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COPING WITH FOURTH INDUSTRIAL REVOLUTION CHALLENGES: LEADERSHIP COMPETENCIES IN THE AIRLINE INDUSTRY

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Abstract

This study aimed to identify leadership competencies crucial for navigating the Fourth Industrial Revolution in the airline sector, utilizing a mixed-method approach, specifically an explanatory sequential design. Data from 210 employees underwent analysis using descriptive and inferential statistics, predictive analytics, and bootstrapping methods. Findings indicated that while age and education had no bearing on leadership competencies, gender, tenure, and positions displayed variations, indicating competency enhancements regardless of demographics. Furthermore, all competencies studied significantly predicted overall success, with some explicitly influencing challenges associated with the Fourth Industrial Revolution. A proposed leadership development framework addressed the findings precisely challenges, with practical implications focusing on driving success and sustainability in the airline industry.

Keywords: Leadership competencies, success, fourth industrial challenges, leadership framework.

Introduction

The aviation industry stands at a pivotal juncture amid the Fourth Industrial Revolution, characterized by automation and digitization reshaping organizational landscapes globally. As firms integrate high standards of research and development along with continuous improvement, market competitiveness is increasingly contingent upon embracing customization, optimization, and self-cognition within the industry. This paradigm shift, called Industry 4.0, interconnects value chains through autonomous systems, heralding a demand for new leadership competencies to navigate the digital transformation (Herold, 2016; Fernández-Miranda, Marcos, Peralta, & Aguayo, 2017). In response, leaders in the aviation sector must adapt to dynamic challenges, distinguishing between adaptive hurdles and technical obstacles while fostering innovation and resilience within their organizations. These challenges necessitate a departure from traditional models of authority towards leadership that mobilizes discovery, tolerates risk, and encourages innovation, highlighting the critical need for an evolved leadership paradigm to confront the disruptive forces of the Fourth Industrial Revolution (Schwab, 2016).

In the Philippine aviation industry, the imperatives of the Fourth Industrial Revolution are keenly felt, urging a reevaluation of leadership competencies to ensure organizational agility and competitiveness. As the nation embraces Industry 4.0 technologies, there is a pressing need to cultivate a cadre of leaders adept at harnessing digitalization, data utilization, and innovation to drive sustainable growth. Such leaders must navigate complexities in communication, critical thinking, and decision-making to bridge the gap between traditional and contemporary leadership skills in the face of unprecedented challenges (Senko, 2018). Moreover, the advent of the COVID-19 pandemic has magnified the urgency of this task, compelling aviation leaders to fortify their adaptive capacities amidst volatile market conditions. As the industry grapples with reduced travel demand and regulatory uncertainties, the imperative for leadership excellence in navigating disruptive change becomes all the more apparent (Sobieralski, 2020; Suau-Sanchez, Voltes-Dorta, & Cugueró-Escofet, 2020).

In light of these exigencies, this study endeavors to elucidate the requisite leadership competencies essential for Philippine airline industry leaders to effectively navigate the challenges posed by the Fourth Industrial Revolution and the COVID-19 pandemic. By examining the intersection of technological disruption, organizational resilience, and leadership efficacy, this research seeks to furnish insights crucial for cultivating leadership acumen tailored to the demands of the contemporary aviation landscape. Through a nuanced understanding of adaptive leadership behaviors, communication strategies, and innovation imperatives, this study aspires to furnish actionable recommendations for fostering a cadre of leaders equipped to steer Philippine airlines toward sustained growth and competitiveness in an era defined by unprecedented change (Leurent & Shook, 2019; Francisco *et al.*, 2019).

Furthermore, this study aims to address significant research gaps concerning leadership competencies amidst the challenges of the Fourth Industrial Revolution and the COVID-19 pandemic. Specifically, it seeks to fill the void in understanding how adaptive leadership behaviors can effectively navigate disruptive changes and external pressures within the aviation sector. Thus, this study endeavors to contribute valuable insights to developing leadership competencies tailored to the unique demands of the contemporary airline industry in the Philippines.

