration, and digitalisation processes (Maz & Gazioğlu, 2023). This development is establishing Türkiye as a regional entrepreneurial hub and indicates its potential to serve as a role model for Central Asian countries.

General Overview of the Entrepreneurship Ecosystem in Central Asian Countries

Central Asian countries (Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan, and Tajikistan) began building their entrepreneurial ecosystems during the transition to a market economy following the collapse of the Soviet Union (Maımaıtıaılı, 2020, s. 59). Despite its rich natural resources, the region has a limited structure in terms of economic diversity and innovation capacity. State policies, the investment environment, education systems and digital infrastructure are key factors in the development of entrepreneurial ecosystems. In recent years, Kazakhstan and Uzbekistan in particular have led the region with reforms supporting entrepreneurship and digital transformation programmes.

Kazakhstan is the most advanced country in Central Asia in terms of its entrepreneurial ecosystem (Ercan & İsmail, 2009). The establishment of international technology centres such as the "Astana Hub", tax incentives provided by the state to attract foreign investors, and free economic zones have strengthened the country's entrepreneurial environment. Furthermore, the emergence of venture capital funds and the acceleration of digitalisation processes have contributed to Kazakhstan having the most institutionalised entrepreneurial ecosystem in the region (Yashnarovna & Behzod,

2025, s. 1130). These factors have positioned Kazakhstan as the leader of the entrepreneurial ecosystem in Central Asia.

Uzbekistan, meanwhile, has developed a rapidly growing entrepreneurial ecosystem through the economic reforms it has implemented in recent years. In particular, the establishment of technology- s such as "IT Park Uzbekistan" encourages the young population to engage in entrepreneurial activities. Furthermore, progress in digitalisation processes is increasing Uzbekistan's entrepreneurial potential. Although not yet as mature as Kazakhstan, thanks to the continuity of reforms, it can be said that Uzbekistan is rapidly advancing towards becoming an important entrepreneurial centre on a regional scale.

In Kyrgyzstan, the entrepreneurial ecosystem is more limited in structure, and entrepreneurial activities are mostly confined to small-scale businesses (Avcı & Ardıç, 2023, s. 583). However, emerging ventures in financial technologies (FinTech) and agricultural technologies point to the ecosystem's future potential. However, the limited investor networks and difficulties in accessing finance constrain the development of Kyrgyzstan's entrepreneurial ecosystem.

The entrepreneurial ecosystem in Turkmenistan is quite limited, with the state's centralised economic structure hindering the development of entrepreneurial activities. There is no suitable institutional environment for individual ventures and innovative business ideas. Similarly, Tajikistan has the region's most underdeveloped entrepreneurial ecosystem due to its agriculture-based economic structure, low level of digitalisation, and weak investment environment.

Overall, Kazakhstan has the strongest entrepreneurial ecosystem in the region thanks to its institutional infrastructure and state support, while Uzbekistan stands out with its rapidly

developing reform process. Kyrgyzstan, Turkmenistan and Tajikistan, on the other hand, have entrepreneurial ecosystems that are still in the development phase due to a lack of investment, financing and institutional support.

Kazakhstan encourages innovative business ideas through technology centres such as the "Astana Hub" and state-supported entrepreneurship programmes. Uzbekistan is developing legal regulations to support the start-up ecosystem alongside economic reforms and incentives to attract foreign investors. In countries such as Kyrgyzstan and Tajikistan, the entrepreneurial culture is still in its infancy, with small-scale businesses and agriculture-based ventures predominating. In Turkmenistan, the state's centralised economic structure poses a significant obstacle to entrepreneurial activity.

The most important potential elements in the region's entrepreneurial ecosystems are the young and dynamic population, the rapid spread of internet and mobile technologies, and the development of regional trade networks. However, lack of access to finance, inadequate entrepreneurship education, limited investor networks, and bureaucratic obstacles hinder the sustainable growth of the ecosystem (Bardakçi, 2025, s. 73). Nevertheless, the acceleration of digitalisation processes and the increase in international cooperation present significant opportunities to strengthen the entrepreneurial ecosystems of Central Asian countries.

Consequently, while Central Asian entrepreneurial ecosystems are developing and possess significant potential, structural challenges must be overcome. In this context, Türkiye's experiences have the capacity to offer a strategic model that could serve as a guide for countries in the region.

Comparison Between Türkiye and Central Asia

When comparing the entrepreneurial ecosystems of Türkiye and Central Asian countries, significant differences are apparent in terms of level of development, institutional infrastructure, and access to financial resources (Serinkan & Güney, 2019, s. 22). Over the past decade, Türkiye has established a strong regional model through comprehensive state policies supporting the entrepreneurial ecosystem, technology parks, incubators, and accelerator programmes. Grants and incentives provided by institutions such as KOSGEB and TÜBİTAK have facilitated entrepreneurs in commercialising their ideas. Furthermore, unicorn startups emerging from Türkiye (such as Getir, Trendyol, and Insider) demonstrate the global competitiveness of the ecosystem. In contrast, the entrepreneurial ecosystems in Central Asian countries are still in their developmental stages and are largely shaped by government policies.

Kazakhstan has the most developed entrepreneurial ecosystem in the region and stands out with technology centres such as the "Astana Hub", while Uzbekistan has shown rapid growth in recent years thanks to the reforms it has implemented (Nurbatsin & Gazzola, 2022, s. 497). However, the entrepreneurial ecosystems in Kyrgyzstan, Turkmenistan and Tajikistan are focused on small-scale businesses, agriculture and the service sector, and face challenges such as limited access to finance, insufficient investor networks and inadequate institutional infrastructure. In this respect, Türkiye has a more institutionalised, diversified and globally integrated ecosystem structure compared to Central Asian countries.

Another important point of comparison is digitalisation and technology-based entrepreneurship. Türkiye has produced successful ventures in e-commerce, fintech, artificial intelligence and logistics technologies and has become a brand in global markets. In Central Asian countries, while digitalisation processes are gaining momentum, the number of technology-based ventures remains

limited. Therefore, Türkiye's digitalisation experiences hold significant potential as a guiding example for Central Asian countries.

Table 1. Current Ecosystem SWOT Table for Türkiye and Central Asian Countries

	Türkiye	**Central Asian Countries**
Strengths	Institutionalised state support, technology parks and incubator centres, unicorn ventures (Getir, Trendyol, Insider), advanced venture capital funds.	Technology centres such as Astana Hub in Kazakhstan, the reform process in Uzbekistan, a young and dynamic population.
Weaknesses	Complex bureaucratic processes, difficulties in attracting global investors, the impact of economic fluctuations.	Lack of access to finance, limited investor networks, inadequate entrepreneurship education, lack of institutional infrastructure.
Opportunities	Young population, strategic geographical location, bridge role between Europe and Asia, potential for integration into global markets.	Acceleration of digitalisation processes, young population potential, regional cooperation mechanisms such as the Organisation of Turkic States.
Threats	Economic instability, political uncertainties, risk of brain drain.	Centralised state structures, political uncertainties, limited interest from global investors, regional competitive pressure.

Source: Author

In conclusion, a comparison between Türkiye and Central Asian countries reveals that Türkiye's entrepreneurial ecosystem is more mature and diversified, while Central Asian countries are still in the development phase. Türkiye's experiences, influenced by shared historical and cultural ties, offer a viable model for Central Asian countries.

Can Türkiye Be a Role Model?

Türkiye's achievements in its entrepreneurial ecosystem hold significant role model potential for Central Asian countries. Over the past decade, Türkiye has become a regional entrepreneurial hub with its rapidly growing digital entrepreneurial environment, government support, technology parks, and investment networks. In particular, the emergence of unicorn ventures such as Getir, Trendyol and Insider demonstrates that Türkiye can produce innovative businesses that can integrate not only into the domestic market but also into global markets (Tekin, 2021, s. 47). In this context, Türkiye is a strong model that can serve as an example for Central Asian countries with its entrepreneurship policies and institutional experience.

Another factor that strengthens Türkiye's capacity to serve as a role model is its shared history, culture, and language ties with Central Asian countries. Regional cooperation platforms such as the Turkic Council facilitate the implementation of joint projects in the field of entrepreneurship and innovation. Türkiye's experience in university-industry cooperation, its technopark model and entrepreneurship training programmes can be considered applicable examples for Central Asian countries. Furthermore, the gains Türkiye has achieved in its digitalisation processes serve as an important guide for Central Asian countries to develop their digital entrepreneurship ecosystems.

However, for Türkiye to become a regional role model, the transfer of experience must not be limited to policies and institutions, but must also include activities aimed at developing an entrepreneurial culture. Türkiye's experiences in areas such as entrepreneurship education, support for young entrepreneurs, promotion of female entrepreneurship, and increasing venture capital funds can contribute to Central Asian countries overcoming their structural problems. The following points can be recommended

to Central Asian countries for the development of their entrepreneurial ecosystems

Policy Transfer: Türkiye's technology parks, incubator centres, and entrepreneurship support mechanisms can be adapted to suit their own economic and social structures.

University-Industry Collaboration: Activities to integrate academic knowledge with the private sector can be carried out by establishing entrepreneurship centres, innovation laboratories, and technology offices within universities.

Developing an Investor Ecosystem: Access to finance for entrepreneurs can be facilitated by encouraging angel investor networks and venture capital funds.

Entrepreneurship Education: Entrepreneurship courses can be promoted in schools and universities, and the culture of entrepreneurship can be strengthened through student communities and young entrepreneur competitions.

Support for Women and Young Entrepreneurs: Drawing on Türkiye's experience, special programmes can be developed to increase the participation of women entrepreneurs and young people in the ecosystem.

Accelerating the Digitalisation Process: The transition to a digital economy can be accelerated by supporting ventures in technology-based fields such as e-commerce, fintech and artificial intelligence.

Regional Cooperation Mechanisms: Joint entrepreneurship projects, funding mechanisms and technology transfer programmes can be developed through platforms such as the Organisation of Turkic States.

Opening Up to International Markets: Policies and strategies can be developed to facilitate access to international markets for start-ups, leveraging Türkiye's global experience.

In conclusion, Türkiye's progress in the entrepreneurial ecosystem, combined with its geographical, cultural and economic proximity, has the potential to create a sustainable role model for Central Asian countries. This model has the potential to strengthen not only economic development but also regional cooperation and global competitiveness.

Conclusion

This study has examined the development of Türkiye's entrepreneurial ecosystem and revealed how it could serve as a role model for Central Asian countries. Türkiye has become a regional entrepreneurial hub thanks to its structure supported by state subsidies, university-industry cooperation, technology parks and incubators, and its unicorn ventures that can access global markets. In contrast, the entrepreneurial ecosystems in Central Asian countries are still in their developmental stages and face structural challenges such as limited financing sources, inadequate investor networks, insufficient entrepreneurial education, and weak institutional infrastructure.

Comparative analysis shows that while Kazakhstan and Uzbekistan have made relatively faster progress, Kyrgyzstan, Turkmenistan and Tajikistan lag behind in terms of their entrepreneurial ecosystems. In this regard, Türkiye's experiences could provide a concrete roadmap for Central Asian countries. In particular, Türkiye's experiences in digitalisation processes, entrepreneurship education, the development of investor ecosystems, and the support of women and young entrepreneurs can be adapted by countries in the region.

In parallel, the steps that Central Asian countries can take in the process of adopting Türkiye as a role model include policy transfer, strengthening university-industry cooperation mechanisms, expanding entrepreneurship education, developing investor ecosystems, accelerating the transition to the digital economy, and effectively utilising regional cooperation platforms. Implementing these steps will not only strengthen entrepreneurship ecosystems but also accelerate regional economic integration.

Consequently, Türkiye's entrepreneurial ecosystem serves as an applicable and sustainable role model for Central Asian countries. Strategies developed based on Türkiye's experience will contribute to building a strong and competitive entrepreneurial ecosystem in Central Asia, thereby enhancing both regional cooperation and competitiveness in global markets.

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BÖLÜM 2

EXPLORING THE DYNAMICS OF MANAGERIAL HUMOR AND PSYCHOLOGICAL SAFETY IN LEADER-MEMBER EXCHANGE (LMX): A QUALITATIVE INQUIRY WITH AI-GENERATED PERSONAS

1. Olgun Irmak ÇETİN[1]

Giriş

Managerial communication is fundamental to effective leadership and significantly influences team climate, employee well-being, and organizational performance. Among leaders' communicative tools, humor is a powerful yet potentially hazardous instrument. This phenomenon is often described as a "double-edged sword," signifying that its appropriate use can enhance cohesion, trust, and psychological safety, whereas misuse can result in offense, exclusion, and a toxic environment. Despite its prevalence in organizational settings, a nuanced understanding of the factors that render humor effective and the conditions under which it succeeds or fails remains a critical challenge for both management theory and practice. In the era of digitalization, the integration of advanced

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technologies into traditional business operations has become a necessity rather than a luxury. Literature has established direct correlations between managerial humor styles and various workplace outcomes, including psychological safety. Leader-Member Exchange (LMX) theory provides a comprehensive framework for elucidating the impact of the unique dyadic relationship between a manager and each subordinate on these outcomes. Nonetheless, a substantial gap persists in understanding the interplay between these concepts. The extant literature has yet to propose a comprehensive model to elucidate the pivotal three-way interaction, specifically how the preexisting relational context of the LMX dyad functions as a moderating filter for the humor-safety relationship. To address this gap, the present study employs a novel exploratory qualitative design utilizing in-depth, semi-structured interviews with 13 diverse AI-generated manager personas. The primary objective of this study is to examine how LMX quality moderates the relationship between managers' use of humor and the subsequent climate of psychological safety. The resulting transcripts were systematically analyzed using thematic analysis facilitated by MAXQDA software. This innovative methodology aims to provide rich contextualized evidence for this integrated model. The contributions of this study are threefold: it extends LMX theory into the domain of informal, high-context communication; adds a critical contextual layer to humor theories; and offers a nuanced, practical framework for managers. The remainder of this paper is organized as follows. The conceptual framework was first established by reviewing the literature on managerial humor, LMX, and psychological safety. The innovative AI-based qualitative methodology is then delineated. Subsequently, four main themes that emerged from the analysis are presented, followed by a discussion of their theoretical and practical implications. This study concludes by acknowledging its limitations and suggesting avenues for future research.

Theoretical Framework and Research Aim

This chapter provides a comprehensive review of the literature concerning the three fundamental concepts integral to this study: managerial humor, psychological safety, and Leader-Member Exchange (LMX) theory. Each concept is scrutinized to establish the theoretical framework underpinning the current research, ultimately leading to the identification of a significant research gap and articulation of the study's primary objectives.

Managerial Humor: A Double-Edged Sword in the Workplace

Workplace humor is a complex and dynamic phenomenon, broadly defined as a communicative act intended to amuse a focal actor and perceived as such by an audience, underscoring the crucial interplay between intentionality and subjective perception (Cooper & Schweitzer, 2024). When applied specifically to an organizational hierarchy, managerial humor is conceptualized as intentional and amusing communication deliberately created by managers for their employees (Wijewardena, Härtel, & Samaratunge, 2017). However, the literature acknowledges that managerial humor is a "double-edged sword." Its effectiveness is not guaranteed because its subjective nature can lead to unintended negative consequences, making its application a significant managerial responsibility (Procházková & Brouwer, 2022).

The most frequently cited framework for understanding this duality is the typology developed by Martin et al., which classifies humor into four distinct styles based on their interpersonal or intrapsychic focus and their benign or detrimental nature (de Souza, Felix, de Andrade, & dos Santos Cerqueira, 2019). Positive styles include affiliative humor, used to build relationships and cohesiveness, and self-enhancing humor, which serves as a personal coping mechanism (Romero & Cruthirds, 2006). Conversely, negative styles include aggressive humor, involving sarcasm or

ridicule without regard for others' feelings (Evans & Steptoe-Warren, 2018), and self-defeating humor, in which individuals joke about their own weaknesses, sometimes to gain approval (Baum, 1985). For analytical clarity, these are often simplified into a positive versus negative dichotomy (Marco, 2020).

The functional outcomes of the two styles were significantly different from each other. At the individual level, positive humor offers stress relief (Mendleson, Golen, & Adams, 1986), enhances job satisfaction (Brender-Ilan & Reizer, 2021), and increases motivation (Call, Flam, Lee, & Sharp, 2024). At the group level, it serves as a social "adhesive," fostering team cohesion (Lyttle, 2007), building trust (Cooper & Schweitzer, 2024), and improving overall performance (Romero & Cruthirds, 2006). In stark contrast, negative humor carries significant risks, including direct interpersonal harm, exclusion (Cooper & Schweitzer, 2024), damage to a manager's professional standing (Lyttle, 2007), and the creation of a corrosive organizational climate that impairs harmony and efficiency (Kaya, 2024).

Ultimately, the impact of any humor style is fundamentally context-dependent, meaning that it is inseparable from a specific social context (Lang & Lee, 2010). The quality of the leader-member relationship (LMX) acts as a critical filter, significantly shaping humor interpretation. High LMX relationships, characterized by trust and loyalty, lead employees to attribute positive intentions to their managers' humor, whereas the same joke might be perceived negatively in a low-LMX relationship (Wijewardena et al., 2017). This indicates that the appropriate use of humor is not a universal skill but is highly contingent on a manager's understanding of their unique relational dynamics with each employee (Brender-Ilan & Reizer, 2021).

The complexity of this study highlights several gaps in existing literature. Scholars advocate for methodological advancements

beyond traditional surveys, a more comprehensive theoretical integration that examines moderators such as Leader-Member Exchange (LMX) and psychological safety, and investigations into emerging contexts such as virtual work (Rosenberg, Walker, Leiter, & Graffam, 2021). These scholarly calls underscore the necessity for innovative approaches to comprehend the intricate dynamics of managerial humor, thereby justifying the exploratory and qualitative methodologies employed in this study.

Psychological Safety: The Foundation of High-Performing Teams

Psychological safety, a concept extensively developed by Edmondson, is fundamentally defined as a shared belief among team members that their environment is conducive to interpersonal risk-taking (Artinger et al., 2025). This perception implies that individuals feel that they can express themselves, inquire, or acknowledge errors without fear of blame, embarrassment, or adverse consequences to their status and careers (Kim, 2020). Managers' behavior is the most critical factor in establishing a climate. Leaders foster psychological safety by demonstrating authentic and humble leadership characterized by self-awareness, relational transparency, and an internalized moral perspective (Tiwari & Lenka, 2016). Conversely, they can easily hinder it through punitive or self-serving behaviors that create a culture of fear, leading employees to engage in defensive decision-making and withhold valuable ideas (Kassandrinou, Lainidi, Mouratidis, & Montgomery, 2023). This climate of safety is not inherent but is a managed outcome of consistent leadership actions. It is cultivated when leaders actively invite input, listen intently, and respond productively to failures or differing perspectives (Plouffe et al., 2023). Such supportive actions serve as a powerful catalyst for innovation and superior performance, as employees feel empowered to experiment with new ideas and engage in creative problem-solving (Yu, Kim, Lu, & Qu, 2025). This environment directly

facilitates candid feedback and extensive knowledge sharing, which are vital for effective decision-making (Moon & Kang, 2024). Consequently, fostering psychological safety is indispensable for enhancing employee well-being, preventing attrition, and ultimately providing a key competitive advantage for modern organizations navigating complex environments (Ahmad, 2025). Leader-Member Exchange (LMX): The Dynamics of In-Groups and Out-Groups Leader-Member Exchange (LMX) theory is founded on the core premise that leaders develop unique, dyadic relationships with each of their subordinates, challenging traditional leadership perspectives that assume a uniform "average leadership style" (Demir & Saylik, 2021). Instead, LMX theory posits that these relationships vary significantly in quality, leading to the formation of an "in-group" and an "out-group." The in-group enjoys high-quality socioemotional relationships characterized by mutual trust, respect, loyalty, and reciprocal influence that extend beyond formal job descriptions, whereas the out-group experiences more transactional exchanges strictly defined by the employment contract (Lin & Wang, 2025). Consequently, the central focus of LMX theory is the nuanced nature of these individualized relationships as the primary unit of analysis for understanding leadership effectiveness (Dinçman, 2021).

Differentiating between in-group and out-group dynamics has significant implications for employees and organizations. High-quality leader–member exchange (LMX) relationships, indicative of in-group status, are characterized by leaders who function as mentors, offering substantial support, autonomy, and valuable information (Özgül & Kılıç Yaşar, 2025). Such a nurturing environment consistently leads to positive outcomes, including increased job satisfaction, heightened organizational commitment, enhanced individual performance, and a greater incidence of organizational citizenship behavior (OCBs), as in-group members feel valued and motivated to exceed their formal responsibilities

(Abu Bakar & Connaughton, 2025). In contrast, low-quality LMX relationships, typical of outgroup status, are primarily formal and provide limited leader access, reduced feedback, and fewer rewards (Comstock, Supovitz, & Kaul, 2021). This deficiency often results in adverse effects, such as elevated psychological strain, diminished motivation, and significantly higher turnover intentions (Zhang, Li, & Hu, 2025). Consequently, the quality of the LMX dyad emerges as a crucial predictor of an employee's overall well-being, engagement, and success within the workplace (Chen, Strejcek, Zhong, & Yang, 2025).

