Leveraging Transdisciplinary Engineering in a Changing and Connected World
P. Koomsap et al. (Eds.)

doi:10.3233/ATDE230613

Group Dynamics and Air Traffic Controllers' Safety Behaviors: Self-Efficacy as a Mediator

Qingli LIU[a] , Su HAN[a], Fan LI[a,1] and Ching-Hung LEE[b]
[a]*Department of Aeronautical and Aviation Engineering, The Hong Kong Polytechnic University, 999077, Hong Kong Special Administrative Region, China*
[b]*School of Public Policy and Administration, Xi'an Jiaotong University, China*

Abstract. Air traffic controllers (ATCers) typically work under fixed team schedules, and the interaction of group members may significantly impact their behaviors. To understand the mechanism by which group characteristics affect the safety behaviors of individual ATCer, this study problematizes the variables of group dynamics and self-efficacy in this setting and proposes a mediation model in which group dynamics impact safety behaviors through self-efficacy. Data were collected using a self-reported questionnaire survey from 85 Chinese ATCers in two Air Traffic Administrations. The results revealed that the indirect effects of two subdimensions of group dynamics (group cohesion and group infectivity) on safety behaviors via self-efficacy were salient, whereas group pressure was not correlated with safety behaviors. This finding implied the partial mediation role of self-efficacy, which was expected to redress an omission in the influence path from group dynamics to safety behaviors from the cognitive mechanism perspective. The results can facilitate a better understanding of how group characteristics impact safety behaviors and also help develop efficient measures to reduce ATCers' safety performance at the group level.

Keywords. Self-efficacy, Group dynamics, ATCers, Safety behaviors, Mediator

Introduction

The year 2022 has seen a rapid recovery for most international routes, and air passenger demand is projected to strengthen in 2024, with an anticipated increase of 4% above pre-COVID-19 levels [1]. This poses a significant challenge for civil aviation personnel, particularly air traffic controllers (ATCers), who play a critical role in ensuring safe air travel. As one of the three major components of civil aviation employees, the primary duty of ATCers is to "prevent aircraft collisions, promote orderly air traffic, and provide flight alarm information" [2, 3]. Unsafe behaviors, such as mistakes in communication, non-standard land-air dialogue, forgetting flight dynamics, and violating gradient rise regulations, are the main factor leading to incidents among ATCers, accounting for 70% or more [4]. Therefore, enhancing ATCers' safety behaviors is considered a crucial determinant of aviation safety.

[1] Corresponding Author, Mail: fan-5.li@polyu.edu.hk.

Group factors are important contributors to safety behaviors. As individuals are typically part of one or more groups, they may behave differently in a group setting than when alone to adapt to the group environment [5]. Numerous studies have identified the significant impacts of group characteristics, such as group norms and group dynamics, on employees' behaviors[6-8]. Especially the group dynamics, which encompasses group cohesion (GC), group infectivity (GI), and group pressure (GP) [9], can explain the behavioral motivation of individuals in the group sufficiently. Separately, group cohesion is the force that encourages members to remain in the group [10]. Group infectivity is the inner driving force including important member's demonstration, fair reward and punishment mechanism, which can coordinate collective efforts to achieve a common group goal [11], while group pressure refers to the stress an employee feels when their opinion diverges from the majority of the group members [12]. Liu, et al [9], for example, conducted research targeting informal groups in construction sites and found that group cohesion positively related to workers' safety consciousness and safety participation behavior, which is consistent with other studies [13, 14]. Additionally, some studies have shown that demonstrations from important figures can trigger the spread of unsafe behaviors [15].

ATCers participants usually work in fixed teams, thus their behaviors may be affected by group traits. Certain group factors, such as leadership [16], safety climate [17], and supervisor support [4] for safety have been identified as crucial to their safety behaviors. However, existing research on the influence of groups on ATCers' safety performance has been limited to studying a single factor. A comprehensive perspective, such as understanding how the three subdimensions of group dynamics affect ATCers' safety practices, remains ambiguous. This has hindered the promotion of safety behavior at the group level. Additionally, there has been limited discussion on the underlying mechanism by which group dynamics affect safety performance. Social cognition theory suggests that individual behaviors are influenced by environmental factors and cognitive perception. Self-efficacy, an individual's belief in their ability to complete tasks and achieve goals at a certain level [18], is an important indicator of ATCers' safety performance [19]. To fill in the above gaps, this research proposes a new theoretical framework that considers the mediating role of self-efficacy between group dynamics and safety behaviors. The study has two objectives: first, to explore whether group dynamics affect the safety behaviors of ATCers; and second, to verify the mediating role of self-efficacy in the aforementioned relationship.