Distinction Between the Fourth Industrial Revolution and Third Industrial Revolution

The Fourth Industrial Revolution represents a paradigm shift integrating cyber-physical systems and emerging technologies, setting it apart from its predecessors. As outlined by (Schwab, 2016), this revolution is distinguished by extreme connectivity, limitless computing power, and automation opportunities such as algorithms and artificial intelligence. Unlike the Third Industrial Revolution, which leveraged information technology and electronics for automation, the Fourth Industrial Revolution harnesses green energies and pivotal technologies like the Internet and 3D printing (Xu, David, & Kim, 2018). The fusion of technologies blurs the boundaries between digital, physical, and biological spheres, disrupting business models and altering workforce skills. While the Third Industrial Revolution laid the groundwork for automation, the Fourth Industrial Revolution's exponential evolution has permeated global industries, transforming management, production, and governance systems on an unprecedented scale. This distinction underscores the profound impact and transformative potential of the Fourth Industrial Revolution on societies, economies, and industries worldwide.

Impact of the Pandemic on Leadership in the Airline Industry in the Fourth Industrial Revolution

The COVID-19 pandemic has profoundly impacted leadership within the airline industry, coinciding with the challenges of the Fourth Industrial Revolution. Sobieralski (2020) noted that airlines globally have faced reduced capacity and sought governmental aid to weather the storm. Suau-Sanchez *et al.* (2020) emphasized the unprecedented obstacles brought about by travel bans and flight cancellations, leading to severe market restrictions and a sluggish recovery trajectory. Consequently, leadership strategies have been reevaluated, focusing on attracting new airlines, securing traffic volumes, and fostering competitiveness (Leurent & Shook, 2019). US Senate Committee on Commerce, Science, and Transportation (2020) stressed the industry's daily struggles amidst the pandemic, compounded by economic downturns and health concerns, resulting in historic unemployment rates and financial strain. In the Philippines, the airline sector experienced a staggering 94% drop in passenger traffic, necessitating government intervention for recovery (Asia Pacific Economic Cooperation, 2020). Effective leadership amidst this turbulence requires navigating complex challenges like financial restructuring and health protocols, restoring consumer confidence, and steering the industry toward resilience and eventual recovery.

Leadership Success

In the contemporary airline industry, successful leadership, particularly amidst the challenges of the Fourth Industrial Revolution, necessitates a diverse skill set capable of navigating the complexities of digitalization and globalization. Morgan (2014) accentuated the importance of leaders possessing a range of leadership and digital competencies to manage dynamic operations effectively. Decision-making emerges as a critical trait, with leaders reliant on data from information systems for strategic decision-making (Murphy, Garg, Sniderman, & Buckley, 2019). Skilton and Hovsepian (2018) underscored the significance of leaders' understanding of advanced technologies like robotics and artificial intelligence for quality decision-making in challenging contexts. Agility is essential for leaders to adapt to changing circumstances and drive continuous improvement (Pineda, 2013), while problem -solving abilities are paramount for swiftly resolving operational issues (Slegel, 2013). Practical collaboration skills are crucial for fostering synergy among internal stakeholders (Robinson, 2014). Ultimately, leadership success is measured by positive outcomes driven by leaders' influence, emphasizing the need for clear vision and organizational effectiveness (Madanchian, Hussein, Noordin, & Taherdoost, 2017; Meraku, 2017).

Leadership Competencies for the Fourth Industrial Revolution

In the dynamic landscape of the Fourth Industrial Revolution, characterized by rapid technological advancements and globalization, leadership competencies are pivotal in driving organizational success and navigating unprecedented challenges. Grzybowska and Lupicka (2017) highlighted the importance of specialized skills in adapting to evolving technologies

and materials, particularly in the manufacturing sector. They identify three core categories of managerial competencies: technical, managerial, and social, emphasizing the need for effective decision-making, problem-solving, and interpersonal skills.