Theoretical Synthesis and The Present Study

A review of the literature reveals a complex interplay between managerial humor, Leader-Member Exchange (LMX), and psychological safety; however, a fully integrated model connecting all three remains a significant research gap. Existing research robustly supports the connections between these concepts in pairs. For example, a reciprocal relationship exists between humor and LMX. On the one hand, positive humor styles function as a key socioemotional resource for building high-quality relationships; for example, affiliative humor fosters strong relational bonds (de Souza et al., 2019), while self-defeating humor can decrease hierarchical distance (Cooper, Sheridan, & Kong, 2025), underscoring humor expression as an active relationship-building tool (Kong, Cooper, & Sosik, 2019). Conversely, the quality of an existing LMX relationship acts as a powerful moderator, shaping employees' perceptions of managers' humor. In high-LMX dyads characterized by trust, employees are prone to attribute positive intentions to a manager's humor, showing greater tolerance (Wijewardena et al., 2017), implying that humor's effectiveness is contingent on the foundational relationship (Romero & Cruthirds, 2006). Furthermore, literature clearly establishes direct links between these variables and psychological safety. Constructive managerial humor fosters a safe

climate by signaling trust and breaking down barriers (Brender-Ilan & Reizer, 2021), whereas aggressive humor erodes it by creating fear and damaging relationships (Fukami, 2023). Similarly, LMX quality is a powerful antecedent of psychological safety, as high-quality LMX relationships provide the support and trust necessary for employees to feel safe enough to take interpersonal risks (Artinger et al., 2025). However, despite these clear dyadic connections (humor LMX; Humor Psychological Safety; LMX → Psychological Safety), a comprehensive review of the sources reveals that no direct theoretical model simultaneously synthesizes these three concepts. While the literature comes closest to noting that LMX moderates the emotional outcomes of humor, it does not articulate how LMX may moderate the specific effect of a manager's humor on the broader team climate of psychological safety. Therefore, this study aimed to address this gap in literature. This study aims to synthesize these established relationships to investigate the nuanced three-way interaction and explore the critical role that LMX quality plays in moderating the relationship between a manager's use of humor and the subsequent level of psychological safety within the team.

Methodology

This chapter delineates the methodological framework employed to investigate the intricate relationship between managerial humor, Leader-Member Exchange (LMX), and psychological safety. This research utilized a qualitative, exploratory design, incorporating an innovative approach to conducting semi-structured interviews with AI-generated manager personas to obtain profound contextual insights. The subsequent sections offer a comprehensive account of this process, commencing with the overall research design, followed by the data generation and participant selection process, and concluding with the method of data analysis and strategies employed to ensure the findings.

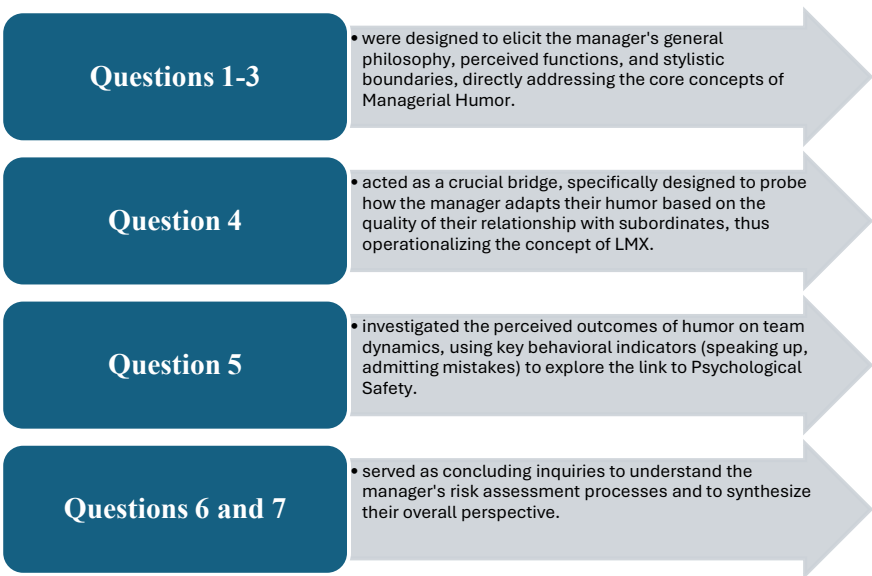
Research Design and Rationale

This study employs a qualitative and exploratory research design to examine the intricate interplay between managerial humor, Leader-Member Exchange (LMX) quality, and psychological safety. A qualitative approach was selected because of its effectiveness in exploring the "how" and "why" of complex social phenomena, thereby offering rich, contextualized insights. Specifically, this research utilizes an innovative AI-powered methodology, wherein semi-structured interviews are conducted with advanced AI-generated managers. This novel design was chosen to investigate the subjective decision-making processes of managers within a controlled environment while addressing the traditional limitations of human participant research, such as social desirability bias and access. In this study, the AI-generated personas are conceptualized as behavioral digital replicas of human managers. As defined in the literature, Digital Twins operate by establishing a digital replica of a physical system, which is utilized to generate ideas and predictions about performance (Atagan Çetin & Pamukçu, 2024). The creation of such replicas involves techniques such as computer modeling and simulations, where data is processed using machine learning and AI to develop insights into operations. Drawing on this framework, our methodology employs AI personas to simulate managerial responses to humor, effectively creating a virtual environment to predict interpersonal dynamics without the risks associated with real-world trials (Fuller et al., 2020). Data were generated through in-depth, semi-structured interviews with 13 (N=13) diverse manager personas facilitated by Gemini. Data generation adhered to a systematic procedure: for each interview, a new session was initiated, prompting the LLM to consistently embody a specific persona. The entire conversational transcript of each interview was saved verbatim to form the raw dataset for this study.

Data Generation and Participants

Sampling strategy was employed to construct 13 manager personas, ensuring a broad range of variations across diverse industries, demographics, and personality traits. The personal characteristics is presented in Figure 1. A semi-structured interview protocol consisting of seven open-ended questions was developed to systematically investigate the core concepts of the theoretical framework. The protocol was designed to transition from a general exploration of the manager's philosophy to specific context-dependent scenarios. The rationale for these questions is as follows.

Figure 1 Logical Flow and Thematic Focus of the Semi-Structured Interview Protocol.



As depicted in the figure, the protocol begins by establishing a comprehensive understanding of the manager's approach to humor (Questions 1-3), directly addressing the fundamental concepts of Managerial Humor. Subsequently, it examines the moderating role of the dyadic relationship (Question 4), thereby operationalizing the Leader-Member Exchange (LMX) component of the study. Subsequently, the protocol explored the perceived impact on team

dynamics, directly correlating the manager's humor with outcomes related to Psychological Safety (Question 5). The interview concluded with questions aimed at capturing the managers' risk assessment processes and synthesizing their overall perspective (Questions 6-7). This structured yet adaptable approach ensures that all key theoretical constructions are thoroughly examined while allowing for the emergence of rich narrative data.

The full interview protocol is presented below:

1. To begin, could you tell me about your general philosophy or perspective on using humor in the workplace? What role, if any, do you see in your day-to-day management and interactions with your team?
2. Thinking about specific situations, for what purposes might you consciously use humor with your team? For example, are there times when you use it specifically to relieve tension, deliver a difficult message more gently, build team spirit, or perhaps for other strategic reasons?
3. Every manager has their own style of managing. Could you describe the type of humor you naturally use most often with your team? On the other hand, are there any types of humor that you consciously avoid or believe cross the line in a professional setting? For instance, what are your thoughts on using sarcasm, teasing, or jokes about personal topics at work?
4. Considering the different individuals on your team, you may have a closer, more established relationship with some, while with others, the relationship may be newer or more formal. Does the nature of your relationship with a specific team member influence the type or style of humor you use? For instance, would a joke you might share with a long-time trusted colleague be different from

one you would share with a new employee you are still getting to know?

5. When you feel that you have successfully used humor with your team, particularly the kind that strengthens relationships, what impact do you observe on the team's general atmosphere or communication style? For instance, do you notice if people seem more comfortable speaking up, sharing new or even dissenting ideas, or perhaps admitting to a mistake without a strong fear of blame?
6. On the other hand, can you recall an instance where a joke or a humorous comment—either your own or someone else's on the team— did not land well or may even have created an awkward situation? How do you personally gauge the risks before using humor, and what steps do you take to 'repair' the situation if a joke has an unintended negative impact?
7. As a final question, reflecting on everything we have discussed today, what is the single most important piece of advice you would give to a new, aspiring manager about using humor as part of their leadership style? In your experience, what is the bottom line of this?

A detailed breakdown of the characteristics assigned to each of the 13 individuals is presented in Table 1.

Table 1 Demographic and Characteristic Features of the Participant Manager Personas

ID	Gender	Age Range	Industry/Sector	Managerial Experience (Years)	Key Personality Trait
YP-01	Female	40-50	Technology	15	Risk-Taker, Results-Oriented
YP-02	Male	50+	Manufacturing	25	Traditional, Rule-Oriented

YP-03	Male	30-40	Finance	8	Analytical, Distant
YP-04	Female	40-50	Healthcare	12	Empathetic, Relationship-Oriented
YP-05	Male	28-35	Creative/Media	5	Energetic, "Good Vibe" Focused
YP-06	Female	45-55	Non-Profit/NGO	20	Mission-Driven, Idealist
YP-07	Male	30-40	Startup/Entrepreneurship	6	Visionary, Ambitious, Flexible
YP-08	Male	45-55	Corporate Security	18 (15 in Military)	Disciplined, Hierarchical
YP-09	Female	50-60	Academia	25+ (5 as Head)	Intellectual, Wry, Bureaucracy-Weary
YP-10	Male	40-50	Construction	20	Direct, Practical, "Doer"
YP-11	Female	35-45	Luxury Retail	15	Extroverted, Brand-Image Focused
YP-12	Male	50-60	Law	30+	Authoritative, Risk-Averse
YP-13	Female	40-50	Hospitality	20	Charismatic, Problem-Solver

- Internal Validity (credibility): To ensure that the findings accurately reflect the "truth" of the data, peer debriefing was conducted continuously, as the lead researcher's interpretations were reviewed and discussed with an academic colleague. Prolonged engagement with the data through multiple readings of the transcripts further enhanced their depth of understanding.

- External Validity (transferability): The extent to which the findings can be applied to other contexts was addressed by providing a thick description. The "Findings" section presents detailed narrative accounts, supported by rich quotes from the diverse sample (Table 1), allowing readers to judge the applicability of the findings to their own situations.

- Reliability (dependability) and objectivity (conformability): These criteria were addressed by creating a clear audit trail. An extensive audit trial was maintained within the MAXQDA project file, which systematically documented the 13 transcripts, the final codebook, all 781 coded segments, and analytical

memos. This allows for complete transparency, enabling an external party to follow the analytical process and confirm that the findings are rooted in the data rather than the researcher's biases.

Findings

The thematic analysis of in-depth interviews conducted with 13 diverse managers identified four principal themes that collectively elucidate the intricate dynamics of managerial humor. These themes encompass the fundamental dichotomy of humor as either a strategic tool or a significant risk, the critical moderating role of relational context, the profound influence of industry culture, and the ultimate impact of humor on essential workplace outcomes such as psychological safety and team resilience.

Overview of the Analysis: Code Frequencies

Before delving into the qualitative themes in detail, it is pertinent to provide an overview of the coding frequencies, which offer a quantitative summary of the most prominent concepts discussed across all 13 interviews. The analysis yielded 781 coded segments. Table 2 illustrates the final frequency and distribution of each code within the established deductive and inductive coding frameworks, respectively.

Table 2 Final Codebook and Frequency of Coded Segments

Code Category	Code Name	Frequency (n)	Percentage (%)
Deductive	Boundaries of Humor	62	7.9%
	Purpose/Function of Humor	55	7.0%
	Impact on Psych. Safety	39	5.0%
	Risk Perception	39	5.0%
	LMX Perception	37	4.7%
	Trust Building	36	4.6%
	Humor Style	27	3.5%
Inductive	Emotional Resilience	43	5.5%
	Principle of Consistency	19	2.4%
	Brand Representation	17	2.2%
	Mission-Oriented Morale	12	1.5%

	Founder's Mentality	5	0.6%
	Field Culture	4	0.5%
	Struggle with Bureaucracy	3	0.4%
Total		**458***	**58.6%**

The total frequency is the sum of the primary codes. The total number of coded segments was 781, as some segments were assigned to multiple codes.

Theme 1: The Nature of Humor - A Strategic Tool vs. An Inevitable Risk

The analysis initially identifies a fundamental dichotomy in managerial perceptions regarding the role of humor in the workplace, which is polarized between its utilization as a strategic instrument and its perception as an unacceptable risk. The first perspective, frequently articulated by managers in dynamic and change-oriented sectors, conceptualizes humor as a deliberate tool for achieving organizational objectives. For example, the technology manager (YP-01) described it as a "high-leverage tool" and a "catalyst for psychological safety." Similarly, the startup founder (YP-07) characterized it as a survival mechanism, stating, "It's the shock absorber on a rally car... Without it, the whole thing would just fall apart." In stark contrast, the second perspective regards humor not as a tool but as an unacceptable risk, a stance upheld by managers in high-consequence professions. The finance manager (YP-03) concluded from his "risk-reward analysis" that humor is an "uncontrolled variable that must be eliminated." This view was taken to its extreme by the law firm's managing partner (YP-12), who asserted: "Words are evidence... Humor is a liability we have no need to incur."

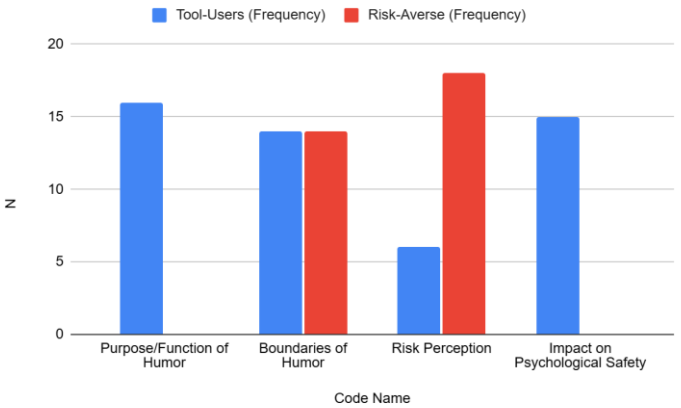
The significant philosophical divergence between the two groups is also reflected in their languages. A comparative analysis of word clouds was performed for the "Tool-Users" group and the "Risk-Averse" groups, as shown in Figure 2.

Figure 2 Comparative Word Clouds Illustrating the Divergent Language of the "Tool-User" and "Risk-Averse" Manager Groups.

As illustrated in Figure 2, the language employed by the “tool users” (left) is predominantly characterized by terms associated with construction and collaboration, such as “team” “creative” “idea” “share” and “build” In contrast, the vocabulary of the “Risk-Averse” group (right) is centered around protective and rule-based concepts, including “professional” “risk” “clarity” and “standard. This visual evidence robustly supports the conclusion that managers' perceptions of humor are not arbitrary but rather align with distinct, opposing profiles based on their professional context.

Figure 3 presents a comparison of the coding frequencies of the two groups across the key conceptual codes.

Figure 3 Comparative Profile Chart of Code Frequencies for "Tool-User" and "Risk-Averse" Manager Groups



As illustrated in Figure 3, a distinct contrast between the two groups is evident. The "Tool-Users" group exhibited high frequencies for codes such as Purpose/Function of Humor (n=16) and Impact on Psychological Safety (n=15). In contrast, the "Risk-Averse" group showed no coded segments for these concepts. Conversely, the Risk Perception code was predominantly associated with the Risk-Averse group (n=18) and was considerably lower for the tool users (n=6). Notably, the Boundaries of Humor code was elevated for both groups (n=14), indicating that, irrespective of their core philosophy, all managers were significantly concerned with establishing clear guidelines. This chart provides compelling visual evidence that managers' perceptions of humor can be categorized into distinct opposing profiles.

Theme 2: The Determining Role of Relational Context - The Role of Trust and Status

The analysis indicates that the effectiveness and interpretation of humor are predominantly contingent upon the quality of the preexisting relationship between the manager and the employee. A quantitative examination of the data revealed that nearly all managers, irrespective of their managerial philosophy, were aware of the need to maintain varying quality relationships with different

team members (LMX Perception). However, the pivotal finding lies not in the awareness itself but in the two distinct strategic responses to this awareness, as shown in Figure 4.

Figure 4 Conceptual Model of Managerial Responses to LMX Differentials

	YP-01	YP-02	YP-03	YP-04	YP-05	YP-06	YP-07	YP-08	YP-09	YP-10	YP-11	YP-12	YP-13
Deductive	0	0	0	0	0	0	0	0	0	0	0	0	0
Purpose/Function of Humor	5	1	4	5	5	7	6	2	4	4	1	7	4
Humor Style	2	2	2	3	2	3	3	1	4	1	1	1	2
Boundaries of Humor	4	3	4	7	3	7	3	8	5	4	4	7	3
Risk Perception	3	2	6	2	1	3	2	3	2	1	2	10	2
LMX Perception	1	1	2	3	3	4	5	2	6	1	4	3	2
Impact on Psychological Safety	3	1	1	5	6	3	6	1	3	2	5	0	3
Trust Building	2	2	1	8	2	0	5	3	1	3	2	4	3
Inductive	0	0	0	0	0	0	0	0	0	0	0	0	0
Brand Representation	0	0	0	0	1	0	0	0	0	0	11	0	5
Founder's Mentality	1	0	0	0	0	0	4	0	0	0	0	0	0
Struggle with Bureaucracy	0	0	0	0	1	0	0	0	2	0	0	0	0
Field Culture	0	0	0	0	0	0	0	0	0	4	0	0	0
Mission-Oriented Morale	0	3	1	0	0	1	0	4	0	1	0	1	1
Emotional Resilience	2	0	1	7	3	6	5	2	4	7	1	1	4
Principle of Professional Consistency	0	4	4	0	0	0	0	2	0	4	2	2	1

As depicted in Figure 4, managers tend to pursue one of two distinct approaches upon discerning varying relationship qualities. Managers with a relational orientation, often found in sectors such as technology, healthcare, and startups, adapt to and cultivate these differences. They strategically adjust their communication by employing humor as a mechanism to establish and reinforce trust with new and existing members. Conversely, managers with a rule-oriented perspective, typically in fields such as finance, law, and manufacturing, aim to neutralize and standardize these differences, perceiving them as potential threats to objectivity and fairness. They adopt a uniform communication style for all employees. This adaptive strategy is exemplified by the startup founder (YP-07), who states, "After a bad investor meeting, I can just say, 'Yes, it was very productive,' with the driest possible sarcasm, and my cofounder immediately understands... This single sentence conveys an hour's worth of information." Such humor serves as a reward for preexisting trust, a privilege that is not extended to new members. In more hierarchical cultures, the right to engage must be "earned." The

construction Foreman's (YP-10) remark on a new apprentice encapsulates this notion: "He needs to earn his place in the banter. It is a sign that he is no longer the 'new kid' but has become part of the team. ' These findings indicate that the relationship itself functions as a crucial filter, wherein the significance of humor is derived not from the joke itself but from the nature of the relationship in which it is conveyed.

Theme 3: The Influence of Organizational Culture and Industry

These findings unequivocally demonstrate that the role and acceptability of managerial humor are significantly influenced by the cultural norms and operational requirements specific to each sector. The analysis identified three distinct "humor scripts" that aligned with various professional contexts. The scripts, along with their primary functions, core metaphors, and representative personas, are presented in Table 3.

Table 3 A Typology of Managerial Humor Scripts by Professional Context

Cultural Cluster	Primary Function of Humor	Core Metaphor Used by Managers	Representative Personas
High-Reliability / Risk-Averse (Law, Finance, Manufacturing)	To Eliminate Ambiguity & Risk	Humor as a "Liability" / "Risk" / "Uncontrolled Variable"	YP-02, YP-03, YP-12
Creativity / Agility-Driven (Startup, Creative Agency)	To Fuel Innovation & Agility	Humor as a "Shock Absorber" / "Fuel" / "Operating System"	YP-05, YP-07
Mission-Driven / High-Stress (Healthcare, Non-Profit)	To Build Resilience & Solidarity	Humor as "Emotional PPE" / "Antidote to Cynicism"	YP-04, YP-06

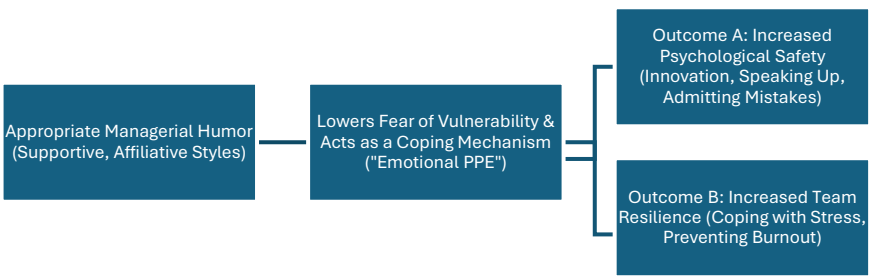
As shown in Table 3, the application of humor varies significantly across industries. In sectors characterized by high levels of responsibility, such as finance and law, humor is predominantly perceived as an unwarranted "liability" (YP-12) or as an "uncontrolled variable that adds noise to a signal that must be perfectly clear" (YP-03). Conversely, in industries that prioritize creativity, such as advertising agencies and startups, humor is institutionalized as an essential asset. The creative director (YP-05) described humor as "the fuel of creativity," while the startup founder

(YP-07) regards it as a "necessity for survival." Additionally, a third distinct perspective is observed in mission-driven professions with high emotional stress, such as healthcare and nonprofit organizations. In this context, humor is considered a vital tool for emotional resilience. As articulated by the healthcare manager (YP-04), it functions as "emotional personal protective equipment (PPE)" that aids the team in managing trauma and stress: This thematic analysis indicates that there is no universal "correct way" to employ humor; its form and function are determined by the specific cultural context of the professional environment.