This study starts by reviewing related works that have addressed the relationship between group dynamics, self-efficacy, and safety behaviors. This is followed by a description of the data and methods used in the study. The results of the reliability and validity tests of the scales and the verification of the mediation role are then presented. Finally, the last section provides a discussion of the estimated results and research conclusions.

1 Literature Review

1.1 Group dynamics and safety behaviors

Since it was first proposed, group dynamics has been widely used in research on team performance, including sports teams, learning teams, and work teams [20-22]. Different meta-analyses have reported a positive association between group cohesion and

performance [23]. For instance, studies by Boone, et al. [20]and Chen, et al. [24] have demonstrated that group cohesion not only facilitates mutual trust and emotional connections among members but also decreases task conflict by clarifying members' role identity and responsibilities. As previously mentioned, group infectivity can motivate group members to devote their efforts to achieving common goals [11], which can lead to a corresponding improvement in individual performance. The higher the group infectivity among ATCers, such as through safe operation demonstrations by important figures, the greater the potential for individual learning of safe behavior and the consequent adoption of more safety practices. Regarding group pressure, it is widely accepted that this force leads members to adopt expected behaviors that align with group norms to eliminate tension and meet their needs for belonging and security[9]. The most direct negative effect of group pressure is conformity behavior among employees. Although few studies have explored the impact of group dynamics on ATCers' behavior, the authors speculate that group dynamics also influence ATCer safety behavior. Based on the above analysis, this research proposes the following hypothesis:

H1: Group dynamics have an impact on safety behaviors among ATCers, specifically:

H1a: Group cohesion has a positive impact on ATCers' safety behaviors.

H1b: Group infectivity has a positive impact on ATCers' safety behaviors.

H1c: Group pressure has a negative impact on ATCers' safety behaviors.

1.2. The mediation role between group dynamics and safety behaviors

The relationship between group dynamics and individual ATCer's safety behaviors may be mediated by self-efficacy. On the one hand, self-efficacy affects individual behavior through consciousness, motivation, cognition, and emotion [25], and extensive research has identified self-efficacy as a salient antecedent of work performance [26-28]. In the safety context, employees with higher safety self-efficacy exhibit a stronger willingness to learn new skills and a more serious safety attitude[29]. Ye, et al. [30], for example, reported that self-efficacy worked as a mediator in the relationships between three safety stressors (i.e., safety role ambiguity, safety role conflict, and interpersonal safety conflict) and safety performance. Furthermore, targeting the 239 commercial pilot participants, the research of Chen and Chen [26]indicated that self-efficacy has direct, positive effects on pilots' safety behaviors. On the contrary, employees with a low sense of self-efficacy may doubt their knowledge and abilities and thus are unlikely to voice their safety opinions or help colleagues with safety issues, resulting in lower safety performance[30]. Therefore, H2 can be put forward:

H2: Self-efficacy and ATCers' safety behaviors are positively related.

On the other hand, it can be concluded from the previous work that the three subdimensions of group dynamics influence self-efficacy by influencing any of the following factors: emotion, mastery experiences, alternative experiences provided by important figures, and organizational support [25]. Group cohesion is helpful in fostering a harmonious atmosphere and positive emotions among members, and group members also gain a greater sense of belonging and organizational support in a cohesive group, all of which enhance the extent of self-efficacy. As for group infectivity, some researchers have found that it encourages group members to search for and share information[31] and enhances group communication. Thus, in highly infectious groups, mastery or alternative experience of an important figure (such as the leader) will convince them of their capacities through social persuasion. However, the aforementioned group pressure

increases both the risk of negative emotions and the herd mentality, resulting in a decrease in group members' self-efficacy levels. Considering the characteristics of a heavy workload, high pressure, and extreme working environment for air traffic controllers[32], research conclusions from other industries cannot be directly applied to them. To verify the above relationship among ATCers, this study proposes the following hypotheses:

H3: Self-efficacy works as a mediator between group dynamics and ATCers' safety behaviors.