Relish (2015) expanded on this by outlining eight significant managerial competencies essential for future leaders, stressing continuous competency improvement and employee support. Creativity is a cornerstone of effective leadership, enabling leaders to perceive new perspectives and generate innovative solutions (Relish, 2015). Entrepreneurial thinking and problem-solving skills equip leaders to seize market opportunities and tackle challenges in diverse settings.

Decision-making competency assumes critical importance amidst the complexities of the Fourth Industrial Revolution (Relish, 2015). Influential leaders must identify alternative solutions and adapt to dynamic environments through continuous learning and strategic resource utilization. Moreover, conflict resolution skills are indispensable for the constructive management of conflicts and for fostering positive outcomes (Rychen, 2016; Verwey, 2018).

Kumar, Zindani, and Davim (2019) elucidated that intelligence competency emphasized holistic perspectives and collaborative processes to address challenges and foster innovation within cultural contexts. Workforce enablement is vital for driving innovation and sustainable growth, requiring leaders to adopt new competencies and empower the workforce (Dadios *et al*., 2018). Research competency equips leaders with skills to analyze data effectively and engage stakeholders through impactful presentations (Grzybowska & Lipicka, 2017).

Sociocultural competency enhances employability and competitive prowess, demanding self-awareness and the ability to analyze social roles effectively (Ieva, 2015). Hunter (2018) emphasized the indispensability of problem-solving competency for navigating the complexities of the Fourth Industrial Revolution and meeting employer expectations. Similarly, Sun (2018) pointed out how entrepreneurial thinking fosters creativity and strategic resource management.

For conflict resolution competency, previous studies advocated that this competency ensured effective workplace dynamics amidst technological disruptions (Segal, 2017; Kunafei, Arifin, & Sultoni, 2019; Lee & Wong, 2019). At the same time, digital competency enables leaders to leverage technology for organizational success (Oberer & Erkollar, 2018; Soni, 2019). Creativity and innovation, on the one hand, drive transformative changes across organizational structures (OECD, 2016; Zakaria, Nasir, & Akhtar, 2019).

As highlighted by several studies (Plutschinski, 2017; Philbeck, Davis, & Larsen, 2018; Pedersen & Ritter, 2019), ethical competency is paramount for addressing ethical complexities and maintaining organizational reputation and societal trust in the digital era. Leaders must integrate ethical perspectives into technological development and daily operations to ethically harness the benefits of the Fourth Industrial Revolution.

Challenges in the Fourth Industrial Revolution

The Fourth Industrial Revolution ushers in a plethora of challenges necessitating collaborative efforts from government and business leaders (Manda & Dhaou, 2019). This collaborative approach is vital for developing nations to navigate the opportunities and challenges posed by digital transformations effectively. Xu *et al*. (2019) delved deeper into the revolution's transformative impact, highlighting shifts in wealth, power, and knowledge driven by technological advancements. Talent emerges as a crucial production factor, surpassing capital and labor in importance. However, these advancements also bring heightened cybersecurity concerns, prompting organizations to prioritize risk assessment and network security.

As analyzed, the skills and challenges that arose during the Fourth Industrial Revolution were diverse (World Economic Forum, 2016; Butler-Adam, 2018). Cognitive skills, together with non-cognitive and behavioral skills, are considered vital for fostering innovation and collaboration. The disruptive influence of technological advancements on current skill sets underscores the necessity for individuals and organizations to adapt to changing skill demands, particularly in problem-solving and understanding organizational processes.

It is revealed that the revolution fundamentally transforms work systems (World Economic Forum, 2016; Chitturu, Lin, Sneader, Tonby, & Woetzel, 2017). Job evolution and disappearance underscore the interplay between workers' tasks and automation. Organizations' enhanced agility in managing workforces through online platforms and flexible arrangements is crucial for adapting to emerging business models and industries. This adaptability ensures a future-oriented workforce with the necessary skills for technological shifts.