Theme 4: The Consequences of Humor - Impacts on Psychological Safety and Resilience

The final and arguably most significant theme identified from the data was the direct influence of appropriate managerial humor on two essential workplace outcomes: psychological safety and team resilience. The causal pathways proposed by the participants are shown in Figure 5.

Figure 5 A Process Model of the Outcomes of Appropriate Managerial Humor



As illustrated by the model in Figure 5, managers across various sectors articulated a clearly defined process. The use of positive, contextually appropriate humor mitigates employees' apprehensions about interpersonal risk-taking. As noted by the creative director (YP-05), this cultural approach ultimately affords the team the

"freedom to be brilliant without fear of making mistakes." Such a secure environment is characterized by an open communication style that enables employees to express themselves freely, challenge ideas, and openly acknowledge errors. Beyond promoting open communication, humor has been identified as an essential tool for fostering resilience, particularly in high-stress environments. Humor serves as a coping mechanism in domains such as healthcare and civil society organizations, where teams encounter persistent emotional and operational pressure. The healthcare manager (YP-04) metaphorically described appropriate humor as "emotional personal protective equipment (PPE), " which shields the team from burnout and allows them to sustain their compassion. Conversely, managers (YP-02, YP-03, and YP-12) who eschew humor because of concerns about risk may not only provide process clarity but also risk cultivating an environment where mistakes are concealed and team resilience is not developed. This scenario underscores the fact that appropriate managerial humor is a critical leadership competency that facilitates team innovation and open confrontation of challenges.

Discussion

This study aimed to investigate the intricate and often paradoxical role of managerial humor in the workplace, with a particular focus on its relationship with psychological safety and the moderating influence of Leader-Member Exchange (LMX) quality. In-depth interviews with 13 managers revealed a nuanced landscape. The analysis identified four key themes: (1) humor is perceived through a fundamental dichotomy of being either a strategic tool or an unacceptable risk, a view heavily dictated by the industry context; (2) the meaning and impact of any humorous act are not inherent to the act itself but are critically filtered through the preexisting relational context of the LMX dyad; (3) the specific organizational and professional culture provides a script that shapes the acceptable

forms and functions of humor; and (4) appropriate humor is a significant leadership competency that directly fosters team resilience and psychological safety. Collectively, these findings contribute significantly to the literature by addressing the theoretical gap in the conceptual framework. While previous research has established dyadic links between these variables, the qualitative exploration provides rich contextual evidence for an integrated model. Specifically, the findings illustrate how and why the LMX relationship, built on trust and shared experience, acts as a critical moderating context that determines whether a manager's use of humor will ultimately build or erode the psychological safety of their team. The following sections discuss the theoretical and practical implications of these findings.

The Contextual Intelligence Dilemma: Humor as Tool and Risk

The primary significant finding of this study is a pronounced dichotomy in managerial attitudes towards humor, which is divided between its utilization as a strategic instrument and its perception as an unacceptable risk. This finding offers substantial qualitative evidence supporting the Contingency Theory within the realm of interpersonal communication. The data strongly indicate that there is no universally "effective" style of humor; rather, a manager's approach is contingent on the operational logic and risk profile of a specific industry. The "high-stakes, zero-ambiguity" paradigm of law and finance necessitates a risk-averse approach, whereas the "fail-fast, high-creativity" paradigm of startups and creative agencies requires humor as a tool for agility and innovation. Therefore, the practical implication for aspiring managers is critical: a "one-size-fits-all" approach to humor is inadequate for success. Therefore, the "tool versus risk" dilemma, therefore, is not a matter of personality but one of contextual intelligence, a conclusion visually reinforced by the starkly different coding profiles of the "Tool-User" and "Risk-Averse" groups presented in Figure 1.

A Relational Theory of Humor: Extending LMX

The second major finding—that the preexisting quality of the leader-member exchange (LMX) serves as the primary lens through which humor is interpreted—provides significant contributions to both LMX and interpersonal communication theories. Traditionally, LMX theory has focused on its influence on formal outcomes, such as job satisfaction; however, the study highlights its pivotal role in shaping nuanced informal social interactions, such as humor. This finding indicates that the function of a humorous act is not an inherent characteristic of the act itself but is co-constructed by the relationship. For instance, a tease that signifies inclusion in a high-LMX dyad may be perceived as microaggression in a low-LMX dyad. From a practical standpoint, this suggests that a manager's "great sense of humor" is less valuable than their "nuanced sense of relationships." The essential skill is to accurately assess the level of earned trust within each dyad and adjust the use of humor accordingly, opting for safer forms until a high-trust foundation is established, as visually represented in Figure 2.

The Institutional Scripts of Managerial Humor

The third theme highlights that managerial humor is not an isolated phenomenon; rather, it is intricately intertwined with and constrained by the broader cultural frameworks of professional industry. This observation robustly supports the institutional perspective of leadership communication. The data illustrate how managers within specific institutional domains, such as law (YP-12) and finance (YP-03), develop convergent, risk-averse humor norms influenced by shared professional pressures, such as liability and the necessity for precision. Conversely, managers in the creative and entrepreneurial sectors (YP-05, YP-07) adopt a divergent framework, wherein humor is institutionalized as an essential tool for fostering innovation and agility. Similarly, care-oriented professions, including healthcare (YP-04) and nonprofits (YP-06), cultivate a

distinct humor framework centered on resilience and solidarity. This finding suggests that the "rules" of humor extend beyond personal or dyadic interactions and are shaped by significant field-level external pressures. The practical implications of this phenomenon are substantial, particularly in leadership development and career mobility. This finding implies that managerial competencies, including communication styles, may not be readily transferable across industries. A manager transitioning from a tech startup to a financial institution must recognize that humor, which is indicative of creativity in their previous role, may be perceived as recklessness in their new environment. Therefore, effective leadership necessitates a high degree of cultural diagnostics—the ability to accurately interpret and adapt to the specific "humor script" that an industry's culture permits and rewards. This challenges the prevailing notion of a universal "charismatic" leadership style, which suggests that the expression of charisma must be adapted to the institutional context to be perceived as legitimate.

Humor as a Leadership Competency for Building Safe and Resilient Teams

The final theme, which suggests that appropriate managerial humor serves as a direct precursor to psychological safety and team resilience, represents a critical outcome of the integrated model proposed in this study. This finding makes a distinct contribution to the literature on psychological safety. While this body of work has established "supportive leadership" as a primary driver of safety, the present study offers a more detailed perspective by identifying the skillful use of context-appropriate humor as a specific micro-level communicative behavior that fosters the necessary trust for interpersonal risk-taking. As demonstrated by the creative and startup personas (YP-05, YP-07), humor can create "the freedom to be brilliant without the fear of being wrong," directly facilitating the learning and innovation behaviors that psychological safety enables.

Furthermore, the concept of humor as "emotional PPE" (YP-04) contributes to the literature on stress and coping, particularly within the Job Demands-Resources (JD-R) model. The findings suggest that appropriate humor is not a mere social pleasantry but a tangible job resource. This resource appears to assist employees in buffering the depleting effects of high emotional demands found in professions such as healthcare and activism, thereby preventing burnout and sustaining long-term performance. The practical implications are clear: organizations should consider the capacity for context-aware humor not as an innate personality trait, but as a developable leadership competency. Rather than dismissing it as a "soft skill," it should be integrated into leadership training programs. These findings suggest that managers who can effectively use humor to create a safe and resilient climate are better equipped to lead teams that are both innovative and sustainable.

Conclusion

This study undertook an exploratory investigation to elucidate the nuanced role of managerial humor by employing an innovative AI persona-based qualitative approach. Through comprehensive, semi-structured interviews with 13 diverse manager personas, a substantial dataset was generated and subsequently analyzed using a six-phase thematic analysis facilitated by MAXQDA software. The findings revealed a complex landscape wherein the function of humor is determined not by a universal style but by a confluence of industry culture, the specific risk profile of the work, and, most critically, the preexisting relational context defined by Leader-Member Exchange (LMX) quality. The central contribution of this study is the articulation and qualitative validation of an integrated model. The analysis provides substantial contextual evidence indicating that the LMX dyad functions as a pivotal filter that decodes the meaning of a manager's humor, thereby determining whether it will foster or erode the climate of psychological safety

and team resilience. This advances the discourse beyond a simplistic "good vs. bad" dichotomy to a more sophisticated understanding of how and under what conditions humor can effectively serve as a leadership tool. As with any research, this study had limitations that must be acknowledged. The primary constraint is intrinsic to this method. Although the use of AI-generated personas facilitates access to a diverse array of managerial archetypes, it is acknowledged that these personas do not embody the full complexity of humans. Their responses were derived from extensive textual data, not authentic lived experiences or unconscious motivations. Consequently, this study provides a robust examination of managerial scripts and logic; however, it cannot encompass the entire range of human emotional complexity. Second, although the 13 personas were designed for maximum variation, the sample is not statistically generalizable; the findings are intended to be exploratory and theory-generating and not definitive. Finally, despite rigorous processes such as peer debriefing, the potential for researcher bias is an inherent limitation of qualitative inquiry. The findings and limitations of this study suggest several promising avenues for future research.

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BÖLÜM 3

CREATING A DIFFERENT SET OF MANAGERIAL CAPABILITIES AMONG COMPLEX PROJECTS: THE CASE OF THE BEIJING AQUATICS CENTER

UMUT UYAN[1]

Introduction

Creating an iconic building as well as environmentally friendly can be extremely challenging in terms of both necessary technical and managerial capabilities. Particularly, the projects that require collective endeavors of many different parties from different disciplines and diverse locations across the world can be more problematic (Thamhain, 2013). In 2003, Chinese government urged to create several landmark buildings for 2008 Beijing Olympic Games and the post-game commercial purposes. National Aquatic Center is also known as Water Cube, one of them and it is created with the aim of swimming venue for the games. Considering new technology, international team effort and innovative design techniques, Water Cube can be evaluated as one of the unique complex projects. Although the Center itself has various positive outcomes according to both traditional project success criteria such

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as time, cost and quality as well as other factors such as impacts on society and business success, the team had to overcome many difficulties at the earliest stage and during the project. In this sense, after project brief and objectives this chapter will attempt to analyze the dynamic nature of National Aquatic Center project from different perspectives of project management in the light of related theories and frameworks.

Project Brief and Objectives

National Aquatic Center designed as a swimming venue for 2008 Olympic Games which includes a 50-meter competition pool and a 33-meter diving pool and a 50-meter warm-up pool (ARUP, 2015). The Center was aimed to contain 17.000 seats for the Olympic Games and 7000 of them are designed as replaceable to serve different commercial, sports and training purposes for the post-game period. The distinctive architectural concept was inspired by natural *soap bubbles* which have no standard pattern and therefore the construction has no conventional straight lines. Most importantly, the building is covered with a kind of plastic which is ETFE (ethylene tetra fluoro ethylene). By using ETFE, the designers aim to store solar energy which can reduce the lighting energy required. *Image 1* illustrates ETFE cushions that were used as covering material for inside and outside of the building. Furthermore, the engineers integrated different technologies into the roof which can collect and reuse rainwater (Zou and Carter, 2010).

It is apparent that the main purpose of the project is creating a landmark building which has a unique architectural design as well as eco-friendly. In terms of traditional project criteria, the given time for the project was approximately 5 years (2003-2008) and the budget for this project was $100 million. Apart from traditional project criteria, the project team of Water Cube is intended to raise environmental awareness which has a huge impact on society. By

doing so, Water Cube might have represented a real transition from the traditional monumental communist architecture to more sustainable design which can protect the resources (Zou and Carter, 2010).

Image 1. ETFE Cushions Covering the Aquatic Centre

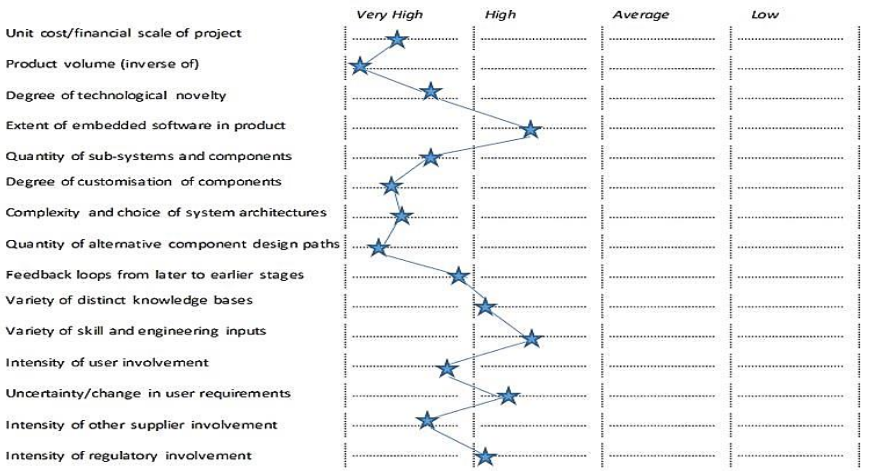
This image was obtained from the official website of ARUP

The Aquatic Center was shaped by differing priorities between the Chinese government and the contractors. In the case of the government, it is important to create a prestigious swimming venue which has a harmony with Chinese culture. On the other hand, the contractors of the project aimed to establish a transparent partnership between parties and to form a dynamic team which can lead to the creation of innovative ideas during the project. In order to meet the expectations of both parties, the project team faced many challenges which will be held in further discussions.

The project, on the other hand, has a highly complex and dynamic nature in terms of required knowledge, skills, systems and networks which are stated above. Particularly, technical difficulties in the customization of components make the project very complex. For instance, 3.500 different ETFE cushions should have manufactured precisely at the right time and the right position for installation otherwise it could have been a technical as well as a financial disaster. In addition, the degree of technological novelty was very high, especially for the initial design phase. After the

project was selected, the design team were asked to create a prototype of the project. However, with current technology, it was almost impossible to create such a complex prototype. Shortly after, the design team decided to apply *open innovation* and ask a company that specialised the process called *rapid prototyping* method (ARUP, 2015). The company managed to create a model with the help of 4D technology and liquid epoxy. To evaluate the complexity of the project Hobday's (1998) *Product dimensions of CoPs* can be used as a tool. As it is illustrated in *Figure 2*, most dimensions of the project can be assessed as very high or high which portray Water Cube as a highly complex project.

Figure 2. Production Dimensions of CoPS adapted to the Project

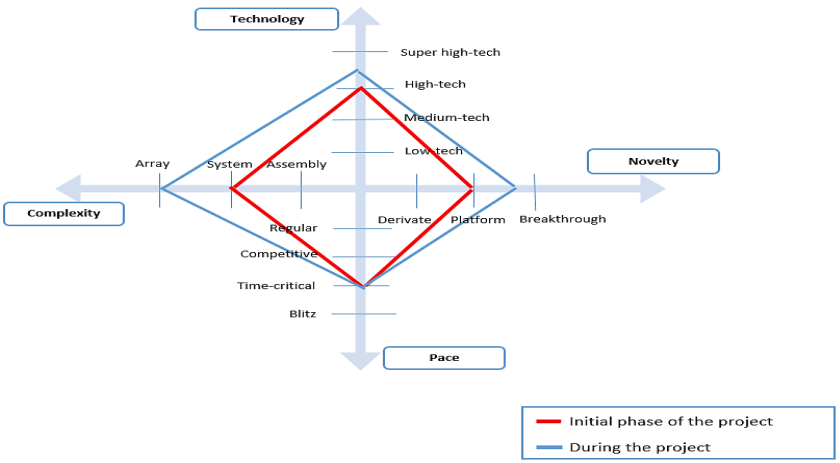


Recent debates in project management challenge the long-standing assumption that all projects can be governed through a standardized set of processes and techniques. As Shenhar and Dvir (2007) argued, projects differ significantly in terms of novelty, technology, complexity, and pace; therefore, each requires a tailored managerial approach. They further emphasize that long-term considerations, such as learning from project experiences and maintaining flexibility to navigate uncertainties, have become

increasingly critical, surpassing traditional concerns of mere efficiency.

The Water Cube project exemplifies this shift. Its sequential yet interdependent activities, coupled with a strict and immovable timeline, created a highly complex environment that could not be managed through conventional planning-and-control methods alone. Consequently, the project management team adopted a *teaming* approach, bringing together experts in temporary, problem-focused groups to address challenges they were encountering for the first time (Edmondson, 2012). Although effective, this method also presented limitations, which will be discussed later. As illustrated in *Figure 3*, the Water Cube's tight time constraints and extensive subsystem scope positioned it within a highly uncertain project environment, one that required sophisticated managerial techniques beyond those offered by traditional project management.

Figure 3. Diamond Model Assessing Project Complexity

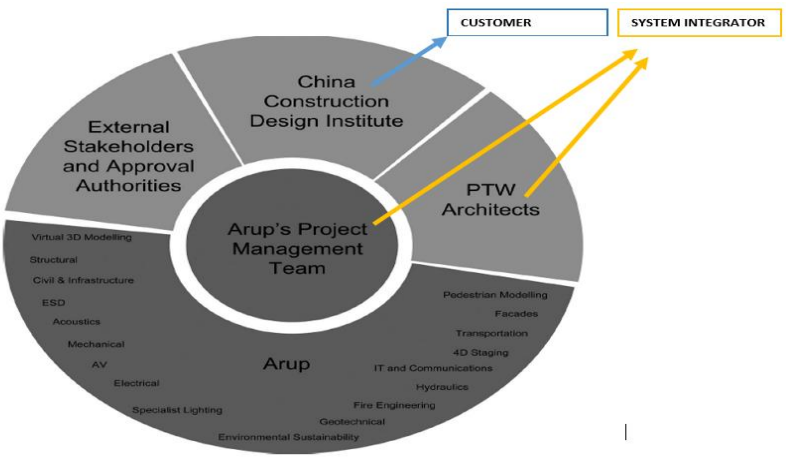


Stakeholders of the Project

Along with rapid growth of Chinese economy, construction jects have become widespread and therefore this brings several

opportunities for international stakeholders such as working with different cultures; as well as risks such as “poor management ability, suppliers’ incompetency to deliver goods and services and high bureaucracy” (Zou et al., 2007). The Water Cube emerged from the collaboration of an international consortium. The consortium consists of three different enterprises: joint-venture of Sydney-based ARUP Design, PTW Architects and China Construction Design Institute (CCDI). *Figure 4* represents stakeholders of the project with respect to the role of parties. The project team contained more than 100 engineers from 20 different disciplines and four different countries which were led by ARUP Project Management (Ho, 2008). The main threat for this project was the difference between the way of doing business of Chinese and Australian partners. Unlike Australian partners, personal relationships are extremely important for Chinese business culture, therefore understanding this dimension and adjusting negotiations and management style according to this factor was vital to the success of the project.

Figure 4. Stakeholders of the Project



Source: Zou, P. X., & Leslie-Carter, R. (2010). Lessons learned from managing the design of the ‘Water Cube’National Swimming Centre for the Beijing 2008 Olympic Games.

Key Challenges Faced During the Project

From the initial phase to completion of the project, the project team had to face many technical challenges. Shortly after the project was chosen, ARUP was struggling to create prototype due to the complexity of the model. Lack of technical knowledge about building a prototype led the project team to apply open innovation and asked another design company to create the prototype. In this sense, the project team tried to solve the problem via system integration. Apart from prototyping problem, there were also some technical challenges that were triggered by covering material of the building. Due to the fact that covering the building with a kind of plastic, ETFE, the possibility of catching fire of the material became more of an issue. Although ETFE passed many firing tests in the past, convincing Chinese authorities to ETFE will be safe for any fire issue was problematic. The other problem with covering the building with plastic was also challenging in terms of the climate conditions in China. Engineers also needed to prove the covering material can resist the bad weather conditions. Lastly, the questions arose whether ETFE can prevent extreme temperatures inside the building and can provide the precise temperature for 2008 Olympic Games.

In China, construction projects must be designed according to national fire standards and Chinese fire code required using extra steel for Water Cube in order to strengthen skeleton of the building against any fire incident. However, the project team opposed the idea of giving extra visible steel would have made the Olympic masterpiece to an ugly building. In order to convince Chinese authority, the team should have proved the steel skeleton of the building strong enough via estimating possible fire incident. Furthermore, Chinese fire code also requires another regulation; the buildings holding 20.000 people must have 200 meters evacuation exit doors (Carfrae, 2006). However, this idea was also challenging

with the design of the project. As illustrated above, the conflict between design and functionality of the building was a big issue that the project team must have dealt with.

Apart from technical challenges, many researchers have emphasized the importance of having soft competencies in order to create an effective project team which may lead desired high project performance (Vincenzo and Mascia, 2012; Bartsch et al., 2013). Stoshikj et al. (2014) suggest that the project team and project stakeholders hold an important set of knowledge that can be applied to the current project and further transferred to future ones. Therefore, they emphasized the collaboration as one of the key success factors of any project. Especially, projects like National Aquatic Center require high collaboration between parties in order to deal with its uncertain and highly complex environment. However, it was a real challenge for the project team of Water Cube to deal with people who came from different cultures and have different skills. Arias (1998) point out that in order to do business in the Chinese market; managers should be aware of "guanxi" approach. Quanxi works at a personal level on the basis of friendship, and affection is a measure of the level of emotional commitment and the closeness of the parties involved (Wang, 2007). The project team must have taken this factor into account in order to create an enabling context for Chinese partners.

