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The influence of safety management system implementation and safety culture with safety motivation as a mediation variable on safety performance on Airnav Indonesia

Wisnu Hadi Prabowo [1], Sorayanti Utami [2], Syafruddin [3]
[1] Master of Management Unsyiah, Indonesia
[2, 3] Faculty of Economics and Business Unsyiah, Indonesia

* Corresponding Author: **Syafruddin**

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Abstract
The purpose of this study was to analyze the effect of the application of a safety management system (SMS) and safety culture with safety motivation as a mediating variable on flight safety performance. The population in this study were all AirNav Indonesia ATC personnel at the JATSC Branch Office (Jakarta Air Traffic Service Center) totaling 381 people. Sampling by simple random sampling method with a total of 160 people. Data processing was carried out using SPSS and Amos software using a structural equation model (SEM) technique. The results showed that of the 5 direct influence hypotheses tested, there was one that was not significant, namely the Effect of the SMS that did not affect flight safety performance at AirNav Indonesia. The highest coefficient of influence that determines flight safety performance at AirNav Indonesia is safety motivation. This means that the higher the Safety Motivation that occurs in this agency, it will greatly affect the level of performance at AirNav Indonesia. Therefore, it is the leadership's task to keep the safety motivation that occurs among AirNav Indonesia is not a problem, so that flight performance is maintained and remains good. The role of the safety motivation variable can act as a mediator on the effect of implementing a SMS on flight safety performance through safety motivation at AirNav Indonesia. This means that the higher the Safety Motivation that occurs in this agency, it will greatly affect the level of performance at AirNav Indonesia. Therefore, it is the leadership's task to keep the safety motivation that occurs among AirNav Indonesia is not a problem, so that flight performance is maintained and remains good. The role of the safety motivation variable can act as a mediator on the effect of implementing a SMS on flight safety performance through safety motivation at AirNav Indonesia. This means that the higher the Safety Motivation that occurs in this agency, it will greatly affect the level of performance at AirNav Indonesia. Therefore, it is the leadership's task to keep the safety motivation that occurs among AirNav Indonesia is not a problem, so that flight performance is maintained and remains good. The role of the safety motivation variable can act as a mediator on the effect of implementing a SMS on flight safety performance through safety motivation at AirNav Indonesia.

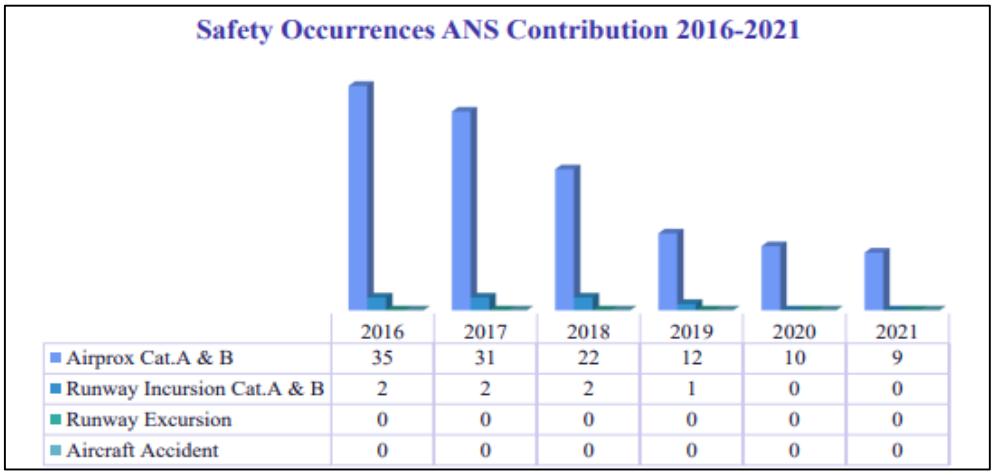
Keywords: Safety management system, safety culture, safety motivation, safety performance, jakarta air traffic service Center, AirNav Indonesia

1. Introduction

Perum, the Indonesian Aviation Navigation Service Provider (Perum LPPNPI) based on the Government Regulation of the Republic of Indonesia Number 77 of 2012 concerning Public Companies (Perum), the Indonesian Aviation Navigation Service Provider, was established with the intent and purpose to provide aviation navigation services following applicable standards for achieving flight efficiency and effectiveness in national and international scope. To ensure that air traffic services are always provided by applicable regulations both nationally and internationally, Perum LPPNPI or also known as Airnav Indonesia applies the principle of a Safety Management System (SMS). One of them is how Perum LPPNPI (Airnav Indonesia) strives to always comply with all regulations and provisions both national and international.