Furthermore, infrastructure plays a fundamental role in the Fourth Industrial Revolution, propelling technological advancements across business processes (Weyer, Schmitt, Ohmer, & Gorecky, 2015). Smart factories and cyber-physical frameworks demand new leadership competencies and skilled information technology professionals capable of operating complex systems and machines central to this revolution.

In addition, operating models are reassessed in the Fourth Industrial Revolution, prioritizing agility in strategic planning and emphasizing platform strategies for global connectivity (Giles, 2015). These strategies pivot towards customer-centric approaches and require alignment with evolving skill requirements to retain and attract talent.

Moreover, cybersecurity challenges encompass data protection, privacy, and ethical considerations (Schwab, 2016; Manda & Backhouse, 2016; Fuller, 2019). Fragmented data protection regulations globally raise concerns regarding personal data processing and resale, necessitating enhanced protection mechanisms for intelligent production systems. Safety concerns surrounding autonomous vehicles require new leadership competencies in safety protocols and policy development.

Objective 1: To describe the profile of the respondents in terms of personal characteristics and related professional background;

Objective 2: To determine the leadership competencies, leadership success, and challenges of airline leaders in the Fourth Industrial Revolution;

Objective 3: To evaluate the leadership competencies and leadership success across characteristics of airline leaders;

Objective 4: To analyze the effects of leadership competencies on leadership success mediated by the Fourth Industrial Revolution Challenges.

Objective 5: To develop a leadership framework.

Research Methods

The study utilizes a quantitative approach to create a leadership framework for improving leadership competencies in coping with the challenges of the fourth industrial revolution in the Philippine airline industry. This study adheres to ethical standards and complies with the provisions of the Data Privacy Act. There is a total population of 210 participants from four airlines industries. For the research instruments, the researcher utilizes adapted questionnaires for leadership competencies, Fourth Industrial Revolution challenges, and leadership success from various authors presented in Appendix A to C.

The specified questions in the survey questionnaire have been tested for reliability to ensure that the tool is reliable. The reliability results showed a Cronbach's Alpha coefficient of 0.953, over 0.7, indicating the instrument's high internal consistency and reliability.

In data analysis, the quantitative and qualitative data responses acquired are analyzed and interpreted using various statistical methods, including descriptive statistics, inferential and causal analytics, and the diagnostic test.

Results and Discussion

Demographic Characteristics of Airline Leaders

The first objective is to describe the airline leaders who have been selected. Based on the responses gathered, Table 1 presents the frequency distribution of the respondents in terms of age, gender, education attainment, tenure, and position.

Table 1
Demographic Characteristics of Airline Leaders

Characteristic	Frequency $n = 168$	Percentage
Age (years)		
25–30	20	11.9
31–40	38	22.6
41–49	51	30.4
50–58	59	35.1
Gender		
Male	91	54.2
Female	77	45.8
Educational attainment		
College	122	72.6
Post Graduate	46	27.4
Tenure (years)		
1–5	55	32.7
6–10	1	0.6
11–15	28	16.7
16–20	24	14.3
20–28	60	35.7

The study examines demographic characteristics of airline leaders, revealing that a significant portion of respondents (35.1%) were aged 50 years or older, with 30.4% aged between 41–49 years and 11.9% aged 25–30 years or younger, indicating a predominance of older leaders who likely acquired their competencies over years of industry experience amid the Fourth Industrial Revolution. Males (54.2%) of respondents constitute the majority, highlighting a gender imbalance in leadership roles within the airline sector. Furthermore, 72.6% of respondents are college graduates, while 27.4% held postgraduate degrees, suggesting a mix of educational backgrounds contributing to leadership development. Notably, 35.7% of respondents has been with their company for 20 years or more, indicating extensive industry experience among a significant portion of the leaders surveyed. Some studies affirmed these findings. Older leaders prevail, suggesting competencies honed through experience rather than formal education alone, aligning with characterizing the revolution's transformative nature (Schwab, 2016). Grzybowska and Lupicka (2017) noted that gender disparities persisted, underscoring the need for diversity initiatives.