H3a: Self-efficacy works as a mediator between group cohesion and ATCers' safety behaviors.

H3b: Self-efficacy works as a mediator between group infectivity and ATCers' safety behaviors.

H3c: Self-efficacy works as a mediator between group pressure and ATCers' safety behaviors.

For the reader's benefit, Fig. 1 provides a graphical summary of the conceptual framework presented in this study.

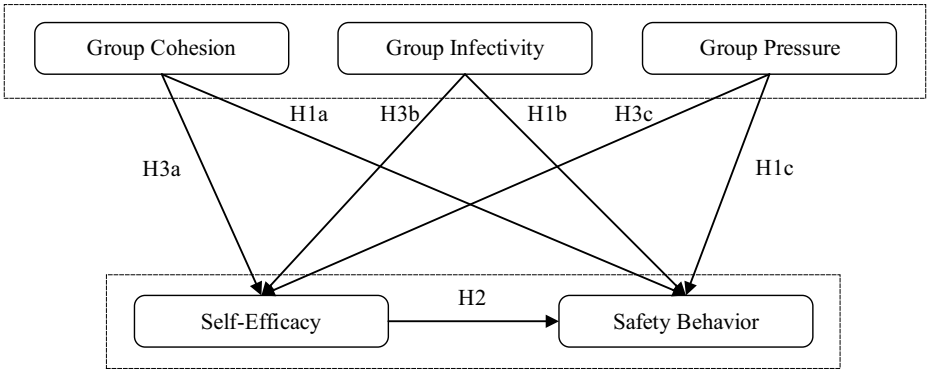

Figure 1. The conceptual framework.

2. Materials and methods

2.1. Participants and procedures

A self-reported questionnaire survey was used in this research to collect data. Targeting the frontline air traffic controllers, data were collected from two Air Traffic Administrations of Civil Aviation in China between January and February 2023. Respondents completed an anonymous questionnaire by clicking on online links sent to their mobile phones or email boxes. With a survey response rate of 96.6%, 85 valid responses were finally received after deleting questionnaires that were too short in response time. The participants were of both genders, with a quantitative dominance of men (65 men and 20 women), and a predominance of those aged 21–30 (64.7%). In addition, the largest proportion of the respondents had a bachelor's education (63.5%), and 1–3 years of working experience (30.6%) (see Table 1). The profile of the

respondents suggests that the data were collected from a diverse group of ATCers with a wide range of demographic characteristics.

Table 1. Profile of respondents.

Characteristics	Number	Percentage
Gender		
Male	65	76.5
Female	20	23.5
Age		
Under 20 years old	4	4.7
21-30 years old	55	64.7
31-40 years old	21	24.7
Over 41 years old	5	5.9
Seniority		
Less than 1 year	18	21.2
1-3 years	26	30.6
3-6years	14	16.5
6-9years	8	9.4
More than 9 years	19	22.3
Education Background		
Technical school or below	14	16.5
Bachelor's degree or below	54	63.5
Master's degree or above	17	20.0

2.2. Research tools

The formal questionnaire consisted of four parts: (1) personal characteristics, (2) items on group dynamics (including GC, GI, GP), (3) items on self-efficacy (SE), and (4) items on safety behavior (SB). Respondents were required to rate their responses using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), where the higher the score, the greater the corresponding dimension.

The three subdimensions of group dynamics (GC, GI, GP) were measured with five, three, and three items, respectively, adopted from Zaccaro and Lowe [33], Saunders, et al. [34], and Liu, et al. [9].

Concerning self-efficacy, it can be categorized into two types: general self-efficacy and specific self-efficacy. Researchers of the former believe that self-efficacy is not context-dependent [27] and can be gained through experience [28]. While the latter view self-efficacy as situational because different activity situations require different abilities. This research follows the latter concept and tends to measure the occupational self-efficacy of ATCers. The items used to test self-efficacy were designed to identify whether ATCers were confident in their ability to deal with daily working problems safely. Three items were developed using the occupational self-efficacy scale[35] and were also tailored to the occupational characteristics of ATCers.