Considering that as a provider of Aviation Navigation Services in Indonesia, Perum LPPNPI (Airnav Indonesia) must ensure that what is implemented in providing services is under applicable rules and regulations, and that includes all things.

However, in reality, the task has not been fully completed properly. This is reflected in the following facts or data safety occurrences. Data on safety occurrences that occur and are a contribution from flight navigation services can be seen in the image below:



	2016	2017	2018	2019	2020	2021
Airprox Cat.A & B	35	31	22	12	10	9
Runway Incursion Cat.A & B	2	2	2	1	0	0
Runway Excursion	0	0	0	0	0	0
Aircraft Accident	0	0	0	0	0	0

Source: Directorate of Safety, Security, and Standardization of Perum LPPNPI

Fig 1: Safety Occurrence ANS Contribution 2016-2021

The data above shows that there is a decrease in the contribution of flight navigation services to the safety occurrence that occurs. However, based on these data, the Airprox Cat incident. A (risk of collision) and Cat. B (safety not assured) which is the contribution of aviation navigation services still occurs every year, where the two categories of Airprox are indicators of measuring the Acceptable Level of Safety Performance (ALoSP))

This fact shows that the mandate that must be carried out by Perum LPPNPI (Airnav Indonesia) has not yet fully gone well, especially concerning flight safety guarantees. Many things can be seen as variable determinants of flight safety. Among them are related to the implementation of the SMS (SMS). As an aviation service provider that provides flight navigation services, Perum LPPNPI (Airnav Indonesia) is obliged to continuously improve its SMS, so that it is always following the national aviation safety program and follows developments. The implementation of a good SMS can make it easier for the Organization to identify hazards that can threaten aviation safety, Ensure the implementation of corrective actions needed to maintain safety performance, Carry out continuous monitoring and assessment of safety performance, as well as continuous improvement – continuity of the overall performance of the SMS. Effective safety management requires a common understanding of all aviation personnel on the duties and responsibilities of the government and aviation service providers. Carry out continuous monitoring and assessment of safety performance, as well as continuous improvement of the overall performance of the SMS. Effective safety management requires a common understanding of all aviation personnel on the duties and responsibilities between the government and aviation service providers. Carry out continuous monitoring and assessment of safety performance, as well as continuous improvement of the overall performance of the SMS. Effective safety management requires a common understanding of all aviation personnel on the duties and responsibilities of the government and aviation service providers.

This is in line with what has been done by ICAO as the International Civil Aviation Organization which has published International Standard and Recommended practices Annex 19 Safety Management, 2013 and ICAO Doc 9859, Safety Management Manual (SMM), 2013 to serve as guidelines for member countries in implementing safety management in each organization in the country. The determination of safety objectives and policies is one of the basic elements in the implementation of the safety of aviation navigation services. With the implementation of a well-developed SMS, it can function as a driver for the growth of a better Safety Culture. However, safety performance will be achieved in accordance with the desired target if every person has an understanding and awareness related to safety (Cai, W. (2005) [4]. In this cultural context, every personnel is required to have a good understanding of the SMS). Thus, in carrying out their duties, each personnel always considers all aspects related to safety to create a safety guarantee.

Another variable that plays a role in contributing to the improvement of flight safety run by AirNav Indonesia is motivation (Khaleghinejad, A., & Ziaaldini, M. (2015) [15]. High employee motivation is needed to support all activities that support the implementation of the SMS so that in the end the targeted safety performance can be achieved properly.

Unlike other research on aviation safety in Indonesia which tends to use a qualitative descriptive approach using secondary data as well as a review of international regulatory aspects such as that conducted by (Supartono, S. (2018) [32], this study looks at aspects of aviation safety in Indonesia). Indonesia from Aviation Air Traffic Control which is the front line in guarding flight safety in Indonesia. This research also applies a multivariate approach that has not been widely used in research related to efforts to maintain safety in the aviation industry (safety aviation).

1.1 Research Problem

The problem of this research is related to the performance of aviation safety in Indonesia. How to implement a SMS, safety culture, safety motivation, and safety performance at Perum LPPNPI (Airnav Indonesia) as a flight navigation operator

who plays a very important role in ensuring flight safety in Indonesia.