Required Competencies for Airline Leaders in the Fourth Industrial Revolution

The second objective of this study is to determine the required competencies for airline leaders in the fourth industrial revolution. The results shown in Table 2 indicate that airline leaders often performed all leadership competencies during this period.

Table 2
Competency Assessment of Leaders

Leadership Competencies	Mean	SD
Problem-Solving	4.21	0.51
Intelligence	4.10	0.53
Workforce Enablement	4.12	0.55
Entrepreneurial Thinking	4.12	0.50
Conflict Resolution	4.42	0.49
Digital Competency	4.16	0.48
Research Competency	4.10	0.40
Sociocultural Competency	4.19	0.46
Creativity and Innovation	4.00	0.47
Ethical Competency	4.00	0.53

The study examines the required competencies for airline leaders in the Fourth Industrial Revolution. Conflict resolution emerges as the dominant competency, with a mean of 4.42 (SD = 0.49), followed by problem-solving, with a mean of 4.21 (SD = 0.50). Conversely, ethical competency exhibited the lowest mean score at 4.00 (SD = 0.53), suggesting potential gaps in this area. These results indicate that airline leaders possess essential competencies for managing conflicts and solving problems, although ethical considerations may have received less emphasis.

Assessment Levels of Leadership Success Indicators

Table 3 shows the assessment levels of leadership success indicators. Among the factors affecting leadership success, collaboration understanding and skills, with a mean of 3.64 (SD = 0.50), reveals the highest significance mean, followed by problem-solving, with a mean of 3.61 (SD = 0.47). Both factors exhibit a high level of influence on leadership success. On the other hand, knowledge shows the lowest mean of 3.48 (SD = 0.51), indicating a moderate level of influence as an indicator of leadership success. Nonetheless, all the factors affecting leadership success displayed a high level of influence that drove leaders to perform their responsibilities better and more effectively in the Fourth Industrial Revolution.

The results specified above are confirmed by various authors (World Economic Forum, 2016; Butler-Adam, 2018), accentuating the importance of cognitive skills as technology increasingly overtakes traditional-based work. Similarly, both non-cognitive and behavioral skills are equally significant in the Fourth Industrial Revolution.

Table 3
Assessment Levels of Leadership Success

Leadership Success	Mean	SD
Knowledge	3.48	0.51
Expertise	3.55	0.50
Agility	3.57	0.45
Problem-Solving Collaborative	3.61	0.47
Understanding and Skills	3.64	0.50

Leadership Awareness of the Fourth Industrial Revolution Challenges

Table 4 presents the factors that affect leadership competency and become the challenges leaders face in the Fourth Industrial Revolution. Dominantly, skills challenges indicated the highest mean of 3.88 (SD = 0.60), followed by work system challenges with a mean of 3.77 (SD = 0.58). The minor factor relates to cybersecurity challenges, with a mean of 3.50 (SD = 0.81). Indicatively, leaders often observe and experience all the identified challenges in this period.

Table 4
Leadership Awareness of the Fourth Industrial Revolution Challenges

Challenges	Mean	SD
Skills Challenges (SC)	3.88	0.60
Infrastructure Challenges (IC)	3.71	0.68
Cybersecurity Challenges (CC)	3.50	0.81
Work System Challenges (WSC)	3.78	0.58
New Operating Model Challenges (NOMC)	3.38	0.72

Several studies (Chitturu *et al.*, 2017; Lozza, 2017) support the findings regarding challenges in work systems, emphasizing the need to adapt to technological advancements. Similarly, Manda and Backhouse (2016) reinforced the results concerning cybersecurity challenges, highlighting the importance of protecting data and system integrity amidst technological transformations.