In addition, the measurement of ATCers' safety behavior consisted of two dimensions: safety compliance and safety participation. As the scale of Neal and Griffin [36] is mature enough to measure the two dimensions of safety behavior, this research mainly refers to Neal and Griffin [36] and combines the characteristics of ATCers to finally form the measurement scale for safety participation. However, for the measure of safety compliance, participants always choose "strongly agree" when asked to what extent they agree with statements like "I always follow safe practices when I work." Inspired by the research of Schopf, et al. [16], we used items from the ATCers

competency framework to measure the level of safety compliance instead of the SC scale from Neal and Griffin [36]. The complete scale can be seen in Table 2.

Table 2. The scale of ATCers.

Dimension		Item	Source
Group Cohesion (GC)	GC1	I get along well with my colleagues	Zaccaro and Lowe [33]
	GC2	I like the team I work with	
	GC3	After work, some of my team members and I often get together	
	GC4	Some colleagues on the team are my good friends	
	GC5	The worker circle makes me feel a sense of belonging at work	
Group Pressure (GP)	GP1	I would worry about being isolated if I didn't follow the crowd	Saunders, et al. [34]
	GP2	I would worry about being considered a loner if I didn't follow the crowd	
	GP3	Following the practice of co-workers will make me feel safe	
Group Infectivity (GI)	GI1	My team has a strong safety atmosphere	Liu, et al. [9]
	GI2	The thoughts, values, and emotions of co-workers are influenced by each other	
	GI3	My leader is bold and confident at work	
Self-efficacy (SE)	SE1	I think I can deal with all the work problems	Liu and Huang [35]
	SE2	I think my work ability is at the forefront of the team	
	SE3	I think I have rich experience and will not make any operation that will cause flight accidents	
Safety Behavior (SB)	SC1	I always manage to arrive, depart, and/or en route traffic using prescribed procedures	Schopf, et al. [16]
	SC2	I always verify the accuracy of readbacks and correct them as necessary	
	SC3	I always follow prescribed procedures for communication and coordination of urgent situations.	
	SC4	I always coordinate the movement, control, and transfer of control for flights using the prescribed coordination procedures	
	SP1	I always assist others to make sure they perform their work safely	Neal and Griffin [36]
	SP2	I will put forward safety-related suggestions for work	
	SP3	I will express opinions on safety matters even if others disagree	
	SP4	I always pay attention to changes in safety policies and procedures	
	SP5	I always take the initiative to learn civil aviation flight safety knowledge	

3. Results

3.1. Reliability and validity test of the scale

In this study, Cronbach's α values were used to test the reliability of the questionnaire. As shown in Table 2, Cronbach's α for each dimension (range from 0.682-0.917) and the Cronbach'α for the overall questionnaire (0.947) can meet requirements as suggested (>0.65) [37]. It indicated an adequate level of construct reliability. Additionally, the convergent reliability of constructs was measured by AVE and CR using AMOS 28.0 software. The results in Table 3 showed that both AVE and CR were greater than the commended thresholds of 0.36 [38] and 0.7[39], respectively.

3.2. Testing for mediation

The GLM mediation model (jamovi; Version 2.3.21) was applied for model building. In this study, direct and indirect effects were calculated using a serial mediation model, with a significance level set to 0.01. The bootstrap method was used with 1000 repetitions to verify the statistical significance of the indirect effect (mediation effect) of self-efficacy in the relationship between group dynamics and safety behaviors. Table 4 showed that the direct effects of GC on SB(b=0.378, p<0.001), and GI on SB were significant (b=0.340, p=0.001), which supported H1a, H1b. Further, self-efficiency was significant in the relationship between GC and SB (b=0.243, p < 0.001) and the relationship between GI and SB (b=0.303, p < 0.001). Therefore, self-efficacy partially mediated the relationship between GC and SB and the relationship between GI and SB, respectively, which supported H3a and H3b. However, the total effect of GP on SB did not pass the significant test (P=0.169), and thus H1c and H3c were not supported.

Table 3. Mean of each variable and Cronbach's alpha, KMO, AVE, and CR of the scale.