1.2 Research Objectives

To find out the determinant factors of flight safety performance and their relation to safety performance variables at AirNav Indonesia. More specifically to analyze the effect of the SMS, Safety Culture, and Safety Motivation on Safety Performance at Perum LPPNPI (Airnav Indonesia)

2. Literature Review

2.1. Safety Management System (SMS)

SMS is a term used to refer to a comprehensive business management system designed to manage the elements of safety and health in the workplace. Meanwhile, Safety Motivation is created at the organizational and individual levels. The problem lies in how the organization, through managers, provides Safety Motivation for employees at all levels to achieve the organization's safety goals. From previous research conducted by Vinodkumar, MN, & Bhasi, M. (2010) [35], it is proven that there is an influence of the SMS on Safety Motivation.

The benefits of implementing an Occupational Safety and Health Management System for companies according to Tarwaka (2008) are: The management can find out the weaknesses of the operating system elements before operational disturbances, accidents, incidents, and other losses arising. Meanwhile, safety performance is defined as "the quality of work related to safety". Improving safety performance in an organization can increase its resilience or resilience and reduce the risk of accidents. From previous research conducted by Tong, R., Zhang, N., Wang, X., & Zhao, H. (2020) [33], it is proven that there is an Influence of SMSs on Safety Performance

H1: The Effect of SMS on Safety Motivation
H3: Effect of SMS on Safety Performance

2.2 Aviation Safety Culture

Safety culture is an interrelation of three elements, namely psychological (person), behavioral (job), and system (organization). That is, three factors make up a Safety Culture, namely workers, work, and organization. Every time your employees use the awards given to them, they are reminded of their accomplishments and the company that pushed them to achieve them. This type of incentive motivates to create a safer workplace and the kind of positive feedback that makes a safety program successful. From previous research conducted by Al-Bayati, AJ (2021) [1], it is proven that there is an influence of Aviation Safety Culture on Safety Motivation. Safety culture is 'something that is created rooted in values, norms and basic beliefs, spread to all members of the organization. Essentially, effective safety measurement plans empower you with quantifiable evidence of what is or isn't working. In addition, if you use effective data and indicators, security measures can even allow you to determine WHY something is not working. From previous research conducted by Arezes, PM, & Miguel, AS (2003) [2], it is proven that there is an Influence of Safety Culture on Safety Performance.

H2: The effect of Safety Culture on Safety Motivation
H4: The effect of Safety Culture on Safety Performance

2.3 Safety Motivation

Safety motivation is an encouragement in employees to take safety actions (Vinodkumar and Bhasi, 2010) [35]. Safety performance targets define the required level of the safety performance of a system. Safety performance targets consist of one or more safety performance indicators, together with the desired results expressed in those indicators. (ICAO Doc 9859 - Safety Management Manual). From previous research conducted by Vatankhah, S. (2021) [34]. It is proven that there is an influence of safety motivation on safety performance.

H5: The Effect of Safety Motivation on Safety Performance

2.4 Safety Performance

This variable refers to organizational performance. In our modern society, the rapid development of technology and concepts such as lean production generate new and more complex risks. Therefore, companies that aim to succeed in working more sustainably must proactively reduce their negative impact on the economy, the environment, and society to an acceptable level. The quality of work safety of an organization is one aspect that can affect the economy, the environment, and society. There is a need within the industry to manage risk and prevent accidents. Major organizational accidents, such as Chornobyl and Bhopal, have demonstrated what effects inadequate safety work can have (Nevhage, B., & Lindahl, H. 2008) [22]. However,

This study will also examine the indirect effect involving safety motivation as a mediating variable

H6: The effect of SMS on Safety Performance through Safety Motivation
H7: The effect of Safety Culture on Safety Performance through Safety Motivation

2.5 Research Model

The model in this study is shown in Figure 2 below.

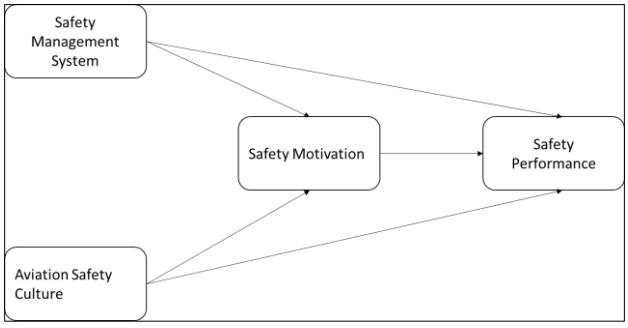


Fig 2: Research Framework

3. Research Methods

A population is a group of people who meet the requirements to serve as respondents. The population used in this study is AirNav Indonesia's ATC personnel at the JATSC Branch Office (Jakarta ATC) totaling 381 people. Due to the time limitations of the researchers, not all of the population were used as respondents, but the researchers limited the number of samples to 160 respondents who were obtained using the Slovin formula. Primary data collection was carried out using a questionnaire plus interviews. Data processing was carried out using SPSS and Amos software using a structural equation model (SEM) technique.