Leadership Competencies Across Demographic Characteristics

Table 5 shows the results of ANOVA tests comparing the mean levels of leadership competencies across airline leaders' age, gender, educational attainment, tenure, and position.

Table 5
Leadership Competencies Across Demographic Characteristics

Demographics Characteristics	*F*	*p*-value
Age	0.651	0.584
Gender	5.25	0.023
Educational Attainment	0.000	0.985
Tenure	3.37	0.011
Position	5.29	0.000

The analysis revealed no significant differences in leadership competency across age groups and educational attainment ($p > 0.05$). For age groups, the results showed $F(4, 163) = 0.651, p = 0.584$, indicating no significant difference. Likewise, educational attainment did not significantly differ in leadership competencies, as indicated by $F(1, 166) = 0.000$, $p = 0.985$. However, gender $F(1, 166) = 5.25$, $p = 0.023$, tenure, and position showed significant differences in leadership competency. Gender exhibited a significant difference in competency. Furthermore, tenure also showed a significant difference in leadership competency, with $F(4, 163) = 3.37$, $p = 0.011$. Position exhibited a significant difference, with $F(7, 160) = 5.29$, $p = 0.000$.

In the airline industry context, leadership competency appears independent of age and educational attainment, suggesting diverse individuals can demonstrate similar effectiveness. However, disparities in gender, tenure, and position highlight demographic influences on leadership competency within airline organizations, corroborating findings from Larsson *et al*. (2003) and Larsson and Hyllengren (2013), who similarly noted the impact of these factors on leadership effectiveness.

Comparison of Leadership Success Across Airline Leaders Characteristics

Table 6 shows the significant differrences between leadership success and the respondents' profiles regarding age, gender, educational attainment, tenure, and position. These findings determine whether there are significant differences in leadership and profiles across the two groups of variables.

Table 6
Leadership Success Across Demographic Characteristics

Demographics Characteristics	*F*	*p*-value
Age	1.675	0.174
Gender	0.247	0.620
Educational Attainment	0.002	0.963
Tenure	0.761	0.552
Position	1.124	0.351

The results show no significant differrence in leadership success across the demographic characteristics (e.g., age, gender, educational attainment, tenure, and position) where $p > 0.05$. This suggests that success in leadership roles is not inherently tied to traits like age, gender, or educational background. Furthermore, it indicates that leadership effectiveness is not solely determined by seniority or position within the organization, emphasizing the importance of other qualities such as communication skills, decision-making acumen, and emotional intelligence. These findings emphasize the need for a shift in talent management and leadership development practices, focusing on nurturing skills and attributes that contribute to effective leadership performance, irrespective of demographic characteristics.

Several studies substantiate the findings, such as Morgan (2014), which highlights the challenges faced by leaders in the Fourth Industrial Revolution era due to rapid technological evolution and globalization, emphasizing the importance of leadership in managing dynamic business operations. Moreover, decision-making skills are crucial in leveraging data-driven insights to manage airline operations effectively (Murphy *et al*., 2019) and technological expertise in facilitating quality decision-making (Skilton & Hovsepian, 2018). Furthermore, agility and problem-solving skills are highlighted as essential traits for navigating operational complexities within the airline industry (Pineda, 2013), while effective collaboration among internal stakeholders is emphasized as imperative for success (Robinson, 2014). Additionally, insights into measuring leadership success based on positive outcomes and effective decision-making further underscore the multifaceted nature of effective leadership (Madanchian *et al*., 2017; Meraku, 2017).

Influence of Leadership Competencies on Leadership Success Mediated by Fourth Industrial Revolution Challenges

The study examines the influence of leadership competencies on leadership success mediated by Fourth Revolution challenges. Table 7 shows the estimates of each predictor variable in the Structured Equation Modeling (SEM). Given that all the *p-values* of each variable are small and less than 0.05, they are all significant predictor variables for leadership success.