Dimension	Mean	Cronbach'α	AVE	CR	Overall Cronbach'α	Overall KMO
GC(Group Cohesion)	3.772	0.891	0.6289	0.8938	0.944	0.897
GP(Group Pressure)	3.243	0.753	0.5396	0.7706		
GI(Group Infectivity)	3.718	0.713	0.4510	0.7094		
SB(Safety Behavior)	3.882	0.947	0.6728	0.9485		
SE(Self-efficacy)	3.620	0.877	0.7182	0.884		
Standard	-	>0.65	0.36	>0.7	>0.65	0.65

Table 4. Indirect and Total Effects.

				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	GC ⇒ CB ⇒ SB	0.243	0.061	0.132	0.360	0.264	4.010	**<.001**
	GP⇒ CB ⇒ SB	0.188	0.093	0.013	0.369	0.195	2.028	0.043
	GI ⇒ CB ⇒ SB	0.303	0.066	0.170	0.429	0.294	4.610	**<.001**
Component	GC ⇒ SE	0.544	0.095	0.372	0.726	0.529	5.750	**<.001**
	SE ⇒ SB	0.446	0.086	0.278	0.616	0.499	5.180	**<.001**
	GI ⇒ SE	0.634	0.102	0.416	0.835	0.549	6.230	**<.001**
	GP ⇒ SE	0.567	0.123	0.293	0.779	0.422	4.620	**<.001**
Direct	GC ⇒ SB	0.378	0.090	0.195	0.541	0.412	4.240	**<.001**
	GP ⇒ SB	-0.045	0.090	-0.222	0.123	-0.047	-0.500	0.617
	GI ⇒ SB	0.340	0.105	0.135	0.552	0.330	3.230	**0.001**
Total	GC ⇒ SB	0.621	0.074	0.476	0.766	0.676	8.401	**<.001**
	GP ⇒ SB	0.1427	0.104	-0.061	0.346	0.149	1.376	0.169
	GI ⇒ SB	0.644	0.088	0.472	0.816	0.624	7.330	**<.001**

Note.Confidence intervals computed with the method: Bootstrap percentiles

4. Discussion and conclusions

This study constructed a new theoretical framework to consider the relationship between group dynamics (i.e., group cohesion, group infectivity, and group pressure), self-efficacy, and safety behavior among air traffic controllers. The meditation role of self-efficacy played in the relationship between group dynamics and safety behavior was also examined. The results supported H1a, H1b, and H2 that group cohesion, group infectivity, and self-efficacy have significant positive impacts on employee safety behavior, while group pressure failed to meet the hypothesis test(H1c, H3c were not supported). The possible reason is that group pressure acts as a double-edged sword for the safety behaviors of ATCers. It's conceivable that group pressure has a negative impact on ATCers' safety behaviors. In other words, the group pressure will prevent members from engaging in risky behaviors if group norms are consistent with the group's safety goal. Otherwise, it will damage safety behavior according to the imitations of unsafe behaviors. Furthermore, the findings supported the partial mediating role of self-efficacy in the relationship between group cohesion and safety behavior, as well as in the relationship between group infectivity and safety behavior. This indicates that group cohesion and group infectivity affect the safety behavior of air traffic controllers by influencing the level of self-efficacy.

This study is a combination of multiple disciplines including aviation safety, cognitive psychology, organizational behavior, etc. The findings of this research enrich the knowledge of ATCers' group dynamics and self-efficacy to a certain extent. Firstly, this research contributes to the literature on aviation safety by providing empirical evidence for the impact of three elements of group dynamics on safety performance among ATCers. Future research can build on these findings by exploring the impact of other factors on safety behaviors among air traffic controllers and other high-risk industries. Secondly, the mediation function of self-efficacy aids in understanding the process by which personal safety behaviors are formed and helps to correct the omission in the impact route from group dynamics to safety behaviors.

Moreover, several practical implications for occupational safety management in ATCers settings are provided. As mentioned, every person has a sense of belonging to a group and does not want to be rejected by the group. To adapt to the group environment, the individual will behave differently in the group than staying alone. Thus, it is easier to change individuals' behaviors from the group than to change individuals directly. For instance, safety managers should pay attention to creating an atmosphere of interpersonal harmony within the ATCer group, such as targeted safety training and increasing the reward for safety demonstration workers, since group cohesion and group infectivity are positively correlated with safety behaviors.

