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RESEARCH ARTICLE

Linking Implementation of Public Policy and Pilot Airmanship to Flight Safety in Indonesia: A Structural Equation Model

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Abstract:

Background:

Although the flight accident rate in Indonesia has declined, several accidents still occur every year. In Indonesia, there are several major factors that can affect flight accidents, such as human error, policy aspect, limited facilities, and technological factors.

Aims:

The present study examines the relationship between the implementation of public policy and pilots' airmanship and flight safety in Indonesia.

Methods:

Questionnaires with 171 questions about airmanship, flight safety, and public policy were distributed to 270 randomly selected Indonesian commercial pilots. A structural equation model was used to test the hypothesis model concerning the implementation of public policy, pilots' airmanship, and flight safety.

Results:

The empirical results strongly support the hypothesis that there is a significant relationship between behavior, emotional intelligence, and selfs-efficacy, and airmanship; a significant relationship between pilots' airmanship and the implementation of public policies; and a significant relationship between the implementation of public policy and aviation safety.

Keyword: Public policy, Airmanship, Flight safety, Structural equation model, Flight accidents, Technological factors.

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1. INTRODUCTION

The transportation sector is a public sector, which depends tremendously on the implementation of public policy to achieve best practice, especially in air transportation. Nowadays, air transportation service demands rapid growth based on passenger requirements, whereas, this condition results in the implementation of public policy related to aviation in order to enhance flight safety.

Based on the Indonesia Statistics Agency's 2017 report, the number of airline passengers has risen to 9.8% from 2016 to 2017, and an increase of 128 million passengers has been recorded during 2017. This rapid growth leads to the expected logical consequence where more frequent flights may increase the probability of accidents. A single or stand-alone factor never causes an accident. There is usually a combination of multiple factors that lead to an accident. These factors that may cause accidents include human factors, the airplane (machine), the environment, the use of aircraft (mission), and the management.

Airmanship is a pilot's skill in flying aircraft, and it should be an integral part of every pilot's training. According to Craig 2000 [1], flight accidents have a close relationship with low airmanship. Similarly, Kern 1997 [2] explains that airmanship consists of six properties, namely situational assessment, situational awareness, knowledge, expertise, ability, and discipline. Regarding the nature of airmanship, this study compiled the hypothesis that airmanship affects the implementation of public policies related to aviation.

In order to consider the relationship between airmanship and public policy, it is essential to identify in advance the definition of airmanship. So, to begin, we must define airmanship as the skills, values, and attitudes that a pilot must

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have in order to carry out the duties and functions of a pilot as well as to achieve flight safety. In this regard, the main link between airmanship and public policy is the achievement of flight safety.

In accordance to flight safety and the factors stated earlier, many scientists have studied aspects of flight safety, such as safety culture [3 - 5], flight attendant safety performance [3, 6 - 7], pilot error [6 - 9], pilot age [8], pilot fatigue [10], influence of pre-flight briefings [11], and weather [12]. Moreover, Alsowayigh's present research contributed to the current state of knowledge and is about the significant role of safety culture as the main predictor of safety performance in civil aviation [13]. In previous studies, flight safety has been evaluated based on both its direct and indirect relationship with the pilot's performance.

This study examines the impact of the relationship between the airmanship of the pilot (overall pilot performance) and the implementation of public policies on flight safety. This study is the first of its kind in this field. Moreover, there are several other aspects to be reviewed in the aviation world, especially in Indonesia, which include the value of airmanship and the implementation of public policies. The purpose of this study is to determine the relationship between behavior, emotional intelligence, and self-efficacy and airmanship; the relationship between airmanship and the implementation of public policy; and the relationship between the implementation of public policy and flight safety. The results of this study will be beneficial for Indonesia's policymakers as the basis for formulating policies to increase aspects of flight safety in Indonesia.

Based on the literature review, the relationship between the pilot's airmanship and the implementation of public policies about flight safety can be summarized into three testable hypotheses, which are listed below:

Hypothesis 1: A positive relationship exists between behavior, emotional intelligence, and self-efficacy and pilots' airmanship.

Hypothesis 2: A positive relationship exists between pilots' airmanship and the implementation of public policies.

Hypothesis 3: A positive relationship exists between the implementation of public policy and aviation safety.