Table 7
Effects of Leadership Competencies on Leadership Success

	t-value	*p*-value
LC→LS→SC	18.06	0.0001
LC→LS→IC	19.29	0.0001
LC→LS→CC	21.00	0.0001
LC→LS→WSC	17.56	0.0001
LC→LS→NOMC	18.05	0.0001

The analysis reveals significant positive effects of various Fourth Industrial Revolution (IR4.0) challenges, including skills, infrastructure, cybersecurity, work systems, and new operating model challenges, on leadership success. Each challenge exhibits a significant positive relationship with leadership success, as its estimated coefficients and associated *t*-values indicate. These findings suggest that leadership competencies are influenced by the challenges posed by IR4.0, indicating a potential mediating mechanism through which these challenges impact leadership success.

These findings corroborate previous studies (Robinson, 2014; Pineda, 2013; Slegel, 2013), emphasizing the importance of agility, problem-solving skills, effective collaboration, and adaptability in navigating organizational complexities and achieving leadership success amidst technological advancements and industry transformations.

Proposed Leadership Framework

The results reveal no significant differences between the levels of leadership competencies across the four age brackets and educational attainment. Given this insignificance, it is essential to consider professional development to adequately equip leaders in the airline industry with the necessary leadership skills, competencies, and knowledge.

Several challenges influence all the respondents in the airline industry. Because of this, establishing a training development program for a competitive advantage in the airline industry was considered, where the proposed framework could be implemented.

Figure 1 depicts the recommended leadership framework, which comprises four categories: professional development, digitalization and technology, leadership strategic planning, and competitive advantage.

Regarding professional development, various activities could enhance these aspects to ensure individual and professional growth. These activities included pursuing post-graduate education (both master's and doctorate degrees), improving other leadership competency skills such as communication and interpersonal skills, acquiring skill-based training, and bench-marking against other professionals to adapt various leadership practices.

On the other hand, digitalization and technology could be facilitated through a technological advancement program to ensure adaptability, resilience, and sustainability in the fourth industrial revolution, where e-services, online pursuits, and technology play a significant role.

The technological advancement program consists of creating virtual teams, establishing new power structures within the organization, and facilitating employee development on digital transformation within the organization. This program includes behavior coaching, upskilling lower-level employees, and assisting employees in technology-related areas.

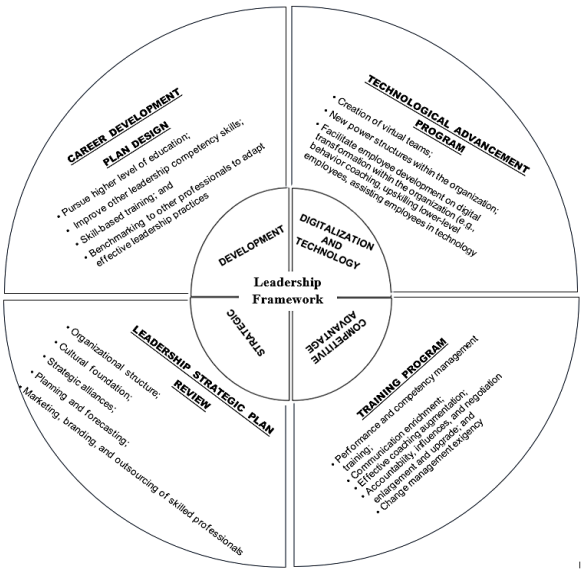

Figure 1. Leadership development framework

Competitive advantage is also considered crucial among the airline industries to excel and compete internationally. To achieve competitive advancement, a training program is realistically deemed essential. This program recognizes different activities, including performance and competency management training, communication enrichment, effective coaching augmentation, accountability, influences, negotiation enlargement and upgrade, and change management exigency.

Leadership strategic planning could be conducted to ensure that the airline industry is on the right track and enhance overall performance in all areas of the company. By reviewing leadership strategic plans, factors that has adverse effects on leadership success could be alleviated. This review covers organizational structure, cultural foundation, strategic alliances, planning and forecasting, marketing, branding, and the outsourcing of skilled professionals.