In the meantime, the team should have established trust between parties in order to ensure tacit knowledge articulation which is necessary for innovation. Managing highly skilled expertise for a temporary time period and encouraging them to involve innovation during the project was another huge difficulty that the management team must have faced. In general, creating an effective team requires *shared identity*, *common goal*, *interdependence*, *personal interaction and mutual influence* (Newell et al., 2009: 167). Nevertheless, Newell and colleagues emphasized that creating a

project team is much harder than creating a normal team because the work that is undertaken in a project is often temporary, fluid, interrupted and distributed. Ultimately, the project team adopted Edmondson's (2012) *"teaming"* approach, rather than relying on a conventional team structure, while also implementing "interface management" (Zou & Carter, 2010), a strategy further elaborated in the subsequent section on success factors.

Strategies Contributing to Project Success

According to Edmondson (2012), in today's fast-moving and ultracompetitive environment, organizations cannot rely on stable teams. By pulling together right people with the right combination of skills and establishing trust within the team can be enough for accomplishing certain tasks. However, stable teams cannot be the best way in a project environment which subject to rapid changes. Due to high complexity and uncertainty, solutions can come from anywhere and organisations should consider this reality in order to create innovative project management. Therefore, rather than forming stable teams, project organisations may consider "teaming" which refers to 'gathering experts from different divisions and disciplines into temporary groups to overcome unexpected problems and identify emerging opportunities' (Edmondson, 2012). By doing so, project teams may prevent both knowledge and learning boundaries. In the case of Water Cube, project team applied this method via introducing *interface management*. They divided the project into volumes, and each volume was owned by a sub-project team (Zou and Carter, 2010). On one hand, those temporary teams aimed to overcome knowledge boundaries via coordination across the project, on the other hand, they became a bridge for cultural exchange. Perhaps one of the most serious limitations of "teaming" is that the approach can lead to chaos because of differences in values, beliefs and expertise. Furthermore, it is not easy to establish

mutual trust especially *swift trust* within the temporary teams (Meyerson et al., 1996 cited in Kramer and Tyler, 1996).

Distribution of power is critical in public-private partnership projects, particularly in China. The projects that are funded by Chinese government may have several disputes according to the power imbalance between the prime contractor and the government. National Olympic Stadium which is also called "bird nest" had some troubles due to the disagreement between the government and the design company (Liu et al., 2008). For instance, the tractable roof of the stadium was cancelled, and this cancellation has affected the scope of the project in terms of post-game purposes. National Aquatic Center could have had the same risk due to the conflicts that are stated above. However, setting a clear vision about the project and sharing this vision with all stakeholders explicitly prevents possible risk associated with government interference. Besides, project team established a close relationship with local government and informed them almost daily basis via a sub-project team. By doing so, the project team not only prevents possible government interference but also reduces bureaucracy.

Apart from successful managerial practices, the project team managed to solve many technical problems via "crowdsourcing" which is also called open innovation. In terms of the future implications of the project, innovation is crucial and the relevant knowledge for innovation may reside inside or outside of the organisation. Therefore, Dhanaraj and Parkhe (2006) emphasized that integration of relevant knowledge can be possible through the development of social networking via gathering specialist expertise from a range of sources, people and locations. In this regard, the project team successfully managed the open innovation process through reducing hierarchical barriers and focusing only core business and allowed the participation of other parties for complementary initiatives. By doing so, numerous new techniques

and a software program were developed particularly for Water Cube project. In order to generate geometry for the structure of the building, optimise structural performance and create a prototype, this software was used (Carfrae, 2006). From the long-term perspective, it is likely the project team may integrate this software into other complex construction projects.

Conclusion

This chapter examines the National Aquatic Center as a complex project shaped by a highly dynamic environment. Managing risks associated with dispersed teams and cross-cultural collaboration required advanced managerial capabilities, including effective negotiation and conflict-resolution techniques. Although the project team faced numerous technical and managerial challenges, many of these were successfully addressed through strategies such as interface management and open innovation. Beyond delivering an iconic and environmentally sustainable structure, the project generated valuable learning outcomes for the team, particularly in working with international partners and navigating culturally driven conflicts that may arise in future projects. In addition to these organizational insights, the Water Cube achieved long-term business success by sustaining its role as a vibrant venue for artistic, sporting, and commercial events after the Olympic Games (Water Cube, 2016). Overall, the National Aquatic Center stands as a successful project according to both traditional criteria and contemporary measures of project performance.

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BÖLÜM 4

REFRAMING HUMAN RESOURCE MANAGEMENT IN A VUCA WORLD

RAHİLE GÜRAN GÖVEN[1]

INTRODUCTION

In recent years, the global business environment has become increasingly complex and dynamic, making even short-term decision-making processes more challenging for organizations. Changing conditions such as transparent markets and an ever-accelerating pace of work have created intense workplace pressures for both large and small companies as well as their employees (Raghuramapatruni & Kosuri, 2017: 16). These developments have compelled organizations to reconsider their existing operational structures and management practices in order to remain competitive and sustainable.

The COVID-19 pandemic has significantly intensified these challenges and has fundamentally altered the way work is organized and performed. Governments around the world implemented

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lockdowns and mobility restrictions to control the spread of COVID-19, and during this period, Human Resource (HR) managers played a critical role in liaising with public authorities and ensuring compliance with mandatory regulations (Sharma & Singh, 2020: 10224). Alongside these regulatory responsibilities, HR departments were required to redesign work arrangements and manage unprecedented workforce-related uncertainties.

The pandemic period represents a concrete example of a VUCA environment characterized by volatility, uncertainty, complexity, and ambiguity. Sudden disruptions in markets, rapid shifts in working conditions, and unpredictable changes in employee expectations forced organizations to operate under highly unstable conditions. While some organizations were able to adapt relatively easily to these changes, others struggled to keep pace with the evolving environment. As technological developments continue to accelerate, the importance of keeping up with a volatile, uncertain, complex, and ambiguous business world has become even more critical for organizational survival.

Organizational sustainability in a VUCA world largely depends on the ability to respond effectively to uncontrollable external conditions. However, one of the defining characteristics of VUCA environments is the lack of sufficient information regarding diagnosis, identification, and interpretation of emerging conditions. In such environments, organizations that are able to select, develop, and support a motivated workforce can make a significant contribution to performance and long-term sustainability. Effective HR strategies include promoting diversity, fostering innovation, strengthening performance management systems, and prioritizing training and development as well as talent acquisition processes (Hamid, 2019: 1).

Leadership also assumes a distinct role in VUCA conditions. Rather than adopting a reactive approach, effective leaders are expected to

act proactively, anticipate potential disruptions, and guide their organizations through uncertainty. This proactive leadership orientation is particularly important in environments where rapid change and limited predictability dominate organizational life.

Although the concept of VUCA has been widely discussed in international literature, studies focusing on VUCA environments within the Turkish context remain relatively limited. Existing research primarily addresses VUCA as a general environmental condition, with fewer studies examining its implications for Human Resource Management from a holistic perspective. Therefore, the aim of this study is to define the concept of VUCA and to contribute to the literature by examining Human Resource Management processes through an integrated framework.

Accordingly, this study reviews research conducted in both international and Turkish contexts on the relationship between VUCA environments and Human Resource Management, and presents examples of HR practices implemented in response to VUCA conditions. By doing so, the study seeks to highlight the strategic role of Human Resource Management in enabling organizations to adapt to volatility, uncertainty, complexity, and ambiguity.

1. LITERATURE REVIEW

1.1.The VUCA Concept: Origins and Evolution

The acronym VUCA—Volatility, Uncertainty, Complexity, and Ambiguity—originated in military strategic thinking. The United States Army War College coined the term in the early 1990s, drawing upon Bennis and Nanus's (1985) leadership theories, to describe post-Cold War geopolitical challenges (Yurdasever, 2019). The Soviet Union's collapse replaced the predictable bipolar superpower competition with a fragmented world characterised by diverse threats and rapid technological change. Traditional strategic

planning models, predicated on stability, clear adversaries, and predictable cause-effect relationships, proved increasingly inadequate for navigating this emerging environment (Sharma & Singh, 2020; Akdemir et al., 2020).

VUCA migrated to business contexts gradually throughout the 1990s, accelerating after the 2008 financial crisis. Scholars recognised that these four dimensions aptly described organisational challenges in an era of globalisation, technological disruption, and Industry 4.0 (Sharma & Singh, 2020). Today, VUCA characterises shifting demographics, evolving customer expectations, business model disruption, and pandemic-driven workplace transformations (Akdemir et al., 2020). The framework's enduring appeal lies in its parsimony: four dimensions collectively capturing contemporary environmental turbulence whilst remaining flexible enough to accommodate diverse organisational contexts.

In Turkish scholarship, VUCA has been adapted as KOMB (Karmaşıklık, Oynaklık, Muğlaklık, Belirsizlik), facilitating local uptake (Yurdasever, 2019; Akdemir et al., 2020). Understanding each dimension enables targeted strategic responses, as approaches for addressing complexity differ substantively from those navigating uncertainty.

1.1.1. The Four VUCA Dimensions

1.1.1.1.Complexity: Multiple Interconnected Variables

Complexity characterises situations where multiple interconnected factors interact non-linearly, creating confusion and making patterns difficult to discern (Raghuramapatruni & Kosuri, 2017). Unlike complicated situations amenable to systematic analysis, complex situations exhibit emergent properties unpredictable from examining individual elements. Small changes can produce disproportionate effects through cascading interactions.

In organisational contexts, complexity manifests across multiple domains. Structural complexity arises when organisations operate across diverse geographical locations, each with its own regulatory environment, tax regime, labour market conditions, and cultural expectations. Multinational corporations must navigate not only linguistic barriers but fundamentally different legal frameworks governing employment relationships, data protection, intellectual property, and commercial transactions (Raghuramapatruni & Kosuri, 2017).

Demographic complexity intensifies as workforces span multiple generations—Baby Boomers through Generation Z—each with different expectations regarding work-life integration, technological fluency, career progression, and employment relationships. Cultural complexity requires accommodating diverse value systems and communication styles: high-context patterns in Asian cultures differ dramatically from explicit Western styles, whilst attitudes towards hierarchy, authority, and individualism vary substantially across cultures.

Technological complexity has proliferated through digital transformation, creating intricate ecosystems where interdependencies are opaque and vulnerabilities difficult to anticipate. The rapid pace of technological evolution ensures today's innovations may become tomorrow's obsolete systems requiring costly replacement or integration.

The challenge is fundamentally cognitive: decision-makers possess limited information-processing capacity and rely on simplifying heuristics inadequate for genuinely complex situations (Raghuramapatruni & Kosuri, 2017). Importantly, complexity differs from complication. Complicated problems are tractable through expert analysis and planning. Complex problems involve fundamental uncertainties about component interactions, exhibiting non-linear dynamics and emergent behaviours. This demands

adaptive, experimental approaches embracing learning through iterative action.

1.1.1.2.Volatility: Rapid and Unpredictable Change

Volatility characterises environments marked by continuous change and turbulence generated by the velocity of that change (Michel, 2016). This dimension encompasses the nature, speed, volume, magnitude, and dynamics of change confronting organisations. Volatile conditions are inherently unstable and may persist for unpredictable durations (Raghuramapatruni & Kosuri, 2017).

A crucial distinction exists between volatility from novel circumstances and volatility reflecting previously experienced patterns. Share price fluctuations following leadership transitions, whilst severe, follow recognisable patterns enabling some preparation (Raghuramapatruni & Kosuri, 2017). However, genuinely unprecedented situations demand heightened vigilance and adaptive capacity. The COVID-19 pandemic exemplifies such unprecedented volatility: few organisations had anticipated simultaneous global health crisis, supply chain collapse, mandatory workplace closures, and wholesale shift to remote working.

Volatility manifests across multiple domains. Market volatility affects demand patterns, competitive dynamics, and customer preferences, shifting rapidly in response to technological innovation, regulatory changes, or macroeconomic conditions. Labour market volatility presents particular challenges: skills shortages emerge rapidly as technological change renders existing competencies obsolete whilst creating demand for new capabilities. The 'Great Resignation' phenomenon during pandemic recovery exemplifies such volatility, as organisations confronted unprecedented voluntary turnover as workers reassessed priorities.

Regulatory volatility has intensified as governments respond to technological change, social movements, and geopolitical tensions

through new legislation. Data protection regulations, environmental standards, labour protections, and tax policies may shift rapidly, sometimes with limited notice, requiring organisations to adapt compliance frameworks and operational practices accordingly.

The primary challenge posed by volatility is temporal: change occurs too rapidly for traditional planning cycles to accommodate. By the time comprehensive analysis is completed and strategic responses formulated, situations may have evolved substantially, rendering carefully developed plans obsolete before implementation. This temporal mismatch demands fundamentally different approaches emphasising agility, rapid sensing and response, and continuous adaptation rather than stability and optimisation.

1.1.1.3.Uncertainty: Unpredictability and Information Deficits

Uncertainty characterises situations where predictability of problems and events is fundamentally absent. Despite limited information availability, basic event causes and potential effects may be understood, yet outcomes frequently result in significant changes (Bennett & Lemoine, 2014; Raghuramapatruni & Kosuri, 2017). Uncertainty represents information deficit regarding future states and probable consequences of current decisions.

A paradigmatic example involves competitive dynamics, such as when rivals unexpectedly launch superior products disrupting established market positions (Bennett & Lemoine, 2014; Raghuramapatruni & Kosuri, 2017). Whilst organisations understand competitors invest in R&D and innovations periodically reshape landscapes, specific timing, features, and market reception remain fundamentally unknowable until materialisation.

Uncertainty differs from risk crucially: risk involves situations where potential outcomes and probabilities can be estimated, enabling expected value calculations. Uncertainty describes situations where either outcome ranges or probabilities—or both—

remain fundamentally unknowable. This distinction has profound decision-making implications. Risk can be managed through diversification, insurance, and hedging. Uncertainty demands different capabilities: making consequential decisions despite incomplete information, adapting rapidly as new information emerges, and maintaining strategic flexibility rather than irrevocable commitments.

Uncertainty manifests across numerous domains. Strategic uncertainty involves fundamental questions about future industry structure, competitive dynamics, technological trajectories, and customer preferences. Regulatory uncertainty complicates long-term planning as governments grapple with technological change, climate transition, and social concerns. Economic uncertainty encompasses questions about future growth rates, inflation trajectories, exchange rate movements, and financial market conditions, affecting virtually all organisational decisions.

For human resource management, uncertainty manifests in questions about future skill requirements, workforce availability, compensation expectations, and employment relationship preferences. As artificial intelligence and automation reshape work, which human capabilities will remain valuable? What skills should organisations develop? How will employees' expectations regarding workplace flexibility, purpose, and psychological safety evolve?

Addressing uncertainty requires organisations to develop 'dynamic capabilities'—the capacity to sense environmental changes, seize opportunities as they emerge, and reconfigure resources and capabilities in response to evolving circumstances. Rather than attempting to predict unpredictable futures, organisations must cultivate ability to respond effectively to whatever futures actually materialise.

1.1.1.4.Ambiguity: Unclear Cause-Effect Relationships

Ambiguity characterises situations where nothing is clear and doubt prevails regarding fundamental cause-effect relationship nature (Bennett & Lemoine, 2014; Raghuramapatruni & Kosuri, 2017). This reflects unprecedented circumstances requiring organisations to confront unknown without established guidelines, frameworks, or past experiences. Unlike uncertainty—where challenges lie in predicting specific outcomes despite understanding basic causal mechanisms—ambiguity reflects fundamental confusion about situation nature itself.

Understanding ambiguity requires experiential engagement; organisations must immerse themselves in ambiguous situations, experiment with different approaches, and develop understanding through direct experience rather than abstract analysis (Bennett & Lemoine, 2014; Raghuramapatruni & Kosuri, 2017). Paradigmatic examples involve market entry into immature or emerging markets, where established business models may not apply, customer preferences remain poorly understood, regulatory frameworks are nascent, and competitive dynamics differ fundamentally from mature markets.

The challenge is fundamentally interpretive: difficulty lies not merely in solving problems or predicting outcomes but in understanding situation nature and identifying which questions to ask. In ambiguous contexts, organisations lack clear sense-making frameworks, environmental signals may be contradictory or opaque, and stakeholders may interpret same phenomena fundamentally differently.

Ambiguity frequently arises during profound transformation—technological revolutions, regulatory upheavals, social movements, or disruptive business model innovations—when established interpretive frameworks prove inadequate. The early digital

transformation stages exemplify such ambiguity: organisations recognised internet technologies would prove consequential but struggled to understand precisely how they would reshape competitive dynamics, customer relationships, and organisational capabilities.

For human resource management, ambiguity manifests when organisations confront unprecedented workforce challenges. The pandemic shift to remote working created ambiguity about productivity measurement, team cohesion, organisational culture maintenance, and career development in distributed environments. Cultural ambiguity presents challenges for multinational organisations, as meanings, symbols, and practices clear in one cultural context may prove fundamentally ambiguous when transferred across cultural boundaries. Technological ambiguity has intensified with artificial intelligence, blockchain, and quantum computing emergence, whose ultimate applications and implications remain fundamentally unclear.

Addressing ambiguity requires distinctive organisational capabilities. Whilst complexity demands analytical capability and coordination, volatility requires speed and flexibility, and uncertainty calls for robust planning, ambiguity necessitates experimentation, learning, and tolerance for provisional understandings subject to revision. Organisations must cultivate comfort with not-knowing, willingness to revise interpretations as new information emerges, and capacity to hold multiple competing interpretations simultaneously without premature closure.

1.2.VUCA PRIME

In the VUCA world, the unpredictable nature of affairs renders planning increasingly challenging. To survive in VUCA environments, leaders must acquire new change management perspectives and capabilities. Change should be viewed as

something natural and ongoing rather than as a discrete event that can be planned. Consequently, instead of viewing change as something controllable and manageable, leaders must embrace the reality of continuously evolving organisational environments and develop organisational capabilities that enable ongoing organisational change (Pearse, 2017: 82). A good leader in the VUCA world must expect the unexpected, anticipate these developments, and be expert in adapting to them (cited in Akdemir et al., 2020: 349).

VUCA is a term that describes the problematic nature of situations encountered in complex, volatile, uncertain, and ambiguous environments. The VUCA PRIME approach, however, sets forth the prime competencies that managers must possess to cope with VUCA situations. In the VUCA PRIME approach, these prime competencies encompass the indispensable characteristics that managers in VUCA environments must have to deal with such conditions.

VUCA PRIME was developed by Bob Johansen, a distinguished fellow at the Institute for the Future and author of the book *Leaders Make the Future: Ten New Leadership Skills for an Uncertain World*. Johansen characterises the best VUCA leaders as possessing vision, understanding, clarity, and agility (Lawrence, 2013: 6). Vision is the envisioned target state that mobilises all elements of an organisation, inspires, and requires mental effort to obtain the best possible view of the future (Awamleh & Gardner, 1999: 346).

In VUCA PRIME, for resolving complexity, leaders must engage in mutual exchange of ideas with all stakeholders and simultaneously be able to utilise these ideas. Complexity is one of the paths of conflict and resolution for making sense of chaos, whilst the negotiation process, which is also a group action, can be met with clarity. In the VUCA world, chaos arrives rapidly and severely. Leaders who can quickly and clearly adjust all the minute details

associated with chaos can make better and more informed business decisions (Lawrence, 2013: 6).

Volatility can be countered with vision, because vision is even more vital during turbulent times. Leaders with a clear vision of where they want their organisations to be in three to five years can better navigate volatile environmental changes, such as economic downturns or new competition in their markets, by making commercial decisions to counter turbulence (Lawrence, 2013: 6).

Ambiguity can be met with understanding—a leader's ability to stop, look, and listen. To be effective in a VUCA environment, leaders must learn to look and listen beyond their functional areas of expertise to understand volatility and lead with vision. This requires leaders to communicate with employees at all levels of their organisations and to develop and demonstrate teamwork and collaboration skills (Lawrence, 2013: 6).

Finally, uncertainty can be countered with agility—the ability to communicate across the organisation and move quickly to implement solutions (Kinsinger & Walch, 2012). In VUCA PRIME, vision, understanding, clarity, and agility are not mutually exclusive. On the contrary, they are interwoven elements that help managers become stronger VUCA leaders. All of these elements are expected of managers in VUCA environments. An organisational culture should be established that progressively recruits agile leaders, develops existing leaders to be agile, and rewards the competencies of vision, understanding, clarity, and agility in the VUCA PRIME approach.

1.3. VUCA and Human Resource Management

The Strategic Imperative: HRM as a Response to VUCA Environments

The contemporary business environments in both developed and developing countries are increasingly characterised by VUCA—Volatility, Uncertainty, Complexity, and Ambiguity. The VUCA terminology captures the rapid changes to which work and work environments are subjected, the diverse needs of employees, and the nearly unpredictable expectations of customers (Hamid, 2019). In this challenging landscape, Human Resource Management (HRM) must focus on overcoming the barriers associated with the characteristics of VUCA environments to achieve competitive advantage for the company. Consequently, HR managers need to develop specific strategies both to address new market conditions and to become industry leaders in existing markets. Every preparation made for the VUCA environment will provide the organisation with sustainable competitive advantage (Hamid, 2019: 1).

The strategic positioning of HRM in VUCA contexts represents a fundamental shift from traditional personnel management approaches. Rather than serving merely administrative functions, HR professionals must emerge as strategic architects of organisational resilience, designing systems and practices that enable organisations not simply to survive turbulence but to thrive amidst it. This evolution reflects a growing recognition that sustainable competitive advantage in volatile, uncertain, complex, and ambiguous environments resides primarily in human capital and organisational capabilities rather than in technological assets or market positioning alone.