2. METHODOLOGY

2.1. Procedure and Participants

This study collected primary data by developing questionnaires and targeting Indonesian commercial pilots. The research location was the Aviation Health Centre, Special Capital Region of Jakarta. The Aviation Health Centre is obliged to issue a health certificate for aircrew. The certificate is a mandatory document for obtaining a flying license. This institution is responsible for conducting health check for all aircrew, with an average of 40 aircrew members per day. A total of 270 pilots who had taken the health assessment in the Aviation Health Centre were chosen randomly as samples from 35 Indonesia Airline Companies. In the study, 40% of the respondents were younger than 30 years old, 44% were between 30 and 50 years old, and 16% were older than 50 years old. Co-pilots and first officers represent about 50% of the study. This demographics shows that the respondents were well targeted, in accordance with the definition by Kern (1997) that airmanship starts at the earliest stage (co-pilot represents the earliest stage of respondents). Moreover, 45% respondents were pilots who had an average of fewer than six years' experience as commercial airline pilots. The experience gained from the learning process, which used to be related to flying hours, could give the pilot an advantage in detecting errors, mistakes, and understanding the causes of the errors.

2.2. Measured Variable

The measured variable is defined by the theory of airmanship, public policy, and flight safety (Fig **1**). Kern explains the theory of airmanship based on the two aspects of pilot performance (*i.e*. behavior, emotional intelligence, and self-efficacy) and pilot airmanship (*i.e*. knowledge, coordination decision making, understands the environment, and recognising risks) [2]. This study used those seven parameters to analyze the level of airmanship for each pilot. While referring to several theories [14 - 17] in relation to public policy, this study uses public policy to define the four aspects of the policy: 1) formulation, 2) implementation, 3) monitoring, and 4) evaluation. Thus, for aspects of flight safety, this study refers to the Indonesia Law No. 1/2009 on Aviation [18]. Each variable used as an input and relation for the SEM model is described as follows.

2.2.1. Behavior (X1)

In this study, habit is defined as the daily activities during the flight. This variable scale is based on four indicators. First is habit (X11), the pilot's activity during the spare time when flying and how the pilot blends in with their colleagues during the flight. Second is response or reaction (X12), described as the ability of the pilot to deal with any possibilities that occur during the flight due to external factors or the environment. The third is stimulus (X13), the pilot's actions when there is a disturbance during the flight. Last is attitude (X14), or the outlook of the pilot when facing an unusual incident.

2.2.2. Emotional Intelligence (X2)

Emotional Intelligence defines the ability of an individual to control their emotions and their ability to respond to others' emotions empathetically. There are four indicators used to measure this variable. First is emotion management (X21), or a person's ability to control and manage their emotions. Second is self-motivation (X22), or the ability to improve self-performance and willingness to sacrifice for the achievement of organisational goals. The third is relationships (X23), the ability to develop social connections with friends or colleagues, to manage the relationship, and to build a network with others. Last is adaptation (X24), or the ability to overcome the pressure and changes that occur depending on the demands of the workplace.

2.2.3. Self-efficacy (X3)

Self-efficacy is defined as an individual's ability to achieve goals through difficult tasks in various circumstances in addition to their ability to think positively. There are four indicators used to measure this variable. First is experience (X31), or the pilot's total number of flying hours. Second is