Conclusions and Implications

The study identifies a spectrum of leadership competencies crucial for navigating the challenges of the Fourth Industrial Revolution within the airline industry. While age and educational background do not significantly influence leadership competencies, gender, tenure, and positions demonstrated notable distinctions. Nonetheless, leadership success remains

consistent across various demographic characteristics, indicating the importance of competency development regardless of diversity. Notably, specific leadership competencies are found to directly impact challenges posed by the Fourth Industrial Revolution, emphasizing the need for tailored training programs and professional development initiatives. The mediation analysis highlights leadership competencies' positive and negative effects on addressing specific challenges, emphasizing the complexity of leadership dynamics in the face of technological disruptions. Moving forward, airlines must invest in targeted leadership development programs, anticipate evolving challenges, and continuously adapt strategies to foster resilience and sustainability in the ever-changing landscape of the Fourth Industrial Revolution.

Therefore, there is a clear need for ongoing evaluation of leadership success irrespective of demographic diversity to ensure alignment with organizational goals. Establishing comprehensive training programs and workshops to enhance leadership competencies, regardless of demographic differrences, is essential for navigating potential challenges and crises effectively. Additionally, exploring other factors influencing leadership success beyond the identified challenges could provide insights to strengthen organizational structures and performance. Embracing digitalization and designing new program models for leadership competency improvement is crucial to ensure adaptability to the Fourth Industrial Revolution's trends. Furthermore, categorizing leadership competencies based on the challenges faced by the airline industry would facilitate targeted interventions and mitigate uncertainties. Strategic planning, regular performance tracking, and proactive engagement in competency development are imperative for enhancing leadership success, competence, and sustainability within the industry.

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Appendix

Appendix A
Composition of Adapted Leadership Competencies Questionnaire

Leadership Competencies	Question Numbers	Source
Problem Solving	1–5	Grzybowska and Lupicka, 2017; Kumar *et al.,* 2019.
Intelligence	6–10	Mdhuli and Makhupe, 2018.
Work Enablement	11–15	Leurent and Shook, 2019; Oberrer and Erkollar, 2018.
Entrepreneurial Thinking	16–20	Osthuizen, 2017; Leurent and Shook, 2019.
Conflict Resolution	21–25	Grzybowska and Lupicka, 2017.
Digital	26–30	Schwab, 2016; Kelly, 2019.
Research	31–35	Grzybowska and Lupicka, 2017.
Socio-Cultural	36–40	Ieva, 2015; Grzybowska and Lupicka, 2017.
Creativity and Innovation	41–45	Grzybowska and Lupicka, 2017.
Ethical Competency	46–50	Philbeck *et al.*, 2018; Siciliano and Tamburrini, 2019.

Appendix B
Composition of Adapted Fourth Industrial Revolution Challenges Questionnaire

Fourth Industrial Revolution Challenges	Question Numbers	Source
Skills Challenge	1–5	Schwab, 2016; Ezell, 2017.
Infrastructure Challenge	6–10	Gubbi *et al*., 2013; Weyer *et al*., 2015; Schwab, 2016.
Cybersecurity Challenge	11–15	Schwab, 2016; Manda and Backhouse, 2016; Ezell, 2017.
Work Systems Challenge	16–20	Schwab, 2016; Ezell, 2017; Alongi, 2017; World Economic Forum, 2016.
Challenges for New Operating Models	21–25	Giles, 2015; Schwab, 2016; Lee and Wong, 2019.

Appendix C
Composition of Adapted Leadership Success Questionnaire

Leadership Success	Question Numbers	Source
Knowledge	1–5	Skilton and Hovsepian, 2018; Murphy *et al*., 2019.
Expertise	6–10	Murphy *et al*., 2019.
Agility	11–15	Pineda, 2013.
Problem-Solving	16–20	Slegel, 2013.
Collaborative Understanding and Skills	21–25	Robinson, 2014.