Empirical research has begun to illuminate the specific HR strategies most effective in VUCA contexts. In a study conducted by Singh and Sorum (2018) with HR professionals from 15 private insurance sector companies in India, several critical strategic imperatives emerged. The researchers concluded that organisations must develop strategies related to talent acquisition, the development of

digitalisation processes within organisations, retaining employees in relation to the VUCA world of organisations, developing continuous dialogue between employees and their managers, and improving workplace diversity (Singh & Sorum, 2018: 58).

More specifically, the findings suggest that organisations can initiate digitalisation initiatives, promote innovative talent recruitment and management methods, increase skill diversity and employees' cultural backgrounds, and finally, train them to effectively handle volatile markets (Singh & Sorum, 2018: 58). These strategic priorities reflect a holistic understanding of HRM's role in VUCA environments: not merely responding to environmental turbulence reactively but proactively building organisational capabilities that transform volatility, uncertainty, complexity, and ambiguity from threats into opportunities for differentiation and competitive advantage.

1.3.1.Complexity Dimension and HRM

Technological developments have enabled employees from different cities and different countries to work together even when not physically co-located, a situation that can create complexities. Similarly, employees from different generations and with different worldviews can work together in an organisation, simultaneously presenting completely different values and perspectives about the world (Jain, 2019). This generational and cultural diversity, whilst enriching organisational capability, creates substantial management challenges as leaders must navigate competing value systems, communication preferences, and work expectations simultaneously.

The first prerequisite for overcoming complexity is developing collaborative leaders who can see the big picture and guide their colleagues to achieve more together. HR must provide ways for leaders in organisations to come together and share what they have learnt and their experiences. The organisation's leaders should take

pride in others' successes and help each other grasp complex situations. HR should encourage seamless sharing of experiences by facilitating conversations across geographies, business units, domains, and levels (Jain, 2019: 84).

This facilitation role extends beyond merely creating forums for interaction; it requires HR to design and implement sophisticated knowledge management systems, communities of practice, and cross-functional collaboration mechanisms that enable distributed learning and collective sense-making. In complex environments characterised by multiple interdependencies and non-linear relationships, no single individual or functional silo possesses sufficient perspective to comprehend the full picture. Organisational effectiveness thus depends upon mechanisms that aggregate distributed intelligence and enable collective problem-solving.

To counter complexity, HR needs to enable collaboration and community building within the organisation. Recognising the importance of communication within the organisation and supporting communication will assist in resolving complexities (Jain, 2019: 84). This communication imperative encompasses both formal channels—such as structured meetings, reporting relationships, and information systems—and informal networks through which tacit knowledge, cultural norms, and social capital are transmitted. HR professionals must attend to both dimensions, creating architectures that facilitate information flow whilst nurturing the relational fabric that enables trust, reciprocity, and collaborative problem-solving.

1.3.2.Volatility Dimension and HRM

One of the main causes of volatility is the rapidly changing nature of technology. Companies today experience a fear of falling behind that underlies the pace of technological change. Many organisations have deployed social intranets and collaboration platforms by leveraging

the power of digital technologies. Integrating digital systems into the main purpose and strengthening the collaboration culture requires restructuring processes and organisational design (Jain, 2019).

This technological volatility extends beyond the deployment of particular platforms or tools to encompass fundamental questions about how work is structured, coordinated, and evaluated. The rapid evolution of artificial intelligence, automation, and digital collaboration technologies means that job roles, skill requirements, and optimal work processes may shift substantially within short timeframes. HR functions must develop capabilities for continuous workforce planning, rapid reskilling, and agile talent deployment that enable organisations to reconfigure human capital in response to technological change.

Another important requirement in a volatile environment is that HR's purpose and objectives are clearly understood by the line. If communication is clear, employees will also be better equipped to deal with severe and unpredictable shifts. Since it is not very possible for HR objectives to be consistently aligned with the company's strategic vision, periodic review and alignment of gradual objectives at the employee level with significant flexibility is important to select the appropriate tools to achieve these objectives (Jain, 2019: 82).

This alignment challenge reflects a fundamental tension in volatile environments: the need for consistent strategic direction must be balanced against the imperative for tactical flexibility. Rigid adherence to predetermined objectives may prove counterproductive when environmental conditions shift dramatically, yet constant revision of objectives can create confusion and undermine commitment. HR must thus develop sophisticated approaches to goal-setting that distinguish between stable strategic priorities and flexible tactical objectives, enabling both consistency and adaptation.

For the volatility dimension, the importance of having vision and the adoption of the main purpose across all levels of the organisation is crucial. Leaders must articulate compelling strategic visions that provide stable reference points amidst turbulence, whilst HR systems must ensure that these visions are translated into meaningful objectives and behavioural expectations at all organisational levels.

1.3.3.Ambiguity Dimension and HRM

In the context of ambiguity, what HR needs to do is encourage employees to think differently to enable innovation. It is necessary to create the necessary environments for employees to present their ideas, encourage them, and truly value employee ideas. Diversity is an important component of thinking differently. There should be a culture of versatility that encourages the discovery of new ideas along with employees' regular daily work. It is difficult to specify what will lead to a great idea, but a conducive environment can go a long way in preparing minds for creative ideas (Jain, 2019: 84).

This innovation imperative requires HR to address multiple dimensions simultaneously. Physical workspace design must accommodate both focused individual work and collaborative ideation. Organisational structures must balance the need for clarity in roles and responsibilities against the flexibility required for cross-functional innovation. Performance management systems must reward creative risk-taking whilst maintaining accountability for results. Compensation and recognition systems must incentivise innovation without creating perverse incentives that prioritise novelty over value creation.

To promote innovation, HR can begin with recruitment for innovation by identifying people who can think outside the box. The second step is to create an organisational culture that supports innovation. Management should nurture an innovation culture by respecting ideas and assigning responsibility for implementation.

The next step is the right reward system that can encourage employees towards innovation. A flexible and entrepreneurial structure enables ideas to be discussed openly. It helps innovations to be developed and implemented more rapidly (Jain, 2019: 83).

The cultivation of innovation capability extends beyond recruitment and culture-building to encompass systematic approaches to idea generation, evaluation, and implementation. HR must design and facilitate innovation processes—such as design thinking workshops, hackathons, innovation tournaments, or internal venture programmes—that channel creative energy productively. These processes must balance encouragement of divergent thinking during ideation phases with convergent decision-making during evaluation and implementation phases, ensuring that creative ideas translate into tangible organisational value.

Moreover, HR must address the psychological barriers that often inhibit innovation in organisational contexts. Fear of failure, concern about career consequences, cultural norms privileging conformity, and cognitive biases favouring familiar approaches can all suppress creative expression. Creating psychologically safe environments where employees feel empowered to challenge assumptions, propose unconventional ideas, and experiment with novel approaches represents a critical HR responsibility in ambiguous contexts.

1.3.4.Uncertainty Dimension and HRM

Workplaces are increasingly becoming borderless and independent of physical location, bringing together not only employees but also partners, vendors, suppliers, customers, and even competitors, in conjunction with flexible working arrangements. These changes in how businesses operate challenge traditional ways of working and thinking, making the future unpredictable. One way to overcome uncertain situations is to eliminate the need for our individual and collective mental models or thought patterns. New perspectives can

always come from people who do not definitively accept all the assumptions of the organisation. A safe environment that does not punish dissenting views is important for employees to express their thoughts and ideas (Jain, 2019).

This emphasis on cognitive diversity and psychological safety reflects a fundamental insight about navigating uncertainty: organisations that cultivate diverse perspectives and encourage constructive challenge are better positioned to recognise weak signals, question flawed assumptions, and adapt strategies as circumstances evolve. HR must thus design selection processes that prioritise cognitive diversity, development programmes that cultivate perspective-taking capabilities, and organisational cultures that reward constructive dissent rather than mere compliance.

Although situations such as geographical boundaries and not working in the same physical environment create complexity, they require communication channels between decision-makers and employees to be kept open at all times. HR should be an excellent digital facilitator that can create constructive conversations. Detailed planning is important for any organisation, but the importance of flexibility should not be overlooked. Uncertainty often leads to plans changing midstream. From an HR perspective, for this mindset to be embedded in organisational values, plans must be revisable to effectively overcome uncertainty (Jain, 2019: 84).

The tension between planning and flexibility reflects a core challenge in uncertain environments. Traditional planning approaches assume relatively stable environmental conditions that enable meaningful forecasting and detailed specification of activities and milestones. Uncertainty undermines these assumptions, rendering elaborate plans obsolete before their completion. HR must thus champion planning approaches that emphasise scenario development, strategic optionality, and rapid adaptation rather than detailed specification and rigid adherence to predetermined paths.

In an uncertain environment, poor outcomes can also be encountered. Learning from failures is important, and at the same time, not giving up in the event of failure, continuing on, and showing resilience is very important. Rather than the blame game, the focus should be on what can be done well in the future (Jain, 2019: 84). This orientation towards learning rather than blame represents a critical cultural attribute in uncertain environments. When outcomes prove unpredictable, organisations must evaluate decisions based on process quality and available information rather than results alone, recognising that good decisions sometimes yield disappointing outcomes whilst poor decisions occasionally produce favourable results through fortunate circumstances.

HR plays a pivotal role in institutionalising this learning orientation through performance management practices that distinguish between controllable execution and uncontrollable environmental factors, development programmes that treat failures as learning opportunities, and leadership selection that prioritises resilience and growth mindset. By embedding these principles systematically across HR practices, organisations can develop the collective resilience and adaptive capacity essential for thriving amidst persistent uncertainty.

CONCLUSIONS

The VUCA framework provides a comprehensive lens for understanding contemporary business environments characterised by accelerating change and rapid transformations. The fundamental characteristic across all VUCA dimensions is information deficiency in diagnosis and identification. When information gaps are high, organisational risk increases correspondingly, potentially leading to suboptimal outcomes and strategic missteps.

Traditional planning approaches assume information gaps can be systematically addressed through comprehensive analysis. However,

the VUCA framework suggests that complete information, the traditional ideal of rational decision-making may be fundamentally unattainable. The velocity of change, interconnectedness of global systems, and emergent properties of complex adaptive systems mean that perfect knowledge remains perpetually elusive. Rather than pursuing impossible informational completeness, organisations must develop capabilities for making consequential decisions despite persistent information gaps, learning rapidly from experience, and adapting strategies continuously.

The implications for Human Resource Management are profound. Complexity demands collaborative leadership and communication architectures aggregating distributed intelligence. Volatility requires clear strategic vision and continuous alignment between strategy and employee objectives. Ambiguity necessitates innovation-enabling cultures and psychological safety. Uncertainty calls for cognitive diversity, flexible planning approaches, and resilience orientation. Collectively, these imperatives position HRM as a strategic architect of organisational resilience rather than merely an administrative function.

Fundamentally, the VUCA framework suggests that human capital represents the primary source of sustainable competitive advantage in turbulent environments. Organisations with motivated, skilled, adaptable workforces supported by HR systems enabling continuous learning, innovation, and collaboration possess capabilities that competitors cannot easily replicate and that retain value across diverse environmental scenarios.

Looking forward, future research should explore how VUCA dynamics manifest differently across cultural and economic contexts, particularly in emerging markets like Turkey. Additionally, empirical investigation of specific HR interventions' effectiveness in building organisational VUCA capabilities remains limited and represents a promising avenue for scholarship.

For practitioners, the VUCA framework offers both diagnostic lens and call to action. HR professionals must evolve from administrative specialists towards strategic architects of organisational resilience. Preparing for VUCA environments represents not a one-time initiative but an ongoing commitment to building adaptive capacity. Sustainable competitive advantage depends not on perfectly anticipating shifts but on cultivating organisational capabilities, underpinned by effective HRM practices, that enable continuous sensing, learning, and adaptation. The ultimate implication is not that the future is unpredictable, but that organisations can develop capabilities to thrive amidst unpredictability through strategic investments in human capital and organisational design.

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BÖLÜM 5

SURVIVING IN A VUCA WORLD: MANAGERIAL PERSPECTIVES ON ORGANIZATIONAL RESILIENCE DURING THE COVID-19 PANDEMIC

KADİR AKSAY[1]

Introduction

Today's business world has taken on a complex and unpredictable structure, changing at an unprecedented pace due to the impact of technological transformations and geopolitical fluctuations. In this dynamic environment, often conceptualized in the literature using the term VUCA, which stands for Volatility, Uncertainty, Complexity, and Ambiguity, staying afloat has become a strategic goal for businesses. The Covid-19 pandemic that emerged in late 2019 pushed the existing VUCA atmosphere to its extreme, creating a 'system shock' that shook all systems, from global supply chains to labor force models. In such periods of deep crisis, the capacity of businesses to adapt to unexpected shocks, absorb them, and transform themselves into a stronger structure after the crisis has once again proven the importance of the concept of 'organizational resilience' (Duchek, 2020). Organizational resilience is not merely a defense mechanism but also a strategic competency directly linked to how decision-makers, namely business leaders, interpret the process and what practical steps they take during crises (Linnenluecke, 2017).

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This study aims to examine in depth the organizational resilience mechanisms demonstrated by businesses in the chaotic environment created by the COVID-19 pandemic, using the 'VUCA' (Volatility, Uncertainty, Complexity and Ambiguity) perspective, which goes beyond traditional turbulence. Adopting a qualitative research design, the study involved semi-structured interviews with 15 executives based in Turkey, Germany, and the United Kingdom, operating in strategic sectors such as healthcare, manufacturing, energy, and e-commerce. The data obtained were analyzed within the framework of the six-stage thematic analysis proposed by Braun and Clarke (2006).

1. Theoretical Framework

1.1. The VUCA concept and COVID-19

The VUCA concept is a framework that describes the chaotic nature of the modern business ecosystem, formed by combining the words Volatility, Uncertainty, Complexity, and Ambiguity. First used in the late 1980s by the US Army War College to describe the post-Cold War world, this term has become one of the key concepts in strategic management literature today (Mack et al., 2016). The components of the concept explain the nature of the risks businesses face: Volatility refers to the speed and magnitude of change; uncertainty refers to the reduced predictability of future events; complexity refers to the multitude of factors influencing decisions and their interdependence; and ambiguity refers to the blurring of cause-and-effect relationships (Schoemaker et al., 2018). In the literature, new management and organizational models are needed to cope with VUCA (Şener, 2025).

The COVID-19 pandemic has created a period in which these four components have simultaneously reached extreme levels on a global scale. The pandemic has triggered volatility through sudden and sharp fluctuations in the markets, and uncertainty through the

lack of clear information about the course of the virus and vaccination processes. The inextricable links between global supply chains have exposed the complexity of the system, with quarantine in one region halting production worldwide. Finally, the unprecedented nature of the crisis rendered standard operating procedures ineffective, creating an atmosphere of complete ambiguity (Şener, 2025). In this context, COVID-19 has proven that the VUCA world is not merely a theoretical concept, but a concrete reality that tests the operational and strategic agility of businesses (Özer & Gürbüz, 2021).

The COVID-19 pandemic process has been characterized not only as a simple external shock, but also as a 'super-VUCA' case demonstrating how interconnected and fragile the global economic system is (Amil, 2024). Traditional risk management models rely on probability and impact analysis of events; however, the uncertainty and ambiguity created by the pandemic has invalidated these models by producing non-linear outcomes. This situation has forced businesses to shift from the pursuit of static efficiency to the axis of 'strategic agility' and 'dynamic capabilities,' defined as the ability to respond quickly to unexpected changes (He & Harris, 2020). Some studies have discussed this process in terms of businesses' capacity to transform into 'learning organizations' during crises and turn the threats posed by VUCA into opportunities (Agudo, 2023).

On the other hand, the complexity created by the pandemic has necessitated organizations to manage not only their own internal processes but also the entire ecosystem in which they operate (suppliers, customers and society). The volatility that became apparent with COVID-19 has profoundly affected decision-makers' sensemaking processes; in an environment where past experiences are insufficient for predicting the future, managers' intuitive and flexible decision-making mechanisms have come to the fore (Lombardi et al., 2021). In this context, organizational resilience in

periods dominated by ambiguity has evolved not only into a 'bounce-back' capability but also into a 'bounce-forward' capability, which is the capacity to use the chaos created by the crisis as a strategic renewal tool This evolution highlights the need for businesses to blend structural flexibility with cognitive capacity to survive in the VUCA world.

1.2. Organizational resilience as a management concept in times of chaos

Organizational resilience is positioned in modern management literature not merely as a defensive reflex developed by businesses against unexpected crises, but also as a dynamic capability that provides a strategic competitive advantage in chaotic environmental conditions. At the theoretical level, resilience is defined as an organization's capacity to absorb a disruptive shock, adapt to it, and learn from the crisis to continue its existence with a more resilient structure (Duchek, 2020). This conceptual framework goes beyond the traditional crisis management understanding of 'bounce-back' to represent a strategic perspective that views crisis as an opportunity for transformation and renewal (bounce-forward) (Linnenluecke, 2017). As emphasized in studies within the Turkish context, resilience functions as a 'corporate immune system' developed by businesses against environmental turbulence, particularly within the uncertainty spiral brought about by the VUCA world (Doğanyiğit, 2023).

The COVID-19 pandemic has starkly demonstrated that organizational resilience theory is not merely an assumption but an operational necessity. The pandemic process has created a 'crisis of meaning' by simultaneously confronting businesses with both supply and demand shocks, rendering existing strategic plans obsolete (Lombardi et al., 2021). The literature emphasizes that resilient organizations go through three fundamental stages (preparation, adaptation, and growth) during this process. In this

context, the common feature of businesses that successfully managed the pandemic is that they recognized the crisis early on at the cognitive level and activated flexible decision-making mechanisms at the structural level (Kantur & İşeri-Say, 2012). Research conducted in the context of Turkey has indicated that the pandemic period has led to certain changes that could be described as the 'new normal,' such as remote working. (Köroğlu & Semerciöz, 2022).

2. Research Methodology

2.1. Research question

This research was conducted using a qualitative research approach targeting participants working in managerial positions across various sectors and levels during the Covid-19 pandemic. The research sought to answer the question, 'In the context of VUCA conditions and the concept of organizational resilience, in which areas did businesses experiencing the super-VUCA period during the COVID-19 pandemic most need resilience strategies?'

2.2. Research type, design and model

Understanding the experiences gained by managers in the context of VUCA conditions during times of crisis - particularly in challenging situations such as a pandemic - is an important research topic. This is because managers play a key role in ensuring business continuity during these periods, and it is a significant reality that they exert extraordinary effort, including emotional labor, to prevent their operations from being disrupted. To understand the experiences gained after these events, collecting data using a qualitative research approach will be extremely useful, particularly for conducting in-depth research. Qualitative research is explanatory in nature and provides rich, detailed information about a topic or issue, but is usually conducted among a small group of people or samples. In the process of designing and conducting qualitative research,

researchers have a more flexible working space because they can control and shape the data collection process more effectively. In this sense, it is possible for researchers to develop new methods and approaches and increase the impact of the research at every stage of the study. This is one of the fundamental characteristics that qualitative research offers to researchers (Baltacı, 2019).

This study followed the case study design from qualitative research designs. The case study design is an empirical research strategy that examines a current phenomenon within its own real-life context and is particularly used in situations where the boundaries between the phenomenon and its content are not clearly defined. The case study to be examined can be a city, an institution, a situation, an accident, or even an experience (Baş and Akturan, 2013). Our study is based on the examination of businesses affected by the Covid-19 pandemic, which fits the VUCA definition of organizational resilience. At this point, explaining the challenging situations for businesses during the Covid-19 pandemic will provide important data for practitioners seeking to develop VUCA-specific strategies.

2.3. Working group (Participants)

The scope of the study consists of managers from businesses that have experienced the super VUCA period during the COVID-19 process and have successfully continued their activities by dealing with situations specific to this period. The businesses where these managers work were selected based on the data in their financial statements over the last year, and purposive sampling was chosen as the sampling method. Purposive (judgemental) sampling is a non-probability sampling method in which the elements that can best provide the necessary information can be selected for sampling (Patton, 1990). Purposive sampling is created by the researcher selecting the elements that are considered to best represent the population. Unlike quantitative sampling approaches developed based on probability theory, the fundamental aim of the purposive

sampling model is to gather in-depth information about the person, event, or situation that constitutes the subject of the research and in line with a specific purpose (Özdemir, 2010). Fifteen (15) managers working in these companies, where the data on the topics were found to be positive, were included in the scope of the study. In accordance with the principle of maximum diversity, interviews were conducted with managers from many different sectors.