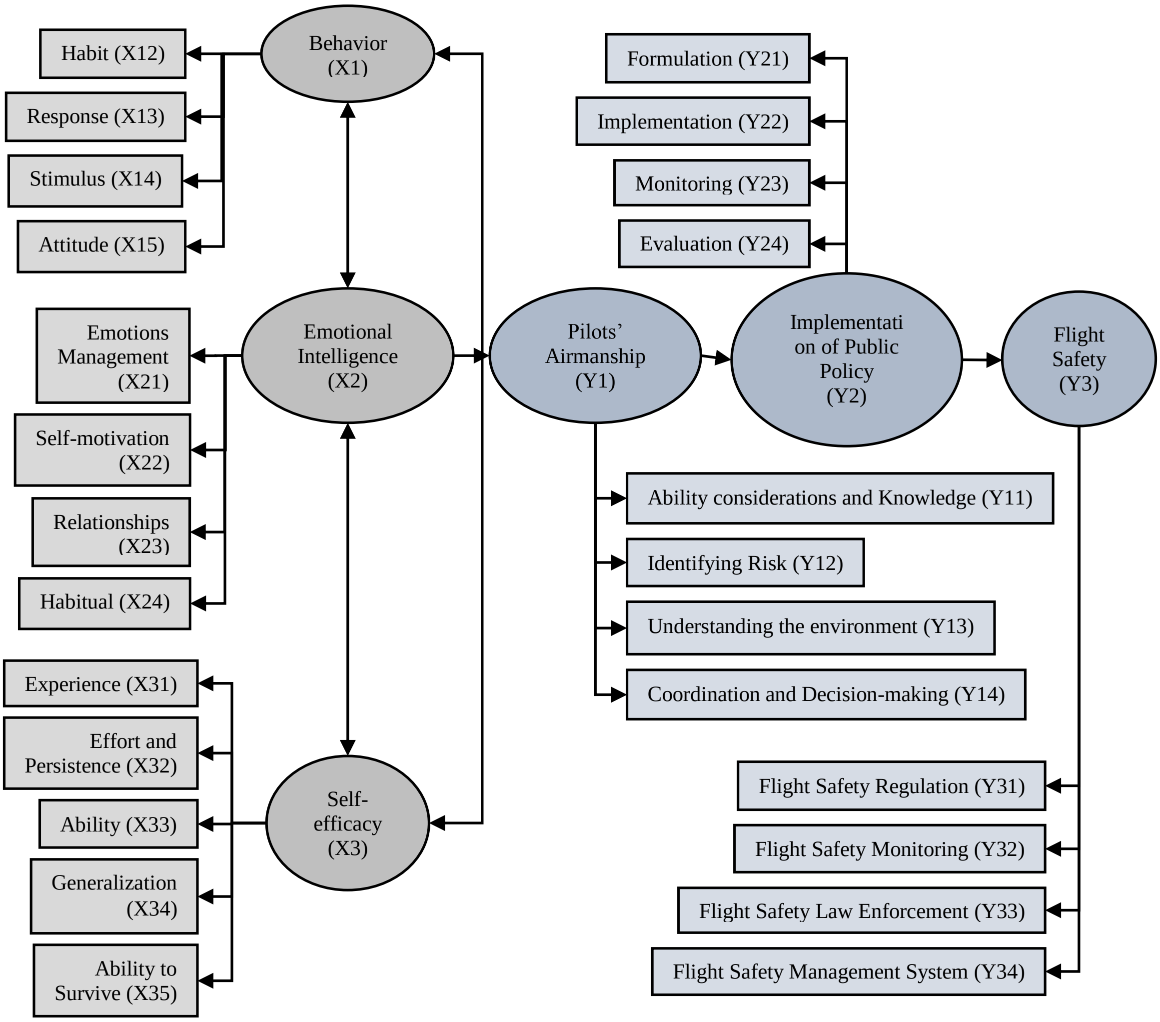

Fig. (1). The concept of this study based on a Structural Equation model.

persistence (X32), interpreted as a person's ability to control their own mind. Third is ability (X33), measured as the ability of a person in solving a problem. Fourth is generalization (X34), interpreted as an ability that is not directly related to one's profession. For example, a pilot who can sing is versatile and has good generalization. Five is strength (X35), which can be defined as endurance and ability to find ways to deal with difficult situations. The ability to survive is related to a healthy mental state and soul.

2.2.4. Pilots' Airmanship (Y1)

Pilots' airmanship is a model or framework for classifying skills that cover a broad range of behaviors and abilities desirable in an aviator. There are four indicators used to measure this variable. First is the pilot's consideration and knowledge (Y11) to operate the aircraft by rules and procedures, resulting in the optimal safety and efficiency of aviation operations. Second is the pilot's coordination and decision making (Y12), coordination being an action carried out by a person to exchange information, organize, and manage the role of each person in executing the task. Decision-making is the ability to pick the best decision available. Both of these capabilities must be imbued within the pilot in order for them to always achieve the goals they have declared. The third indicator is understanding the environment (Y13), meaning a pilot's understanding of the phenomena that occur in the environment such as weather, community circumstances, and other aviation supporters. Last is recognizing risks (Y14), the pilot's ability to recognize risks that jeopardize flight safety. If there are problems during the flight, such as severe weather, then there are risks to be considered when choosing an alternative airport or making a forced landing in existing conditions.