Measurement of the variable SMS variable uses a measuring instrument of 8 (eight) items adopted from Tarwaka (2008). Then the safety culture consists of 5 (five) question items taken (Zohar, 1980). Furthermore, there is safety motivation consisting of 4 (four) questions taken from (Vinodkumar and Bhasi, 2010) [35], and finally, the safety performance variable consists of 5 (five) items adapted from (Wang and Netemeyer, 2004) [36]. Testing the causality hypothesis was carried out using a structural equation model with criteria CR > 1.960 and P < 0.05

4. Research Results

4.1 Characteristics of Respondents

The characteristics of the respondents in this study were mostly male with age levels between 40 to 49 years and were married and had an Academy/Diploma education. The average length of work of respondents is that they have worked more than 20 years so the respondents here are skilled employees and already have a lot of experience in the field of air traffic navigation.

4.2 Research Instrument Tests

a. Validity test

A validity test is conducted to measure how valid each indicator is in representing each variable. If it turns out that there are indicators that are not valid, they will be eliminated and only valid indicators will be maintained. Validity testing was carried out using construct validity techniques.

Table 1: Constructive Validity Results

			Estimate	SE	CR	P
a17	<---	SMS	1,000			
a16	<---	SMS	4,596	1.056	4,354	***
a15	<---	SMS	4,972	1,141	4,358	***
a14	<---	SMS	4,636	1.062	4,366	***
a13	<---	SMS	5,172	1,189	4,349	***
a12	<---	SMS	4,717	1.089	4,332	***
a11	<---	SMS	2,349	,621	3,784	***
a10	<---	SMS	1,645	,489	3,362	***
a22	<---	Organization_Culture	1,000			
a21	<---	Organization_Culture	1.123	,067	16,742	***
a20	<---	Organization_Culture	1,260	,065	19,419	***
a19	<---	Organization_Culture	1,273	,067	19.088	***
a18	<---	Organization_Culture	1,176	,066	17,706	***
a23	<---	ATC_Motivation	1,000			
a24	<---	ATC_Motivation	2,221	,244	9.103	***
a25	<---	ATC_Motivation	2,474	,262	9.452	***
a26	<---	ATC_Motivation	2,417	,256	9,449	***
a27	<---	Safety_Performance	1,000			
a28	<---	Safety_Performance	1.132	0.054	20.778	***
a29	<---	Safety_Performance	1.031	0.048	21.307	***
a30	<---	Safety_Performance	1.070	0.048	22,489	***
a31	<---	Safety_Performance	,367	0.046	7,997	***

From the results of the validity tests that have been carried out, it turns out that all existing indicators meet the requirements, namely the P-value is less than 0.05. Thus, all the indicators involved in this study deserve to be maintained.

4.3 Confirmatory Factor Analysis (CFA)

CFA is part of the Structural Equation Modeling (SEM) analysis. SEM is a complete model analysis intended to test the models and hypotheses developed in this study. This analysis was carried out after the analysis of the measurement model through the Confirmatory Factor Analysis (CFA) test. From the results of the CFA test, it is known that there is one indicator of the job competence variable, namely the X2.4 indicator which has a loading factor value of 0.5 so the indicator is not included in the next test. SEM analysis was carried out by testing the significance of causality through the regression cohesion test.

Because they are not meet the requirement, the indicators for SMS3, safety Motivation 1, and Safety Performance1 must be eliminated.

4.4 Goodness of Fit

Based on the results of the SEM analysis, it is known that the goodness of fit index value is still problematic. For GFI, RMSEA TLI, and IFI, have exceeded their respective limit values. However, CMIN/DF and AGFI still do not meet the criteria. Therefore, model modification is still needed. After reification of the model by adding a covariance line to the items that have the largest MI value, the results have met expectations. The goodness of fit value can be seen in Table 1 and the results of the structural equation modeling analysis can be seen in the following table.

All indicators tested for the feasibility of the model have exceeded the required threshold value so that the model can be said to be fit and can be continued in the next data processing.