However, this study has limitations due to the scarcity of participants. Although the sample size in this paper meets the requirement of statistical tests, the sample size was small. In future studies, attempts will be made to use larger datasets to improve the accuracy of the study results.

References

[1] I.C.A. Organization, Latest News and Highlights Accessed:10-3-2023, https://www.icao.int/Newsroom/Pages/default.aspx

[2] Å. Ek, M. Arvidsson, Enabler for safety improvements in air traffic control, *Aviation Psychology and Applied Human Factors*, 2012, Vol. 2:2, pp. 82-94.
[3] D. Xue, L.-T. Hsu, C.-L. Wu, et al., Cooperative surveillance systems and digital-technology enabler for a real-time standard terminal arrival schedule displacement, *Advanced Engineering Informatics*, 2021, Vol. 50, 101402.
[4] K. Read, R. Charles, Understanding teamwork errors in royal air force air traffic control, *Safety Science*, 2018, Vol. 109, pp. 36-45.
[5] E. Mayo, *The Human Problems of an Industrial Civilization*, Routledge, Abingdon, 2003.
[6] L. Zhang, Q. Liu, X. Wu, et al., Perceiving interactions on construction safety behaviors: Workers' perspective, *Journal of Management in Engineering*, 2016, Vol. 32.5, 04016012.
[7] L. P. Andersen, I. L. Karlsen, P. Kines, et al., Social identity in the construction industry: implications for safety perception and behaviour, *Construction management and economics*, 2015, Vol. 33.8, pp. 640-52.
[8] B. Choi, S. Ahn, S. Lee, Role of social norms and social identifications in safety behavior of construction workers. I: Theoretical model of safety behavior under social influence, *Journal of construction engineering and management*, 2017, Vol. 143.5, 04016124.
[9] S.-x. Liu, Y.-q. Zhu, Q. Chen, et al., Research on the influencing factors of grassroots employees' safety behavior from the perspective of informal groups in workplace, *Safety Science*, 2023, Vol. 158, 105959.
[10] L. Festinger, Informal social communication, *Psychological review*, 1950, Vol. 57.5, 271.
[11] G. Park, M. Spitzmuller, R. P. Deshon, Advancing our understanding of team motivation: Integrating conceptual approaches and content areas, *Journal of Management*, 2013, Vol. 39.5, pp. 1339-79.
[12] R. K. Nováková, S. Vávrová, Self-regulation of behaviour in the context of peer pressure and risk behaviour, *Procedia-Social and Behavioral Sciences*, 2015, Vol. 171, pp. 158-65.
[13] L. L. Wang, Q. G. Cao, C. G. Han, et al., Group dynamics analysis and the correction of coal miners' unsafe behaviors, *Archives of Environmental & Occupational Health*, 2021, Vol. 76.4, pp. 188-209.
[14] H. Jiang, J. P. Wang, Y. Han, et al., Structural Equation Model Analysis of Factors in the Spread of Unsafe Behavior among Construction Workers, *Information*, 2018, 9(2), 39.
[15] Y. Han, Q. Mei, D. Zhou, et al., Propagation characteristics of unsafe behaviors for construction workers from the perspective of group closeness, *J Saf Sci Technol*, 2016, Vol. 12, pp. 187-92.
[16] A. K. Schopf, J. Stouten, W. B. Schaufeli, The role of leadership in air traffic safety employees' safety behavior, *Safety Science*, 2021, Vol. 135, 105118.
[17] K. Bergheim, J. Eid, S. W. Hystad, et al., The Role of Psychological Capital in Perception of Safety Climate Among Air Traffic Controllers, *Journal of Leadership & Organizational Studies*, 2013, Vol. 20.2, pp. 232-41.
[18] A. Bandura, W. H. Freeman, R. Lightsey, Self-Efficacy: The Exercise of Control, *Journal of Cognitive Psychotherapy*, 1997, Vol. 13(2), DOI: 10.1891/0889-8391.13.2.158.
[19] M. Makara-Studzinska, M. Zaluski, P. Jagielski, et al., An Exploration of Perceived Stress, Burnout Syndrome, and Self-Efficacy in a Group of Polish Air Traffic Controllers and Maritime Navigators: Similarities and Differences, *International Journal of Environmental Research and Public Health*, 2021, 18.1, 53.
[20] K. S. Boone, P. Beitel, J. S. Kuhlman, The effects of the win/loss record on cohesion, *Journal of Sport Behavior*, 1997, Vol. 20.2, 125.
[21] G. Bosselut, J.-P. Heuzé, O. Castro, et al., Using Exploratory Structure Equation Modeling to validate a new measure of cohesion in the university classroom setting: The University Group Environment Questionnaire (UGEQ), *International Journal of Educational Research*, 2018, Vol. 89, pp. 1-9.
[22] S. A. Carless, C. De Paola, The measurement of cohesion in work teams, *Small group research*, 2000, Vol. 31.1, pp. 71-88.
[23] D. J. Beal, R. R. Cohen, M. J. Burke, et al., Cohesion and performance in groups: a meta-analytic clarification of construct relations, *Journal of applied psychology*, 2003, Vol. 88.6, 989-1004.
[24] J. Chen, W. Y. Lim, B. C. Tan, et al., The role of functional diversity, collective team identification, and task cohesion in influencing innovation speed: Evidence from software development teams, *Journal of Global Information Management (JGIM)*, 2018, Vol. 26.2, pp. 163-92.
[25] A. Bandura, Self-Efficacy: Toward a Unifying Theory of Behavioral Change, *Psychological Review*, 1977, Vol. 84.2, pp. 191-215.
[26] C.-F. Chen, S.-C. Chen, Measuring the effects of Safety Management System practices, morality leadership and self-efficacy on pilots' safety behaviors: Safety motivation as a mediator, *Safety science*, 2014, Vol. 62, pp. 376-85.