2.2.5. Implementation of Public Policy (Y2)

Policies are all rules that authorities have been determined which the public must obey (14). While implementation is the application of policy, Grindle 2017 [19] explained that the success of policy implementation depends on the formulation or content of the policy. Based on theory and past publications [15, 17, 19 - 21], a public policy indicator is the same as an implementation indicator. Based on these explanations, there

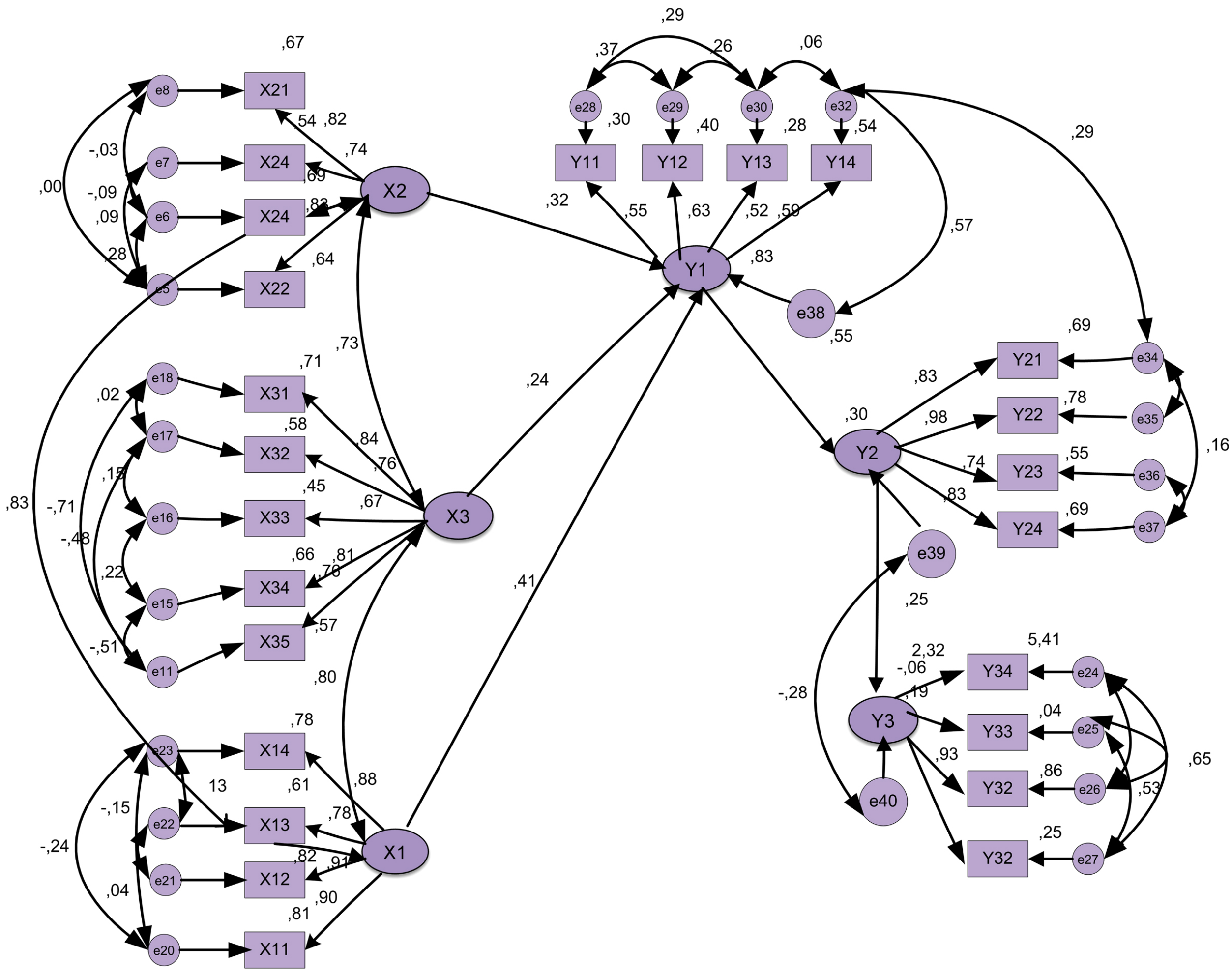

Fig. (2). Structural Equation model.

are four indicators used to measure the implementation of public policy, as follows. First is policy formulation (Y21), defined as the policy design that is based on data and the demand of the community and authorities. The second is the implementation of policies (Y22), defined as applied policies. Third is policy monitoring (Y23), defined as the process of supervision of the parties who carry out the rules through established procedures. Last is evaluation (Y24), defined as the correction and refinement for the implementation of the policy based on the analysis and opinions of experts and practitioners to avoid errors in future regulations.