Table 1 Participants

Participant Code	Sector Focus	Country	Position / Seniority	Corporate Scale
P1	Healthcare (Medicine)	TR	CEO (+30 years)	Medium-sized
P2	Healthcare (Medicine)	TR	CEO (+15 years)	Medium-sized
P3	Manufacturing (Furniture)	TR	CEO (+10 years)	Medium-sized
P4	Manufacturing (Rail Systems)	TR	Head of R&D (+15 years)	Large-scale
P5	Services/Trade (Textiles)	TR	E-Commerce Manager (+5 years)	Large-scale
P6	Food	TR	CEO (+20 years)	Large-scale
P7	Manufacturing (Machinery)	DE	Purchasing Manager (+25 years)	Medium-sized
P8	Energy (Air Conditioning)	UK	CEO (+10 years)	Small-sized
P9	Food	TR	Manager/Founder (10+ years)	Small-sized
P10	Finance / Consultancy	TR	CEO (+10 years)	Small-sized
P11	Manufacturing (Furniture)	TR	Supply Chain Dir. (+15 years)	Large-scale
P12	Energy	TR	Purchasing Manager (+10 years)	Large-scale
P13	Technology (Software/Energy)	TR	Entrepreneur (+2 years)	Start-Up
P14	Manufacturing (Machinery)	TR	Senior Manager Consultant (+15 years)	Large-scale
P15	E-Commerce (Furniture)	TR	Entrepreneur (+3 yıl)	Start-Up

Source: Created by the author

2.4. Reliability and validity

The fundamental criteria determining the scientific quality of qualitative research, namely validity and reliability (Tutar, 2022), have been addressed in this study through a systematic approach encompassing both internal and external dimensions. To enhance the internal validity (credibility) of the study, the triangulation strategy was utilized (Yıldırım, 1999). In this context, 'researcher triangulation' was achieved through the coordinated work of multiple researchers in the data collection and analysis processes, and 'data-driven triangulation' was achieved by interviewing different participant profiles operating in the same sector. Furthermore, direct quotations were included in the text to transparently reflect the participants' perspectives, thereby supporting the consistency of the findings based on raw data. Technical measures were taken to prevent data loss in order to maintain the reliability of the research. In this regard;

• Participant Confirmation: Interview transcripts were sent to participants via email to confirm the accuracy of the data and its alignment with participant views.

• Internal Reliability: In line with Creswell's (2016) recommendations, digital recordings were meticulously compared with transcriptions, and findings were presented as they were, without any researcher interpretation.

• External Validity and Reliability: To ensure the transferability (external validity) of the research, the sample selection, data collection tool, researcher role, and analysis processes were described in detail. The hierarchical consistency of the findings with the discussion section and the consensus among researchers are other elements that reinforce the external reliability of the study.

2.5. Data collection and analysis methods

A data collection guide consisting of three sections was created for this research. The first section aimed to obtain information about the company, the sector in which it operates, and the country (2 questions). The second section focused on information about the managers participating in the research (1 question). The third and final section aimed to obtain opinions on the relationship between the COVID-19 pandemic and organizational resilience (2 questions). The data collection guide was prepared with five questions. The questions were prepared based on the special circumstances experienced during the COVID-19 period and the organizational resilience literature. In-depth interviews were used to collect the data. In this context, questions aimed at understanding whether the participants had different views and opinions were also directed at them in a semi-structured interview format. Some interviews were conducted using the video recording feature of the ZOOM© program due to the pandemic conditions.

In analyzing the qualitative data obtained within the scope of the research, the thematic analysis method, which is frequently preferred in the social sciences and systematically reveals the main trends in the data, was adopted. The six-stage analysis process developed by Braun and Clarke (2006) (familiarization with the data, initial coding, searching for themes, reviewing themes, defining themes, and reporting) formed the core analytical framework of the study. Thematic analysis not only describes the content of the data set but also identifies meaningful patterns (themes) within complex data, providing the researcher with a flexible and in-depth area for interpretation (Nowell et al., 2017). In the thematic analysis process, the researcher's familiarity with the data and meticulousness during the coding stage are critical to the validity of the results (Braun & Clarke, 2006). In this regard, transcripts obtained from interviews with managers were read repeatedly, the data was first reduced to

conceptual codes, and then these codes were structured within the context of ‘Dynamics Challenging Businesses During the COVID-19 Process’ by considering the relationships between them.

2.6. Research Findings

Opinions on ‘which issues challenged businesses the most during the COVID-19 pandemic, reflecting VUCA characteristics’ were examined as they provide guidance for understanding the characteristics of the period and developing strategies for similar periods. In other words, it is important to highlight the situations businesses faced in order to better understand this period.

Participants particularly emphasized the difficulty of finding customers during the COVID-19 period. Some examples from the interviews are provided below.

"...the potential financial difficulties that could arise in the face of possible situations due to a decline in demand alarmed us, as it did all companies. [P-3]

“...there were periodic difficulties related to demand; we experienced temporary difficulties due to our dealers being unable to operate during full lockdown periods and at weekends.” [P-11]

"...as a company involved in energy distribution, we experienced a decline in our industrial electricity sales during the lockdown periods. On the other hand, although there was an increase in residential consumption, we still experienced a slight decline in our sales. Although we came very close to the previous year's sales, we were unable to meet our sales target for this year." [P-12]

“...the shutdown of the facilities we serve and their reduction in investments decreased the demand for our company, which provides software solutions to solar energy production facilities...” [P-13]

Another issue highlighted by most participants concerned problems with the supply chain. These problems included suppliers failing to deliver the requested products, demanding high shipping costs, and being unable to find suitable transport for their products or unable to find it within the desired timeframe, according to the data obtained. Below are some noteworthy examples related to this issue.

“Because I knew beforehand that China has long holidays in certain years. They are called annual holidays. We would experience supply issues during these periods. We experienced such a situation two or three months before the emergence of Covid-19. There was something strange here, I sensed something. Even though it wasn't a holiday period, there were delays in product supply from Chinese suppliers. They were being confrontational with us; they were making all sorts of excuses, like “We'll send it, but we need a private plane”. Something's not right here! So I reported this to senior management. In my report, I wrote something like, “I think there's something wrong in China, I can't explain it, but...”. This report served as an early warning during the process of finding alternative suppliers.” [P-7]

“...we are a small dairy producer. We have to buy milk from our supplier, the milk producer. For example, you cannot say to the producer, ‘Demand for ayran and yoghurt has fallen, we cannot buy milk from you,’ so we had these milks processed into cheddar cheese, which has a longer shelf life, by another company we collaborate with. However, we may not have made any profit from selling the cheddar cheese." [P-9]

“..Since we source raw materials from overseas markets when our stock runs out, we experienced some difficulties at first when those markets closed. We considered what alternatives we could produce and turned to different products..” [P-2]

"...we have critical systems such as brakes, which we source from European countries. Suppliers informing us that there may be delays in the delivery of semi-finished products has pushed back our deadlines and consequently the deliveries for which we are responsible." [P-4]

"...a process that is very negative for world trade, also known as the container war between the US and China, has begun. For shipments from China to the UK, prices have reached €10,000 per container. This situation has significantly increased companies' costs during this period. [P-8]

"…Freight charges increased twofold, threefold. This situation, which directly affected costs, was a compelling factor." [P-6]

Another issue emphasized by participants was concerns regarding employee health. It was stated that a challenging decision-making process was experienced in this regard, particularly during the first wave of the Covid-19 pandemic, concerning what measures should be taken to continue working.

"…a situation concerning employee health, which is crucial for the continuity of the business, forced us into a difficult decision-making process. First of all, we had to make very quick decisions. In this context, we reduced face-to-face communication with suppliers and the public we deal with to zero for three to four months…" [P-6]

"…actually, a situation that no one could have imagined was the first challenging factor of the pandemic; even before anything was apparent, getting employees to understand the strict measures we had taken, that is, explaining our sensitivity towards health to our employees, was difficult for us. At first, employees did not want to accept the situation…" [P-7]

Another issue affecting businesses during this period, highlighted by interviewees, is problems with collections and payments.

"... but apart from that, our biggest problem as an industry is collection difficulties. We are a business that mainly provides services to public hospitals. Public institutions are unable to make payments due to the difficulties of the period. We have experienced difficulties in collecting public receivables. We hope this will be resolved soon." [P-1]

'... therefore, taking measures such as short time working allowance was psychologically difficult for us. During this period, we made it easier for our customers to make payments that were due, and we also requested deferrals for our payments.' [P-3]

During lockdown periods, fieldwork requiring face-to-face contact with customers – particularly tasks such as data collection from production facilities or quality control – has been highlighted in some participant responses as causing problems with coordination, communication and data collection.

"...this process affected us considerably with the new normals. You cannot attend meetings or see customers. You do things via Zoom®, but people in our sector really like elbow contact. This is the case in Turkey and, as far as I have observed, in the UK too. What I mean is that you need to establish warm relationships with customers; to put it bluntly, you need to touch them. As a company that goes to construction sites and projects, and is present in the field for both training and control purposes, we were unable to do this during certain periods. This situation was a different experience that put us in a difficult position..." [P-8]

"…we are a company that produces medicines and specifically serves the gynecology sector. The cancellation of doctor visits and medical conferences reduced our efforts to introduce our

products to doctors and communicate with them, and we immediately considered taking steps to resolve this issue…" [P-2]

Another point emphasized by participants was that this was an unprecedented period. It was particularly noted that, regardless of how much preparation had been made, this pandemic situation was the first of its kind in the last 100 years, making it a very different experience for everyone. Some participants stated that, no matter what measures were taken, there would inevitably be shortcomings.

"...it is necessary to approach a crisis environment of this magnitude during a pandemic differently than a normal crisis environment. Such a crisis has never been experienced before, and I hope it never happens again, but if it does, we can use the experience we have gained during this period. What I mean is that this was not a crisis that anyone expected or took precautions against." [P-8]

"...as a business serving hospitals, we felt unprecedented pressure when assigning our employees to hospitals. It was not a situation that could be prepared for or prevented. However, the dedication of the employees in that regard.." [P-1]

"...full lockdowns and weekend closures reduced our dealers' sales, but subsequently there were surges in demand. In this respect, we faced a different situation with fluctuating customer demand..." [P-11]

"First of all, I must say that the pandemic was an element that was not in anyone's risk inventory; I believe a similar situation was last experienced during the plague. Frankly, I don't think even very large global companies could have foreseen such a situation. It is true that we were caught unprepared..." [P-6].

In addition to the statements discussed in more detail above, other challenging situations highlighted by the interviewees included opportunistic suppliers/companies raising intermediate product

prices, declining profit margins, lack of coordination, concerns regarding human resources, insufficient working hours, exchange rate volatility, issues related to digitalization, and not having a strategic risk map. These were other issues reported by participants numbered [P-4], [P–5], [P-10], [P-14], and [P-15].

The data obtained above has been analyzed to create the following thematic table. The table shows the themes and which VUCA component they are associated with.

Table 2 Thematic Distribution of Factors Challenging Businesses

Main Theme	Subthemes	Frequency (n)	VUCA Component
Market Conditions	Market contraction / Demand contraction	7	Volatility
Operational Processes	Supply chain issues	5	Complexity
Human Factor	Employees' psychological problems	4	Ambiguity
Financial Sustainability	Collection / Payment issues	4	Uncertainty
Managerial Processes	Coordination difficulty	2	Complexity
Macroeconomic Conditions	Exchange rate volatility	1	Volatility
Profitability	Shrinking profit margins	1	Ambiguity

Source: Created by the author

4. Research Findings and Evaluations

According to the analysis results, ‘Market Contraction and Demand Decline’ (n=7) was identified as the crisis area most

emphasized by managers. This situation demonstrates that the sudden demand shocks created by the pandemic directly threaten businesses' revenue models. From the perspective of Braun and Clarke (2006), this finding represents a key theme that reflects the dominant role of ‘external environmental factors’ on organizational survival during times of crisis.

The second dominant theme, ‘Supply Chain Problems’ (n=5), reflects the fragility of businesses' logistics networks and the complexity of the global system. The finding of ‘Difficulty in Coordination’ (n=2), which supports this theme, points to the erosion of organizational communication due to remote working and restrictions.

Another noteworthy finding is the theme of ‘Employee Psychological Issues’ (n=4). Qualitative data reveal that managers had to contend not only with financial indicators during this process, but also with employees' anxiety levels and loss of motivation. This situation confirms that ‘human capital management’ is of critical importance in building organizational resilience (Nowell et al., 2017).

Finally, financial bottlenecks supported by ‘Collection and Payment Issues’ (n=4) concretize the paralyzing effect of uncertainty on cash flow management. When all these findings are considered as a whole, it is evident that the challenges faced by businesses follow a hierarchical order, with the fundamental concern being the maintenance of market presence, followed by operational and human adaptation processes.

This research, conducted under the extreme VUCA conditions created by the Covid-19 pandemic, analyzed not only businesses' struggle for survival but also their ability to learn from the crisis, as seen through the eyes of managers. The research findings demonstrate that multidimensional challenges such as

market contraction, supply chain disruptions and employee psychological well-being have transformed organizational resilience from a static state of protection into a capacity for 'bounce-forward'. In light of the data obtained, it is a strategic imperative for managers to adopt a management approach that focuses on employee motivational wellbeing as much as financial statements during times of crisis, to diversify supply channels by reducing dependence on a single source, and to integrate the digital agility gained during the pandemic into long-term business models. For the academic community, this study points to the need for longitudinal research examining the long-term transformative effects of resilience and comparative analyses covering different country cultures, going beyond mere situation assessment during crises. Ultimately, organizations that embrace uncertainty as data rather than an obstacle and develop their adaptive capacity in this chaotic atmosphere will be the structures that demonstrate the highest resilience against future VUCA periods.

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BÖLÜM 6

A CONCEPTUAL ANALYSIS OF GAME THEORY FROM THE PERSPECTIVE OF DEFENSE AND SECURITY STRATEGIES

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Introduction

The term *"game"* in game theory refers to a social interaction environment in which strategic decisions are made Game theory is a mathematical modeling framework that analyzes the strategic interactions among decision-makers whose choices mutually affect one another. Its analytical domain encompasses the strategic behavior of multiple actors, referred to as *players*, and examines how these interactions produce equilibrium outcomes. In this sense, game theory can be succinctly defined as the theory of interactive strategic decisions (Luce & Raiffa, 1957; Shubik, 1983. Myerson, 1991).

Over the past decades, game theory has been widely applied across the social sciences from economics and international relations to law, public administration, political science, psychology, biology and sociology (Osborne, 2004). Thematically, it has provided the theoretical foundation for national and international applications in

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areas such as auctions, contracts, bargaining, and negotiation (Schmidt, 2002). A number of distinguished scholars have been awarded the Nobel Prize in Economics for their pioneering contributions to the development and application of game theory.

The primary purpose of game theory is to identify the best or optimal strategies for players engaged in interactive decision-making. Within this broad analytical field, where individuals, institutions, and states are defined as players, game theory functions as a managerial and analytical tool for determining the most effective strategic choices (Gibbons, 1992; Myerson, 1991). The use of game theory in the field of defense strategies parallels its accelerated development after the Second World War. During the Cold War, states sought to anticipate the effects of their strategic decisions on those of their adversaries, giving rise to the institutionalization of strategic analysis (Poundstone, 1993). This period marked the convergence of game theory and defense strategy as mathematical reasoning became integral to modeling deterrence, escalation, and equilibrium in global security affairs.

In the 21st century, the significance of game theory as a decision-support tool has grown even further under the influence of the VUCA conditions that characterize modern defense and security environments. The term VUCA—an acronym for volatility, uncertainty, complexity, and ambiguity—was first adopted by the U.S. Army War College in the 1990s to describe the evolving post–Cold War strategic landscape[2]. It captures the key characteristics of today's security environment, where rapid change, unpredictability, interconnectedness, and lack of clarity define strategic decision-

[2] The first reference to this concept is found in Warren Bennis and Burt Nanus's book *Leaders: Strategies for Taking Charge* (first published in 1985). It is noted that the term was incorporated into the U.S. Army War College's curriculum development documents in 1987 and appeared for the first time in the 1988 curriculum.

making. Volatility reflects the accelerated pace of change and the growing difficulty of adaptation within unstable environments. Uncertainty denotes the reduced predictability of events and the declining reliability of historical data for anticipating future developments. Complexity refers to the expanding interdependence and multi-layered relationships among global security factors, which make analysis and coordination increasingly difficult. Finally, ambiguity highlights the diminishing clarity in distinguishing threats from opportunities, where situations can no longer be assessed in simple black-and-white terms (Lawrence, 2013; Bennett & Lemoine, 2014; George, 2017). Together, these four elements define the modern strategic context in which defense planners must operate, demanding adaptive, analytical, and anticipatory approaches to policy and decision-making.

As VUCA conditions increasingly shape security decision-making, strategists must adopt analytical tools that enable them to anticipate interactions, assess probabilities, and design adaptive strategies. In this regard, game theory provides a comprehensive framework for modeling interdependent choices, analyzing rational and boundedly rational behavior, and supporting the formulation of robust defense strategies in a volatile and uncertain world. As noted by Camerer (1991), many aspects of strategy formulation and implementation align closely with the game-theoretic framework. Therefore, strategy researchers and practitioners should take full advantage of the logical insights and analytical rigor that game-theoretic reasoning provides. Ultimately, game theory serves as a fertile source of conceptual and testable propositions, offering strategists both theoretical guidance and practical tools for exploring complex decision environments.

Building on this conceptual foundation, the following sections examine key theoretical constructs of game theory and interpret them within the context of defense and security strategies.

Each section addresses a core analytical principle of game theory—rationality, equilibrium, cooperation and competition, coordination and anti-coordination, zero-sum interaction, credibility of strategic moves, and probabilistic reasoning—and discusses its relevance to strategic decision-making in defense and security domains. Together, these sections aim to demonstrate how game theory provides a coherent analytical lens for understanding the dynamics of strategic interaction and the formulation of defense strategies under conditions of uncertainty and interdependence. The paper concludes with an integrated discussion and forward-looking assessment, highlighting the implications of game-theoretic reasoning for contemporary defense planning and strategic foresight.

1. A Rational Player Always Prefers the Dominant Strategy

Rationality, as the fundamental assumption of game theory, refers to a decision-maker's tendency to act in a way that serves their own interests or maximizes their personal benefit. In the field of defense strategies, the need for rational behavior aligns closely with game theory's core rationality assumption.

In order to conduct a strategic analysis within the framework of game theory, the potential payoffs that decision-makers may obtain at the end of the game must be identified or estimated. These payoffs do not necessarily have to be monetary. Within a broader understanding of utility, any outcome that improves (or at least does not worsen) the position of the decision-maker can be recorded as a parameter in the player's payoff set. From the perspective of game theory, decision-makers should prefer strategies that yield higher payoffs to those that provide lower payoffs. Regardless of other players' decisions, if one strategy consistently offers a higher payoff to a player compared with their other possible strategies, that strategy is considered dominant. Conversely, a strategy that provides lower payoffs is referred to as a dominated strategy. A rational player

always prefers a dominant strategy. However, if no dominant strategies exist for the players in a given game, they must identify equilibrium points by considering the strategies of others (Fudenberg & Tirole, 1991; Gibbons, 1992).

The concept of dominance was first addressed as a solution method by mathematician and social scientist Duncan Luce and economist Howard Raiffa in their 1957 work *Games and Decisions*. The principal analytical method related to dominance is the Iterated Elimination of Dominated Strategies (IEDS). According to this method, whether a strategy is dominant or dominated depends on the payoffs it produces (Luce & Raiffa, 1957). Dominance can appear in strong or weak forms. If a player's strategy yields higher payoffs than another of their strategies, it is classified as a *strongly dominant* strategy; if it yields lower payoffs, it is a *strongly dominated* strategy. Conversely, if a strategy produces payoffs that are higher or equal to another strategy's payoffs, it is characterized as a *weakly dominant* strategy, with its counterpart referred to as a *weakly dominated* strategy (Gibbons, 1992; Karabacak, 2021).

In defense and security strategy, the assumption of rationality reflects the expectation that states and military organizations act to maximize their own security and strategic advantage. A dominant strategy in this context represents the choice of policies or military postures that deliver the best outcomes regardless of an adversary's behavior such as maintaining credible deterrence capabilities, developing early-warning systems, or forming strategic alliances that strengthen national security unconditionally. Yet, as in game theory, pure dominance is rare in real-world defense environments. Most strategic contexts demand the constant evaluation of costs, risks, and adaptive responses. Rational defense actors must therefore balance short-term gains with long-term stability, ensuring that the pursuit of advantage does not provoke escalation or undermine the broader strategic balance.

2. Strategies are Mutually Adjusted and Equilibrium is Always Possible

Game theory demonstrates mathematically that players can select the best (optimal) strategies under existing conditions, and that there may exist a state of equilibrium in which no player has an incentive to unilaterally deviate from their current strategy. The existence of equilibrium does not imply that there are no strategies that could yield greater payoffs for the players. Rather, it signifies that the equilibrium point represents an *optimal* outcome within the prevailing circumstances of the game and in light of the strategies chosen by others. The equilibrium point, therefore, identifies the combination of strategies that are optimal for the players given the current structure and conditions of the game (Nash, 1950; Nash 1951).

In any combination of strategies that does not constitute an equilibrium, there is at least one player who has a strategic incentive to change their strategy. Under existing conditions, the process of mutual adjustment among strategies continues until a stable combination emerges in which unilateral deviations no longer occur. Any change in the prevailing conditions will, in turn, generate new incentives for strategic deviation and lead to the formation of new equilibria. As conditions evolve, rational players will update their strategies accordingly, thus re-establishing the game around a new equilibrium.

The earliest traces of the equilibrium concept in economic thought can be found in competitive market models analyzed during the first half of the nineteenth century. Within the framework of game theory, however, the first scholars to formalize this notion were mathematician John von Neumann and economist Oskar Morgenstern. In their seminal 1944 publication Theory of Games and Economic Behavior, they developed an equilibrium concept for zero-sum games that satisfy certain conditions (von Neumann &

Morgenstern, 1944). Nevertheless, it was John F. Nash who established the conceptual and theoretical foundations of equilibrium in game theory. Through his groundbreaking work published in 1950 and 1951, Nash formulated what later became known as the Nash Equilibrium, a fundamental principle asserting that each player's strategy is optimal given the strategies chosen by all other players (Nash, 1950; Nash 1951).