[27] B.-J. Kim, S.-Y. Jung, The mediating role of job strain in the transformational leadership–safety behavior link: The buffering effect of self-efficacy on safety, *International journal of environmental research and public health*, 2019, Vol. 16.8, 1425.

[28] D. K. Adjekum, An evaluation of the relationships between collegiate aviation safety management system initiative, self-efficacy, transformational safety leadership and safety behavior mediated by safety motivation, *International Journal of Aviation, Aeronautics, and Aerospace*, 2017, Vol. 4.2, 1169.

[29] A. A. Chughtai, Creating safer workplaces: The role of ethical leadership, *Safety Science*, 2015, Vol. 73, pp. 92-8.

[30] G. Ye, Q. Xiang, L. Yang, et al., Safety Stressors and Construction Workers' Safety Performance: The Mediating Role of Ego Depletion and Self-Efficacy, *Frontiers in Psychology*, 2022, Vol. 12, 818955.

[31] J. F. Super, P. Li, G. Ishqaidef, et al., Group rewards, group composition and information sharing: A motivated information processing perspective, *Organizational Behavior and Human Decision Processes*, 2016, Vol. 134, pp. 31-44.

[32] E. Öge, M. Çetin, S. Top, The effects of paternalistic leadership on workplace loneliness, work family conflict and work engagement among air traffic controllers in Turkey, *Journal of Air Transport Management*, 2018, Vol. 66, pp. 25-35.

[33] S. J. Zaccaro, C. A. Lowe, Cohesiveness and Performance on an Additive Task - Evidence for Multidimensionality, *Journal of Social Psychology*, 1988, Vol. 128.4, pp. 547-58.

[34] L. W. Saunders, B. M. Kleiner, A. P. Mccoy, et al., Developing an inter-organizational safety climate instrument for the construction industry, *Safety Science*, 2017, Vol. 98, pp. 17-24.

[35] E. Liu, J. T. Huang, Occupational self-efficacy, organizational commitment, and work engagement, *Social Behavior and Personality*, 2019, 47.8, pp. 1-7.

[36] A. Neal, M. A. Griffin, A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels, *Journal of Applied Psychology*, 2006, Vol. 91.4, pp. 946-53.

[37] D. Perry Hinton, P. R. Hinton, I. Mcmurray, et al. *SPSS explained*, Routledge, London, 2004.

[38] C. Fornell, D. F. Larcker, Structural Equation Models with Unobservable Variables and Measurement Error - Algebra and Statistics, *Journal of Marketing Research*, 1981, Vol. 18.3, pp. 382-8.

[39] J. F. Hair, Multivariate data analysis: An overview, *International encyclopedia of statistical science*, 2011, pp. 904-7.