2.2.6. Flight Safety (Y3)

Aviation safety is the process of activities involved in carrying out flight operations safely from departure to destination. This variable is measured by five indicators based on Indonesia Law No. 1/2009 on Aviation. First is the Aviation Safety Regulations (Y31), defined as the flight policy created by related parties to establish flight safety. Second is aviation safety supervision (Y32), which is defined as an activity or follow-up to safeguard violation against the standard operation of a flight that has been determined by the related party. The third is the enforcement of aviation safety law (Y33), defined as an action to sanction violations of the rules that have been decided. Last is the aviation safety management system (Y34), defined as the system that regulates and manages flights using existing rules.

2.3. Analysis

The questionnaire data was analyzed using a Structural Equation Model (SEM). In general, a Structural Equation Model is defined as "statistical techniques that seek to represent hypotheses about the means, variances, and covariance of observed data or relation between independent variables versus dependent variables in terms of a smaller number of structural parameters defined by a hypothesized underlying model" [22 - 24]. The SEM concept that builds support for our hypotheses is shown in Fig (**1**). The SEM has been executed on AMOS, an SPSS module.

The variable in the SEM technique is called a construct or latent variable (a variable which cannot be measured directly) and the indicator is an observed variable (the operational measurement of the latent variable). After the arrangement of variables and indicators are expressed in the model, the SEM is used to process validity and reliability tests. Validity and reliability tests were performed using Confirmatory Factor Analysis (CFA) on each latent variable, which include Behavior, Emotional Intelligence, Self-Efficacy, Airmanship, Implementation of Public Policy, and Aviation Safety.

Since the SEM had a unidimensional structure, the Root Means Squared Error of Approximation (RMSEA), Goodness of Fit Indices (GFI), Tucker Lewis Index (TLI), and chi-square (X^2/df) test were used as model evaluation criteria. Referring to Schreiber (2006), the limit value that shows the model acceptance of these indexes is as follows: $X^2/df \leq 3$; $0.8 \leq$ RMSEA ≥ 0.6; TLI and CFI ≥ 0.95.

3. RESULTS

3.1. Data Normality

In order to perform the next step of the SEM model, the data (univariate or multivariate) should pass the distribution test. Data was assumed to be in a normal distribution if the critical ration of skewness or kurtosis values was less than ± 2,58. The result of the tested dataset showed a normal distribution, detailed below in Table **1**.

3.2. Confirmatory Factor Analysis: Validity and reliability test

The validity and reliability tests were carried out using confirmatory factor analysis on each of the latent variables, namely Behavior, Emotional Intelligence, Self-Efficacy, Airmanship, Implementation of Public Policy, and Flight Safety, using the AMOS 5 program. Table **2** shows the calculation of CFA for each measured variable. The standardized loading shows a significant value in the range of 0.59 – 0.93, higher than the minimum value (0.5). However, the error value for most of the indicator variables shows less error (0.14 – 0.55), except for Coordination-decision-making (Y14), Monitoring (Y32), and Management-system (Y34), which show 0.6, 0.64, and 0.6 for error, respectively. Overall, the standardized loading factor and R value for each main variable show good agreement. This result indicates that the data was valid and reliable enough to use in the SEM.

3.3. Structural Equation Model

The results also showed that the structure of the model has been "fit" (X^2 = 633,076***, df = 241, X2/df = 2.627, RMSEA = 0.057, TLI = 0.987, CFI = 0.994), producing a relatively good suitability index. All the estimated parameters were statistically significant ($p < 0.001$) and showed the expected sign, supporting the hypotheses. The SEM path that represents the relation between the measured parameters is shown in Fig (**2**), described as follows. First, Behavior (X1), Emotional Intelligence (X2), and Self-efficacy (X3) have a positive effect on Airmanship (Y1), which gained significant support, shown by regression coefficients of 0.410, 0.240, and 0.324 respectively (Hypothesis 1). Second, Airmanship (Y1) has a positive influence on the Implementation of Public Policies (Y2) and gained significant support, shown by a regression coefficient of 0.548 (Hypothesis 2). Third, Implementation of Public Policies (Y2) has a positive effect on Aviation Safety (Y3), shown by a regression coefficient of 0.250 (Hypothesis 3).