Over time, continued academic research has extended Nash's concept to a variety of new game forms. As a result, multiple refinements and extensions have emerged within the field of non-cooperative games, including the Subgame Perfect Nash Equilibrium, Bayesian Nash Equilibrium, Perfect Bayesian Nash Equilibrium, Sequential Equilibrium, Trembling-Hand Perfect Equilibrium, and Proper Equilibrium. These equilibrium concepts represent alternative formulations, advanced versions, or stronger variants of the Nash equilibrium, each applicable to specific strategic environments (Myerson, 1978; Gibbons, 1992).

From a defense strategy perspective, the concept of equilibrium captures the delicate balance among actors' threat perceptions, deterrence capabilities, and defense policies. As in game theory, a strategic equilibrium in the international security environment exists when no state has an incentive to unilaterally alter its current course of action. This equilibrium, well illustrated by the dynamics of nuclear deterrence, is sustained through the constant assessment of how each side might respond to the other's moves. Yet even subtle changes in the security landscape, such as technological innovations, new alliances, or shifting threat perceptions, can disturb this balance and force states to readjust their strategies.

Consequently, in defense planning, equilibrium should be viewed not as a static endpoint but as a dynamic condition that requires ongoing adaptation. States must continuously refine their

policies to maintain both deterrence and stability amid evolving circumstances.

3. The Choice Between Cooperation and Competition is Determined by the Game's Payoff Structure

Game theory approaches the nature of interactions through the lenses of cooperation and competition. On one end of the relational spectrum between decision-makers lies full cooperation; on the other, pure competition. Although prevailing conditions may sometimes necessitate entirely cooperative or fully competitive strategic choices, the dynamic nature of real-world contexts often requires a balance between the two. Based on the cooperative and competitive dimensions of interactions, game theory broadly categorizes games as competitive (non-cooperative) games and cooperative (coalition) games.

However, in game theory, competitive games do not necessarily describe a domain in which players always behave competitively. Such games also analyze the possibilities and effects of cooperative strategies within the existing conditions and their influence on payoffs. One of the most prominent game forms that illustrate the dynamic interaction between competition and cooperation is the Prisoner's Dilemma. The theoretical foundation of this game was developed in the early 1950s by mathematicians and game theorists Merrill Flood and Melvin Dresher under the auspices of the RAND Corporation. Their studies on conflict and cooperation, known as the Flood-Dresher Experiments, provided the experimental basis for later theoretical developments (Poundstone, 1992).

The Prisoner's Dilemma analyzes situations in which players obtain lower payoffs even though a more beneficial equilibrium is available. The general assumption is that players, motivated by

short-term self-interest, act competitively resulting in an equilibrium that yields suboptimal payoffs.

In a Prisoner's Dilemma-type game, achieving higher payoffs is only possible if the players adopt a cooperative attitude. The main ways to encourage such cooperation are either to transform the game's payoff structure or to alter the players' perceptions of the game's time horizon (duration of interaction). Within the existing payoff structure of the Prisoner's Dilemma, the key factor that promotes cooperation and higher payoffs is the repetition of interactions. In one-shot games (or single interactions), decision-makers tend to view the counterpart as a rival and prioritize individual gains over mutual interests. However, in repeated games, the future influences the present as much as the past. Repetition allows players to observe their counterparts' previous strategies and adjust their own accordingly, opening the path to cooperation. In such repeated interactions, players are likely to choose cooperation when the long-term benefits of collaboration outweigh the short-term gains of competition. Within the analytical scope of game theory, the central questions concern which strategic patterns promote cooperation and under what conditions the cooperative equilibrium can be sustained (Leyton-Brown & Shoham, 2008; Carmichael, 2005).

In defense and security policy, the balance between cooperation and competition mirrors the structural forces that shape how states act and respond. Game theory teaches that the structure of payoffs determines whether players choose to cooperate or compete, and this logic applies equally well to international security. When shared benefits such as collective defense, intelligence sharing, or arms control, outweigh the lure of acting alone, cooperation becomes the rational path. Yet when power imbalances, mistrust, or conflicting interests prevail, competitive behavior and deterrence strategies tend to dominate.

The Prisoner's Dilemma illustrates this tension vividly: states often face strong short-term incentives to defect, even when collaboration would better serve their long-term security. Overcoming this dynamic in defense strategy requires building institutional trust, fostering transparency, and creating durable frameworks that promote sustained cooperation. Repeated interactions, joint military exercises, and enduring alliances such as NATO demonstrate that even in a fundamentally competitive world, stable cooperation is both achievable and essential.

4. Conditions Sometimes Support Coordinative and Sometimes Anti-Coordinative Strategies

In game theory, the fundamental element that defines different game forms is the payoff structure. Depending on this structure, a game may either encourage players to act in coordination or, conversely, incentivize them to act in opposition. Games with payoff structures that promote coordinated actions are referred to as coordination games, whereas those that discourage coordination are known as anti-coordination games.

In coordination games, there are often structural obstacles within the game's design that make it difficult for players to choose mutually coordinated actions. Therefore, coordination games do not necessarily model situations in which players explicitly cooperate, but rather those in which players can achieve higher payoffs if they are able to coordinate their strategies. In such games, greater utility for all players is possible only when they select mutually compatible strategies. However, the existence of these strategies does not make a coordination game a cooperative one. The essential feature of cooperative games is the presence of binding agreements or contracts that require players to act in concert (Binmore, 2007).

At their core, coordination games model the trade-off between achieving higher payoffs through coordination and securing

lower, but safer, outcomes through self-protective strategies. In these games, when multiple Nash equilibria exist, the equilibrium that players converge upon depends on the extent to which their expectations can be aligned. In coordination games with multiple Nash equilibria, the points where players' expectations coincide are referred to as "focal points", a concept popularized by Thomas Schelling (Schelling, 1960; McCain, 2009). In contrast, anti-coordination games represent situations where conditions prevent players from moving in coordination. In this type of game, one player's gain depends on their ability to persist in, or even escalate, a competitive or confrontational strategy that compels the other player to withdraw. These games, which reflect the dynamics of escalating tension, essentially involve strategies that increase risk to such a degree that the opposing player is forced to retreat. When both players adopt highly competitive or aggressive strategies, the resulting combination can be mutually destructive, leading to significant losses for both sides. Thus, in anti-coordination games, the level of escalation or risk-taking must be carefully calibrated as high enough to pressure the opponent into backing down, but not so high as to trigger mutual harm (Carmichael, 2005; Rasmusen, 2007).

Models that would later be described as "anti-coordination games" were extensively studied in international relations theory and strategic studies during the 1960s and 1970s. Their work demonstrated how the logic of anti-coordination could illuminate the strategic behavior of states operating under the constant threat of conflict (McCain, 2009). In defense and security strategy, the distinction between coordination and anti-coordination reflects how states either align or deliberately diverge in pursuit of strategic advantage. Coordination dynamics emerge when actors enhance collective security by synchronizing their strategies through shared communication systems, joint command structures, or interoperable defense technologies within alliances. Such coordination reduces

uncertainty and strengthens the credibility of deterrence. Yet, real-world security environments often display anti-coordination tendencies, where strategic success relies on differentiation rather than alignment. In regional rivalries or crisis escalation scenarios, for instance, one state's assertive move may prompt another to respond with restraint or a counterbalancing action. The Cold War's nuclear brinkmanship is a classic example, as each superpower sought advantage by compelling the other toward caution. For defense strategists, the key challenge lies in discerning when stability depends on harmonized strategies and when it requires calculated divergence maintaining a delicate balance between alignment for security and opposition for deterrence.

5. There are Situations in Which Reconciliation is Impossible

There are cases in which one player's gain is possible only through the loss of another. Within the analytical framework of game theory, such situations are mathematically modeled as zero-sum games. Early research in game theory focused heavily on two-person zero-sum games, and the first formal mathematical results were obtained in this domain. The concept was first examined comprehensively by John von Neumann, who laid the theoretical foundations of two-person zero-sum games in his 1928 paper (von Neumann, 1928). Nearly half of Theory of Games and Economic Behavior, the seminal work he co-authored with Oskar Morgenstern, is devoted to the detailed theoretical treatment of two-person zero-sum games.

Zero-sum games constitute an important area of mathematical analysis. In two-person zero-sum games, the analytical roadmap that determines how each player should play is referred to as the solution of the game. In zero-sum games, the total payoff of all players always equals zero. In other words, one player's gain is exactly equal to the other's loss. Within such games, the possibility

of trust-based cooperation does not exist. Because the interests of the players are diametrically opposed, any form of communication or apparent cooperation typically serves the purpose of manipulation or deception. In the literature, zero-sum games are therefore referred to as strictly competitive games. rom this perspective, it can be inferred that while every zero-sum game is necessarily a competitive one, not every competitive game is zero-sum. Zero-sum games represent a special subset of the broader domain of competitive games (Neumann & Morgenstern, 1944, Peters, 2008). This fundamental understanding offers a critical analytical lens for decision-makers and strategists in fields such as international relations, public administration, and business management.

In defense and security policy, zero-sum games capture situations where one actor's strategic gain comes directly at another's expense, which is a logic that often underpins high-stakes conflict and deterrence dynamics. Territorial disputes, nuclear balance scenarios, and arms races exemplify such settings, where mutual trust is scarce and strategic communication functions largely to mislead, signal, or deter. The Cold War arms buildup vividly illustrates this pattern: each superpower's attempt to enhance its own security through armament inevitably diminished the other's sense of safety, sustaining a fragile equilibrium of mutual competition.

Yet defense strategists must avoid overextending the zero-sum perspective. Not every competitive environment fits this rigid model. The belief that victory can only be achieved through purely competitive approaches often leads players to perceive competitive games as zero-sum and to adopt excessively adversarial strategies. However, game-theoretic analyses have demonstrated that in many competitive games, greater payoffs can often be achieved not through unrestrained rivalry, but rather through a balance between competition and cooperation. In many modern security contexts such as counterterrorism, cybersecurity, and regional stability missions,

cooperative and competitive motives frequently overlap. The challenge, therefore, lies in recognizing when a zero-sum framework truly applies and when opportunities exist for mixed-motive or positive-sum outcomes through coordination, alliance-building, and shared security mechanisms.

6. The Credibility of Strategic Moves Must Be Established or Undermined

In game theory, strategic moves may take explicit or implicit forms and often carry the content of a promise or a threat. These two concepts (promise and threat) are intertwined in the game theory literature and are sometimes used interchangeably. In the broadest sense, any strategy adopted by a player can be interpreted as a promise or a threat to take a particular course of action. Game theory analyzes these promise or threat-based strategic moves in terms of the interests of the players. If fulfilling a promise or carrying out a threat serves the interests of the player who made it, then the opposing player has reason to take the promise or threat seriously. Strategic moves that align with a player's own interests are considered to have credibility (or reliability) in the eyes of others. Conversely, if fulfilling a promise or executing a threat is not in the promising or threatening player's interest, the other player has no reason to trust or take it seriously. In other words, strategic moves that do not serve a player's interests lack credibility for their counterparts (Kelly, 2003; Geçkil & Anderson, 2010)

From this conceptual foundation, two essential analytical questions emerge: (1) How can a player enhance the credibility of their own strategic moves? (2) How can a player undermine the credibility of their opponent's strategic moves? Game theory provides answers to these questions through the analysis of interactive strategic behaviors. These questions establish a bridge between game theory, behavioral sciences, and psychological

factors. Players' decisions, thoughts, and actions are influenced by their psychological states, situational contexts, information access, and cognitive constraints. Consequently, elements such as communication, emotion, and perception management must be taken into account as determinants of strategic moves within games (Winter, 2014).

Building on these insights, the field of behavioral game theory, which has developed significantly since the final quarter of the twentieth century, examines how psychological factors influence players' strategic choices. This line of research expands classical game theory by incorporating human behavior, bounded rationality, and emotional dynamics into the analysis of strategic interaction.

In defense and security strategy, credibility is the foundation of deterrence and strategic communication. According to game theory, a promise or a threat carries weight only when it is perceived as credible, meaning both believable and feasible. States and alliances strengthen credibility through visible military capabilities, consistent policy behavior, and clearly defined red lines. A deterrent threat loses its effectiveness once an adversary begins to doubt the willingness or ability to act on it. At the same time, disinformation, deception, and calculated ambiguity can be employed to undermine an opponent's confidence in their own assessments or to weaken the perceived reliability of their commitments.

During the Cold War, both the United States and the Soviet Union invested significantly in maintaining credible second-strike capabilities because deterrence stability depended on mutual belief in each side's capacity to respond. In modern defense policy, managing credibility involves not only maintaining adequate military posture but also ensuring coherent political signaling, alliance unity, and effective information operations. These factors collectively shape how strategic intentions are perceived and determine whether deterrence or coercion succeeds.

7. Probabilities Must Always be Considered in Strategic Evaluations

In game-theoretic analysis, the probabilities of strategy selection are an integral part of strategic evaluation. Strategies that are played with a 100 per cent likelihood are called pure strategies, whereas those chosen according to a probability distribution are referred to as mixed strategies. Probabilistic strategy selection also appears in games with incomplete information, a major area within game theory. In such games, some players possess private information that others do not have about the game. Mathematically modeling incomplete-information games becomes possible only by incorporating probability distributions into players' strategy choices (Fudenberg & Tirole, 1991; Gibbons, 1992). There exists a strong interaction and internal adjustment process between probabilities and strategies. The frequency with which strategies are chosen affects the realization of certain probabilities, and in turn, the realization of those probabilities influences the frequency of strategic choices. This mutual adjustment and alignment between probability and strategy selection in identifying optimal strategies was first subjected to mathematical analysis through game theory (Harsanyi, 1967; Harsanyi, 1968).

Game theory also employs probability calculations to examine players' incentives to deviate from equilibrium. Within this framework, the persistent existence of equilibrium in a game also implies the persistent possibility of deviation from that equilibrium. Game theory demonstrates that when the cost of deviation from equilibrium is high, the probability of deviation is low; conversely, when the cost of deviation is low, the probability of deviation increases (Fudenberg & Tirole, 1991). Game-theoretic analysis accounts for even the smallest probabilities in strategic evaluation and can identify equilibria that incorporate them. It does so by assigning small probability values to each strategy in the strategic

set, thereby modeling alternative scenarios that may arise during gameplay. In particular, within the realm of incomplete-information games, incorporating small probability values enables game theory to function as a managerial tool that facilitates more foresighted and adaptive decision-making (Heap & Varoufakis, 1995; Webb, 2007). In defense and security strategy, integrating probabilities into decision-making reflects an understanding that strategic environments are inherently uncertain and often shaped by incomplete information. Just as game theory accounts for mixed strategies and probabilistic outcomes, defense planners must assess not only known threats but also the likelihood and potential impact of emerging scenarios. Modern risk assessment tools such as intelligence estimates, threat probability matrices, and scenario-based wargaming embody this probabilistic approach.

For example, effective deterrence planning relies on estimating how likely an adversary is to respond aggressively, misinterpret intentions, or comply with signaling. Assigning probability values to these possibilities allows strategists to find a careful balance between readiness and restraint, helping to prevent both overreaction and complacency. In today's rapidly evolving defense landscape, characterized by technological change and hybrid threats, probabilistic reasoning enables decision-makers to anticipate low-probability but high-impact "black swan" events[3]. Incorporating such models into defense planning ultimately strengthens strategic

[3] Author and thinker Nassim N. Taleb examined "black swan" phenomenon in detail in his influential book *The Black Swan*. He explains that events described as black swans share three defining characteristics. They are rare and unpredictable because there are no clear signs in historical data that point to their occurrence. When such events take place, they have profound and widespread consequences that can transform existing systems and beliefs. After they occur, people often interpret them as if they had been predictable all along. Taleb's perspective draws attention to a fundamental limitation in human reasoning, showing how we tend to ignore rare yet transformative events until they actually happen (Taleb, 2007).

foresight, improves resource allocation, and enhances resilience in the face of unexpected challenges.

8. Results and Discussion

The conceptual analysis in this study shows that game theory offers a clear and multidimensional framework for understanding decision-making in defense and security environments. Through its core principles of rationality, dominance, equilibrium, cooperation and competition, coordination and anti-coordination, zero sum logic, credibility, and probabilistic reasoning, game theory provides both explanatory power and practical guidance for strategic behavior. The findings suggest that rationality, as the foundation of game theory, aligns closely with the logic of defense planning, where states and institutions aim to maximize security outcomes while operating under constraints of limited resources and information. In reality, however, pure rationality is rarely attainable. Political considerations, bounded rationality, and uncertainty all complicate the process of making sound strategic decisions. This highlights the growing importance of behavioral extensions of game theory, which integrate psychological and cognitive dimensions into defense decision support systems.

The concept of equilibrium is especially relevant to deterrence and stability. In strategic terms, equilibrium represents a condition in which no actor gains from acting alone, much like deterrence stability, where escalation is avoided because all sides understand the high cost of defection. The analysis indicates that equilibrium in defense contexts is dynamic rather than fixed, continuously shaped by technological advances, alliance structures, and changing threat perceptions. Treating equilibrium as an adaptive process rather than a static end state enables planners to maintain stability in volatile security conditions.

Another key insight concerns the interplay between cooperation and competition. It is the structure of incentives rather than intentions that determines whether actors choose collaborative or adversarial strategies. Defense cooperation such as joint military exercises, collective defense treaties, or intelligence sharing illustrates situations where cooperative outcomes yield greater benefits than unilateral actions. Yet mistrust and short term self interest, reflecting the logic of the Prisoner's Dilemma, often prevent states from achieving optimal collective security. Institutional mechanisms that extend the time horizon of interactions, such as alliance commitments, are therefore critical to sustaining cooperation. Coordination and anti-coordination dynamics further explain how defense actors navigate crises and strategic signaling. Coordination enhances mutual security through interoperability and shared doctrines, while anti coordination produces advantage through differentiation and asymmetric positioning, as seen in brinkmanship and deterrence signaling. Modern defense competition often involves carefully managed instability, in which actors project resolve and capability without triggering uncontrollable escalation. Understanding these opposing dynamics allows strategists to design communication and posture policies that combine firmness with restraint.

Although traditional defense analysis has often assumed a zero sum framework, the study finds that contemporary security challenges rarely fit this rigid model. Many domains such as cybersecurity, counterterrorism, and space governance are better understood as mixed motive environments where cooperation and competition coexist. Game theory's ability to integrate these complex incentives bridges classical realist thinking with modern systems approaches in defense strategy. At the same time, credibility remains central to strategic success. Deterrence and coercion depend not only on military capability but also on the perceived willingness

to act. Maintaining credibility requires consistent signaling, reliable policy behavior, and demonstrable readiness, while disinformation and ambiguity may be used strategically to undermine an adversary's confidence. The findings emphasize that credibility management now extends beyond force posture to include alliance cohesion, public diplomacy, and information operations.

Finally, probabilistic reasoning reinforces the need to anticipate low probability but high impact events in defense decision-making. Modeling mixed strategies and incomplete information reflects contemporary approaches to risk assessment, wargaming, and strategic foresight. Incorporating probability-based thinking into planning helps decision-makers allocate resources adaptively and assess potential scenarios more accurately, particularly in volatile, uncertain, complex, and ambiguous (VUCA) environments. Overall, the results demonstrate that game theory is not merely an abstract analytical construct but a practical tool for managing uncertainty, structuring strategic interactions, and evaluating the consequences of alternative defense choices. Its logical framework supports the creation of more coherent, forward looking, and resilient defense policies. Nevertheless, because this study is conceptual, its findings remain limited in empirical scope. Future research should expand on these insights through simulation modeling, experimental wargaming, and computational analysis to better capture the nonlinear, adaptive, and human aspects of defense decision processes. Integrating game theory with behavioral insights and data driven analytics could greatly strengthen strategic foresight and enhance the practical value of theoretical models in both national and international security planning.

Conclusions

This study explores how the core principles of game theory can be applied to defense and security strategies, focusing on the

ways mathematical reasoning helps illuminate the logic of strategic interaction among military and political actors. By examining key concepts such as rationality, dominance, equilibrium, cooperation and competition, coordination and anti coordination, zero sum logic, credibility, and probabilistic reasoning, the analysis highlights how game theory provides a structured lens for understanding decisions made under conditions of interdependence, uncertainty, and risk. The findings show that game theory functions as both a decision support and foresight tool, helping strategists think more systematically in volatile and uncertain defense environments. Its focus on rational behavior, incentives, and equilibrium offers a framework for interpreting deterrence, alliance management, and escalation control. Incorporating game theoretic reasoning into defense and security planning encourages more adaptive, evidence based, and forward looking strategies, especially in the face of volatility, uncertainty, complexity, and ambiguity that define the modern security landscape. At the same time, this study is conceptual rather than empirical, and its conclusions should be understood as interpretive rather than predictive. Future work can expand on these ideas through simulation modeling, wargaming, and behavioral experiments that explore how real decision-makers align with or diverge from theoretical expectations. Collaborative research connecting behavioral game theory, cognitive psychology, and defense analytics can deepen understanding of how bounded rationality shapes choices in complex strategic situations.

Ultimately, integrating game theoretic thinking into defense strategy development enriches both theory and practice. It equips policymakers and strategists with clearer tools for navigating uncertainty, optimizing limited resources, and sustaining stability in an increasingly complex and interconnected world.

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BÖLÜM 7

UNMANNED AERIAL VEHICLES (UAV) AND SAFETY: CONCEPTUAL FRAMEWORK, BIBLIOMETRIC ANALYSIS AND CURRENT APPROACHES[1]

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Introduction

Unmanned aerial vehicles (UAVs) have been identified as one of the most revolutionary technologies that the 21st century will experience. Unmanned aerial vehicles have not only outlived their military application origin but have become an indispensable tool in people's lives. UAVs have also been identified as the technology of the future and have opened a whole economy and employment arena, including logistics, agricultural, mapping, and search and rescue missions, owing to the advantageous costs and flexibility of UAVs (Macit et al. 2025). This rapid development has, however, brought forth a whole host of aviation safety concerns.