Table 1. Assessment of Normality.

Variable	Min	Max	Skew	c.r.	kurtosis	c.r.
Y21	1,000	4,000	,057	,380	,305	1,023
Y22	1,000	4,000	,221	1,484	1,038	3,482
Y23	1,000	3,000	-,519	-3,480	-,192	-,644
Y24	1,000	4,000	,179	1,200	1,185	3,975
Y11	1,000	3,000	-,305	-2,049	,124	,416
Y12	1,000	4,000	,234	1,568	1,465	4,914
Y13	1,000	4,000	,238	1,599	2,653	8,899
Y14	1,000	4,000	,493	3,305	2,546	8,541
Y31	1,000	4,000	-,295	-1,977	,453	1,521
Y32	1,000	4,000	-,287	-1,928	,179	,601
Y33	1,000	4,000	-,209	-1,402	,206	,690
Y34	1,000	4,000	-,326	-2,187	,946	3,174
X31	1,000	2,000	-,254	-1,703	-1,936	-6,492
X32	1,000	3,000	-,092	-,620	-1,772	-5,944
X33	1,000	3,000	-,250	-1,677	-1,508	-5,058
X34	1,000	2,000	-,059	-,398	-1,996	-6,696
X21	1,000	2,000	-1,077	-7,224	-,840	-2,819
X22	1,000	3,000	-,763	-5,118	-1,115	-3,739
X23	1,000	3,000	-,894	-5,997	-,864	-2,899
X24	1,000	2,000	-1,166	-7,823	-,640	-2,147
X25	1,000	3,000	-1,124	-7,543	,105	,351
X11	1,000	4,000	-,107	-,717	,293	,982
X12	1,000	4,000	-,418	-2,803	,987	3,312

(Table 1) contd.....

Variable	Min	Max	Skew	c.r.	kurtosis	c.r.
X13	1,000	3,000	-,480	-3,217	,086	,288
X14	1,000	4,000	-,175	-1,172	,492	1,652

Table 2. Confirmatory factor for each variable. Validity measured by standardized loading (valid if ∂ > 0.5); The reliability was measured by error and coefficient of determination (reliable if Error < 0.6 and R > 0.6).

Main Indicator	Indicator Variable	Std. loading /est. (∂)		Error (e=1-	R
Behaviour (X1)	Habit (X11)	0,93	0,86	0,13	0,92
	Response (X12)	0,88	0,77	0,22	
	Stimulus (X13)	0,79	0,62	0,37	
	Attitude (X14)	0,89	0,79	0,20	
Emotional Intelligent (X2)	Emotions Management (X21)	0,78	0,60	0,39	0,88
	Self-motivation (X22)	0,87	0,75	0,24	
	Relationships (X23)	0,86	0,73	0,26	
	Habitual (X24)	0,71	0,50	0,49	
Self-efficacy (X3)	Experience (X31)	0,64	0,40	0,59	0,88
	Effort-Persistence (X32)	0,84	0,70	0,29	
	Ability (X33)	0,78	0,60	0,39	
	Generalization (X34)	0,80	0,64	0,36	
	Ability-survive (X35)	0,82	0,67	0,32	
Pilots' Airmanship (Y1)	Ability-consideration-knowledge (Y11)	0,74	0,54	0,45	0,79
	Identifying-risk (Y12)	0,79	0,62	0,37	
	Understanding-environment (Y13)	0,67	0,44	0,55	
	Coordination-decision-making (Y14)	0,62	0,38	0,61	
Implement-ation of Public Policy (Y2)	Formulation (Y21)	0,89	0,79	0,20	0,92
	Implementation (Y22)	0,90	0,81	0,19	
	Monitoring (Y23)	0,79	0,62	0,37	
	Evaluation (Y24)	0,89	0,79	0,20	
Flight Safety (Y3)	Regulation (Y31)	0,73	0,53	0,46	0,75
	Monitoring (Y32)	0,60	0,36	0,64	
	Law-enforcement (Y33)	0,72	0,51	0,48	
	Management-system (Y34)	0,59	0,34	0,65	