Though research on UAVs has been conducted in academia since the 1960s, it was first in studies of a modern kind that are based on research by Seaberg, Etter, and Records in 1972. Currently, however, research on UAVs in relation to flight safety has proliferated. Scopus searches on thousands of documents that combine "UAV" and "safety" concepts in research are available, as documented by Macit et al. in 2025. The most important lesson gleaned from such research is that "the human factor, not technological shortcomings, is key to understanding risks." For flight safety, according to his research findings, a pilot must have not just initial but advanced experience and a solid awareness of flight safety, as documented by Ateş in 2022. Other reviews also make it clear that mobile technology is an absolute necessity for overcoming the human factor in aviation systems and that such technologies are critical for improving flight safety

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and overcoming human factors, as documented by Macit et al. in 2025.

Still, it is not easy to reap these benefits of safer operating conditions. According to AL-Dosari, Hunaiti, and Balachandran (2024), it is the need of “well-designed drone systems” to ensure the maximal benefits of drones with respect to safety and security considerations. Along with designing, the term “cognitive UAVs” has received increased attention in this regard. According to Dehghan and Khosravian (2024), it is crucial to ensure improved situational awareness with the help of cognitive systems based upon artificial intelligence, with the aim of decreasing human error during drones’ operations and maximizing safety at the operative level.

This section examines the development of safety-focused scientific studies in the field of UAVs from a conceptual and bibliometric perspective. First, the operational, technological, and regulatory dimensions of UAVs and their safety requirements are addressed, followed by a presentation of the findings of a bibliometric analysis conducted to highlight trends in the literature. The study proposes a checklist of pre-flight, in-flight, and post-flight safety considerations and summarizes current approaches to UAVs and safety.

Conceptual Framework

Safety risks in unmanned aerial vehicle operations, the contribution of human factors to accidents, and the increasing importance of digital tools in safety management have been addressed based on the literature review.

In literature of UAVs, the general risk categorization for safety includes either technical malfunctioning or interaction with other aircraft. Collision with other aircraft was listed by Swihart et al. (2003) and Le Tallec (2005) as one of the key safety hazards in the early studies. The risk factor of wildlife interaction was also studied by Junda et al. in 2015.

This is coupled with the commercial development of the sector. Savaş et al. note that there is an urgent need for the regulation in key areas, such as the integration in non-segregated airspace. Therefore, in Turkey, the DGCA established the legal framework "Unmanned Aerial Vehicle Systems Instruction (SHT-İHA)". Yet, due to the rapid proliferation in numbers, local authorities had to take further action. For instance, in 2019 Istanbul Airport identified the potential for UAVs to become a threat to flight traffic in its safety bulletin.

Even though UAV systems may be "unmanned," the flight process does not escape from the human involvement and control aspect. Qi, Wang, and Jing (2018) explained that there is a high degree of risk due to the cognitive dissociation that may be linked with the remote pilot. The literature review supports the fact that the cause of most accidents is usually pilot-related, such as loss of situational awareness and lack of consistent training. In this regard, Dehghan and Khosravian (2024) note that SA is a condition of satisfactory unmanned aerial vehicle operation. They referred to situational awareness as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their near future status."

The apparent lack of direct sensory input for the remote pilot hampers maintaining SA, leading to "skill-based errors" and "judgment errors." Macit et al. (2025) found the same explanation because meteorological information-one of the aspects of SA-always needs much assistance to get.

Enhancing safety awareness depends on delivering all possible information accurately in the operation to pilots. Turğut and Şeker (2022) identified the necessity for additional safety applications. In supporting this view, AL-Dosari et al. (2024) suggested the "Drone Safety and Security Surveillance System, D4S". According to their research, standardised systems can revolutionise the concept of safety since they permit "timely decision making" that is critical to one's safety. Wild et al. (2025) assert a similar opinion, stating that mobile technologies allow for the facilitation of safety management systems even in resource-constrained settings.

Bibliometric Analysis

Within the scope of the research problem, studies in the literature were examined using bibliometric analysis methods to analyze the relationship between UAVs and the concept of safety from the perspective of pilots and/or users. Bibliometric analysis involves applying quantitative techniques and visualization to studies to explore the in-depth structure of a specific field in the existing literature (Donthu et al., 2021). One of the most popular programs for this methodology, VOSViewer, was developed by Van Eck and Waltman (2010) for creating scientific bibliometric maps and visuals.

To ensure a certain level of quality and consistency in

the studies, the Scopus database was selected, and the analysis was conducted based on the studies retrieved. A search in the Scopus database using the keywords “unmanned aerial vehicles uav” and ‘safety’ with the “article title, abstract, keywords” option listed a total of 8,469 studies. Of these studies, 4,405 were conference papers, 3,607 were articles, 226 were reviews, 149 were book chapters, and the remainder were other sources. The studies began in 1993, and nearly half of them were conducted between 2023 and 2025 (Figure 1). Furthermore, approximately 35% of the studies were engineering-focused, and approximately 70% were conducted in China and the US.

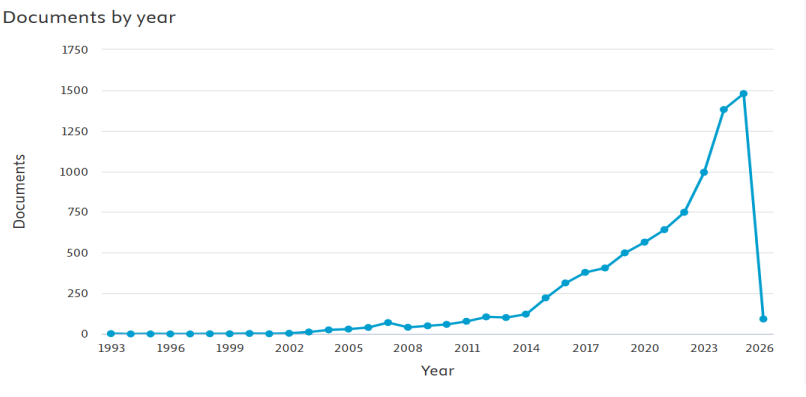

Figure 1: Distribution of studies by year

The study focused on narrowing down keywords within the “subject area” framework to achieve accurate results and enable analysis, listing 2050 studies from the fields of “Social Sciences, Decision Sciences, and Business, Management, and Accounting.” Using the obtained data, a co-occurrence analysis was performed in the VOSViewer

program based on bibliometric data. Accordingly, Figure V1 was created with 962 keywords that had the highest weight and intersected with at least five studies from the keywords in the 2050 studies in the Scopus database. In the figure, the larger circles represent the weight of the keywords, the lines between them indicate the co-occurrence/connection between the keywords, and the colors represent clusters formed from keywords used in studies connected to each other.

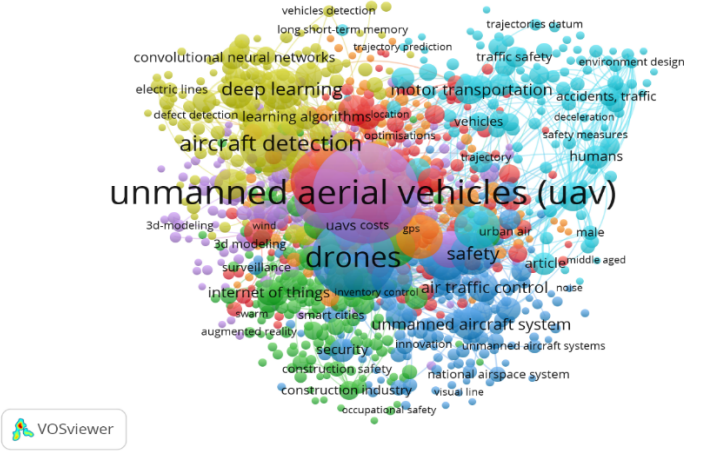

Figure 2: Scopus Database Network Analysis

In the network analysis shown in Figure 2, seven clusters were formed with 292 keywords. Owing to the nature of the study, concepts such as UAV and Drone stood out as the keywords with the highest weight, while keywords such as “risk assessment, safety, safety engineering, accident prevention, aircraft accident, human, and decision making” were listed as keywords with 1000 or

more connections. In parallel, while relevant studies were retrieved from the Scopus database, the keyword “operator” was also added, 144 studies were listed, and a term co-occurrence analysis was performed on the abstracts, as shown in Figure 3. In the analysis of the most frequently used words in the abstracts, terms such as “national airspace system, efficiency, pilot, avoidance, low altitude airspace, obstacles, FAA, regulation,” which directly reveal the relationship between operators and safety, stood out as the most frequent words.

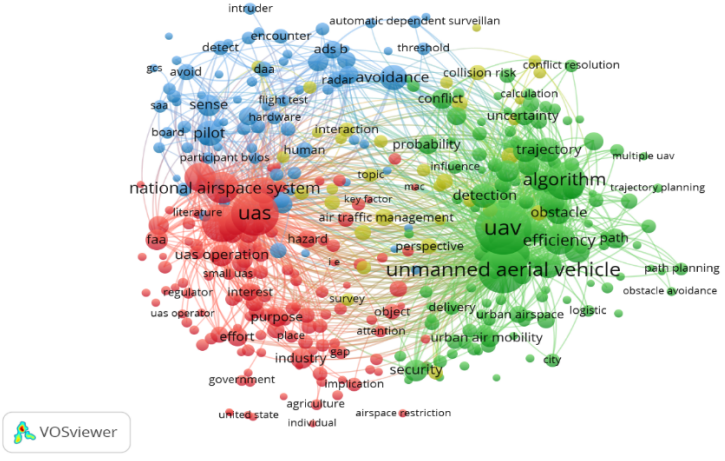

Figure 3: Term Co-Occurence on Abstracts

When studies obtained from the Scopus database and analyzed using a deductive approach are examined, it is seen that there are multidimensional and intersecting relationships between UAVs and safety in general. Analyses conducted specifically on operators/pilots

regarding human influence in direct operational processes have shown that many factors are effective, ranging from airspace management to regulations and from the aircraft itself to the competence of operators.

Operational Checklist Focusing on UAVs and Safety

The checklist method is widely believed to be one of the most basic but efficient human-error reduction tools in the aviation field. The literature repeatedly points out that in high-risk working environments, if pure memory-centered procedures are found less efficient, reminder and verification systems can greatly contribute to improved performance in terms of safety (Degani & Wiener, 1993; Reason, 1998). For all categories of aviation personnel, such as pilots, maintenance personnel, flight attendants, and ground staff, checklists are a basic tool in implementing standard operating procedures (FAA, 2009).

On analysis of the UAV operation environment, it has been noticed that the procedures performed in the checklists are not well standardized compared to the conventional air transport environment and in most of the cases are only dependent on the UAV's manufacturer's guidelines or the pilot's habitual procedures. Such an environment is considered to be conducive to the growth of risks with higher potentials in the aviation sector due to 'human-related' variables. It has been identified in the current literature that the major UAV incidents reported in the past are 'human-related' due to planning deficiencies, control deficiencies, decision-making deficiencies, and procedural deficiencies (Hobbs & Lyall, 2016; Tvaryanas et al., 2006).

According to Gawande (2009), checklists are defined as products that can offset human cognitive imperatives with beneficial properties in decreasing the likelihood of error, most specifically within tasks involving low repetition, high stress, and pressing timelines. In the aviation arena, checklists are basically meant to act as an aid in reminding people of what they need to do, besides facilitating an appropriate arrangement of control, verification, and decision processes at critical points (Degani et al., 2004). In this regard, checklists can be noted as one of the mechanisms of defense within human factors (Reason, 1998).

The relevance of this checklist approach is well understood when examined with regards to UAV operational matters. UAV operators are usually not present in their aircraft but create their awareness through various monitoring screens and remote controls. This can increase their perceptual blind spots and chances for errors to occur (Hobbs and Lyall, 2016). The processes for before, during, and after-flight activities can be organized with checklists to guide and cue their attention to various key points.

Pre-flight checklists lie at the core of safety, especially when considering planning and preparation phases. Critical analysis of factors such as airspace control, mission, environmental factors, battery, and system integrity can help prevent many unsafe scenarios, as may happen when flights take place. This is supported by literature, suggesting efficient use of pre-flight planning time coupled with use of standard checklists helps prevent errors during flight operations by a substantial margin (FAA, 2009). Within the scope of this study, a 14-item pre-

flight checklist for UAV flights was prepared based on long -duration flights, authority reports, and a literature review. The tasks in this checklist are listed item by item;

- Meteorological conditions were assessed for suitability for flight,
- The suitability and structure of the area for flight were assessed,
- Take-off and landing areas were defined,
- Flight was planned,
- Estimated flight duration was determined,
- UAV/Drone firmware is up-to-date,
- Control remote/application is up-to-date,
- The flight area is no more than 5 miles from an airport,
- There are no visible defects in the UAV/Drone and equipment,
- The UAV/Drone battery is fully charged,
- The propellers are properly installed and tightened,
- The camera is properly mounted and positioned,
- An SD card is inserted for the camera,
- Additional equipment to be used for the flight has been prepared (if any).

In-flight checklists are processes involving many controls. This phase is regarded as the period when the

chance of having an unsafe condition arises. Constant monitoring of the system performance of equipment, control outputs, flight dynamics, and environmental factors contribute to the timely recognition of variations due to human-related factors. Structured process of control enables better decision-making by the pilots, which lessens the workload of the cognitive processes of the pilots (Wickens et al., 2021). As a result of long-duration flights, authority reports, and literature review, a 9-item checklist for in-flight UAV flights was prepared within the scope of this study. The tasks in this checklist are listed item by item;

- Controlled take-off was performed,
- Control was exercised 10 feet forward, backward, right and left,
- Flight altitude was set not to exceed around 400 feet,
- Flight was not conducted outside the line of sight,
- Flight was not conducted over areas where people were present,
- Flight was not conducted over stadiums or other sports fields,
- Flight was not conducted over emergency response areas,
- Flight was not conducted near other aircraft,
- Flight equipment and the drone were continuously visually inspected.

Post-flight checklists contribute to the safe end of the

flight, the continuity of operation over time, and the safety of the equipment. Conducting data logging, conducting maintenance, handling the batteries, and preserving the equipment within a standardized structure is crucial for preventing hazardous situations that might appear during the next flight. In this respect, the checklists are regarded as an auxiliary tool that ensures the continuity of the safety culture (Reason, 1998).Within the scope of this study, an 8-item post-flight checklist for UAV flights was prepared as a result of long-duration flights, authority reports, and literature review. The tasks in this checklist are listed item by item;

- A controlled landing was performed,
- The UAV/Drone power was switched off,
- The UAV/Drone was checked for damage,
- It was ensured that the flight objective was achieved,
- Data was checked and transmitted,
- Necessary information for flight documents was recorded,
- The UAV/Drone batteries were positioned for charging,
- The UAV/Drone was positioned appropriately.

In summary, there is great potential in the systematic integration of the checklist method into UAV activities. The transfer of a method, which has already been verified many times in literature within traditional aviation activities, into a UAV scenario in a practical, experience-based manner

will lead to enhanced safety management.

Current Approaches Focusing on UAVs and Security

In the past few years, UAVs have found various applications in different domains, mainly in civilian and commercial air transportation, but in addition, in the domains of agriculture, logistics, disaster relief, and security. This widespread use of UAVs has culminated in new challenges for airspace safety and security. In contrast to conventional air transportation, a significant part of UAV operations is exercised in non-segregated airspace using limited control tools, while many UAV pilots are certified after short training courses. This clearly proves that the safety of UAVs involves multi-dimensional problems for which comprehensive solutions have to be found in a technical, human-related, legislative, digital, and safety culture-related manner.

A major body of safety literature related to UAVs is based on airspace and risk management. Airspace integration of UAVs can generate safety risks like collision, loss of situational awareness, and loss of control. According to Qi, Wang, and Jing (2018), human factors have been shown to play an extremely significant role in UAV safety. The author argues that the absence of the human pilot from the UAV increases safety risks due to factors like cognition, distraction, and loss of situational awareness. A similar view has also been presented by Sharma and Chakravarti (2005), who found that human-machine interaction deficiency can result in direct safety underperformance.

In relation to risks associated with UAV safety,

systematic methodologies, as well as preventive strategies, must play a significant role. According to Clothier et al. (2017), setting safety-oriented boundaries throughout the design operation of UAVs plays a vital role in ensuring not only UAV safety but, more importantly, safety within the surrounding areas of both UAV users as well as other aircraft. Notably, the ever-increasing regulations associated with UAVs within various nations present complex challenges during UAV safety management. Savaş et al. (2018) argue that disparities within various UAV safety regulations within nations, as well as the absence of a comprehensive global framework, present critical safety challenges, particularly within non-segregated airspace. Kurt & Ünür (2015) argue that ambiguities associated with UAV safety policies present critical challenges within UAV safety.

Human factors are another area that assumes importance and grows from strength to strength as a topic of UAV safety research. The training, experience, and safety consciousness of UAV pilots are the determining factors that define the safety of operations. According to research by Doroftei et al. (2024), UAV pilots with varying training have different safety behaviors under identical operational settings. This illustrates the need for standardized training systems and techniques that facilitate safety consciousness. Experience and training for enhanced success and safety of flights have direct implications for UAV pilots, according to a commentary by Ateş (2022).

Recently, digitalization and mobile technology have begun to gain attention in literature for their potential to

play a critical role in supporting UAV safety. The availability of safety-related information with ease and speed is expected to have positive effects on decision-making processes for UAV pilots and can further help to decrease human error. According to Mouloua et al. (2001), loss of positional awareness is identified as one of the key contributing factors for UAV accident incidents, and integrated digital systems are identified to be potential and useful for mitigating this factor. Within this perspective, provision for meteorological information, airspace restrictions, government-related documents, and operational checklists using digital systems is identified to be a recent and innovative approach with consideration to safety issues. In their research work, Macit et al. (2025) identified that provision for meteorological information, airspace restrictions, government-related documents, and operational checklists for UAV pilots using mobile apps would increase pilot awareness on safety.

Although checklists are considered to be one of the basic elements of safety processes in aviation, they have not been applied systematically in UAV operations for a long time. Nevertheless, it is clear that checklists applied in classical aviation are extremely efficient with respect to eliminating human factor-related errors. According to Yardımcı (2019), if there are no checklists applied during UAV operations, especially before taking off and during the operation itself, safety risks may increase. Since the applied software provides a digital delivery based on a friendly design, it is possible for these processes to be supported.

Another significant contemporary method within the

framework of UAVs' safety is improving the level of the safety culture itself. According to Turğut and Şeker (2022), dangerous use of UAVs, or using these vehicles by people who lack an adequate level of safety awareness, presents significant threats. To this end, it is crucially important to ensure the development of an appropriate level of the so-called safety culture, emphasizing technical solutions, as well as safety behavior. Also, digital solutions contribute positively to this process because they help ensure continuous provision of all relevant technical personnel with safety information absorbed into their activity-based decisions.

Altogether, the current trends in UAVs and safety have gone beyond mere risk analysis and include perspectives on areas like human factors, legislation, digitalization, and safety culture. Based on the literature study, it has been found that the main areas that need to be focused in order to ensure the safety of the UAVs include enabling information access, awareness of pilot safety, and standardization of pilot procedures. The solutions developed in the current scenario can be considered effective in enabling safe pilot behaviors.

Conclusion and Evaluation

In the broadest sense, unmanned aerial vehicles have been on the global agenda for many years, but they have recently become accessible to everyone. While they are heavily used as military and defense systems, today we see an increase in their use across a wide spectrum, from commercial operations to individual interests. In parallel, UAV safety processes, provided through systematic and multi-element tracking processes, have transitioned to a

use that could raise safety concerns down to the individual pilot/operator's competence.

As seen in the literature review section throughout the study and in the bibliometric analyses conducted on relevant literature studies, the popularity of UAV systems is also reflected in the academic studies. Approximately 22,000 studies were listed in a search using the keywords UAV or Drone. For this study, the relevant studies were first reduced to approximately 8,500 at the safety level, and then analyses were performed on approximately 2,000 studies based on the field of study. In parallel, the analyses conducted also showed that the safety framework of UAV/drone systems generally approached a human-centered conclusion. Throughout the approximately 100-year history of modern aviation, humans have always been at the center of the system and its most critical element, and the human factor is one of the most important elements in the context of aviation safety. With the proliferation of UAV/drone systems, the shift of control from the center to the individual also creates one of the most important safety concerns regarding this system. At this point, the perspective and perception of the relevant operators/pilots in the UAV system regarding the concept of safety are also important in terms of both the general aviation system and other possible factors. It is critical for both authorities and individuals to recognize and accept that humans, who are at the center of all aviation systems, are also a critical element in this system and to implement regulations that increase safety in this regard.

Based on the results obtained from the literature, it appears that placing the human factor at the centre of the

UAV-Safety relationship to ensure safe operations is the most appropriate approach. In this sense, as indicated by the studies, the necessity of establishing systematic safety procedures emerges. Within the scope of this study, it is considered necessary to expand the proposed sample checklists according to needs, utilize digital applications, and ensure easy access to all necessary information for UAV pilots with a focus on safety. Future studies could focus on developing procedures, legal and technical infrastructure in the UAV-Safety relationship.

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GEÇİCİ KAPAK

Kapak tasarımı devam ediyor.