4. DISCUSSION

From this study, it can be seen that the relationship between Airmanship and Public Policy is meant to achieve flight safety. A pilot's personal airmanship development is an essential part of eliminating flight accidents. A Personal Airmanship Development Plan shall lead to airmanship excellence (called airmanship 2.0, whereas pilots' current airmanship is called as airmanship 1.0). Airmanship 1.0 is characterized differently by each pilot and has become a sophisticated understanding applied differently by each pilot based on their understanding. The Personal Airmanship Development Plan that every pilot shall practice will result in the development of Airmanship 2.0, which maintains elements like airmanship challenges that motivate the pilot to fly more often by providing exciting and airmanship developing aeronautical challenges. In addition, the practice of Airmanship 2.0 requires pilots to fly often enough to maintain the proficiency required for safe flying. The social aspects related to membership in an Airmanship 2.0 culture would also significantly add to pilots' enjoyment of personal flying. The rewards and recognition are an integral part of the culture and meaningfully enhance an airman's overall enjoyment of flying.

Airmanship 2.0 also notably increases the value for money established by Airmanship 1.0. The overall costs of practicing Airmanship 2.0 can be even lower than those incurred in Airmanship 1.0. However, even if costs are higher in specific cases, the value received through utility, enjoyment, and safety make it worthwhile. Airmanship 2.0 continuously enhances airmanship skills, knowledge, and capabilities. Furthermore, it ensures a way for pilots to become safer, more-proficient aviators.

Moreover, based on the views of experts, policy formation and public policy implementation have been very closely linked - implementation regarded as the provision of means to conduct a policy and can cause certain impacts/consequences. Implementation can be interpreted as action prepared after a defined policy to establish how to achieve that policy's goal. Without implementation, a policy would not be able to achieve its intended results, and a different interpretation of its goal may occur.

The theory of public policy implementation is inseparable from public policy theory. Policy was defined as anything that can or cannot be done by Dye in 1987 [25], and a policy can also be considered a government's relationship with its environmental community [14]. In this study, policy can be measured by indicators of its formulation and implementation. The results show that these two categories of indicators have a significant relationship with the implementation of public policy. The next analysis is the link between the results of this study and the theory of public policy implementation according to Smith and Larimer (2009) [16]. Their theory stated that policy implementation is a process or plot. Smith's concept views the policy implementation process from the perspective of social and political change, where policies made by the government aim to make improvements or changes in the community as the target group. Moreover, the theory shows that the three indicators have a significant relationship with the implementation of public policy. Based on the results of the above analysis, the researcher suggests that the results of this study are similar and support Smith's theory of public policy implementation [16].

In summary, the relationship between public policy and airmanship can be explained as follows. Public policy to achieve aviation safety, which is issued either by the regulator or operators, is proposed in general. Public policy, although it is not directly related to the Pilot, shall be understood by the pilot in order to improve the service quality of the pilot, particularly concerning flight safety. A pilot must know and understand the public policies that relate both directly and indirectly to aerospace and aviation safety and may impact flight safety. In this manner, pilots can follow the pillars of knowledge that exist in airmanship.

CONCLUSION

The implementation of public policy in conjunction with airmanship in regard to flight safety in Indonesia can conclude as the following part. A pilot's behavior, emotional intelligence, and self-efficacy have a significantly positive effect on their airmanship. In addition, if all regulations from the conceptual level to the technology are implemented well, flight safety improves. Most importantly, pilot behavior was found to be the variable with the highest influence on airmanship. This indicates that the attitudes and habits of pilots in everyday life will be able to reflect their actions performed while working in the aircraft.

In practice, this study recommends two points for policymakers in Indonesia. First, it recommends compiling and evaluate the regulations governing airmanship pilot standardization and flight safety before, during, and after flights. Second, the Indonesia government, in this case, the Ministry of Transportation, should compile and propose a special law on aviation safety which emphasizes the need for better airmanship. This Special Aviation Safety Law will be different from Law No. 1 concerning aviation, with the hope that the Act focuses on regulating aviation safety conflicts of interest.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

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CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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