4.5 Hypotheses Testing with Structural Model

Table 2: Confirmatory Factor Analysis

			Estimate
a17	<---	SMS	,226
a16	<---	SMS	,863
a15	<---	SMS	,874
a14	<---	SMS	,901
a13	<---	SMS	,850
a12	<---	SMS	,807
a11	<---	SMS	,366
a10	<---	SMS	,266
a22	<---	Organization_Culture	,740
a21	<---	Organization_Culture	,827
a20	<---	Organization_Culture	,944
a19	<---	Organization_Culture	,929
a18	<---	Organization_Culture	,869
a23	<---	ATC_Motivation	,468
a24	<---	ATC_Motivation	,774
a25	<---	ATC_Motivation	,858
a26	<---	ATC_Motivation	,858
a27	<---	Safety_Performance	,850
a28	<---	Safety_Performance	,840
a29	<---	Safety_Performance	,852
a30	<---	Safety_Performance	,879
a31	<---	Safety_Performance	,402

Table 3: Evaluation of Criteria for Goodness of Fit Indices

No	Goodness of Fit Indices	Cut Off Value	Test results	Information
1	CMIN/DF	<2	1,407	Fit
2	RMSEA	0.08	0.033	Fit
3	GFI	0.90	0.957	Fit
4	AGFI	0.90	0.938	Fit
5	TLI	0.90	0.990	Fit
6.	IFI	0.90	0.992	

4.6 Direct Hypothesis Testing

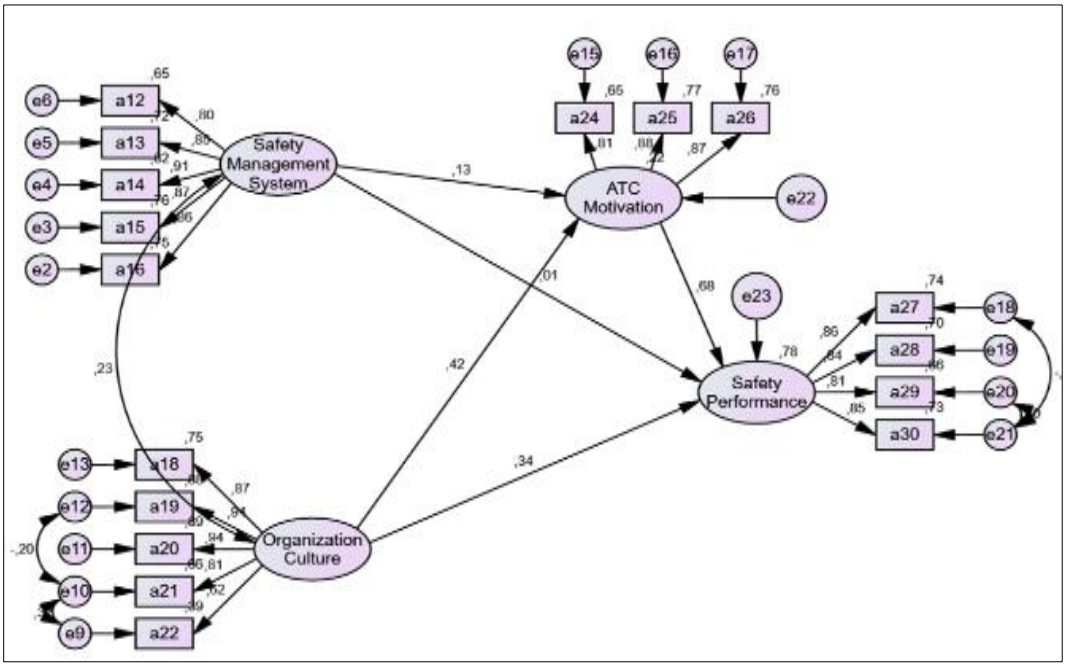


Fig 3: Structural Model

Table 4: Results of Structural Equation Modeling Analysis

Endogenous		Exogenous	Estimate	SE	CR	P	Beta
Safety ATC_Motivation	<---	SMS	,139	0.056	2,489	0.013	,130
Safety ATC_Motivation	<---	Organization Culture	,840	,118	7,141	***	,423
Safety_Performance	<---	SMS	0.013	,034	,398	,691	0.014
Safety_Performance	<---	Organization Culture	,612	,036	17,439	***	,341
Safety_Performance	<---	Safety ATC_Motivation	,611	0.035	17,438	***	,677

4.7.1. Influence Effect of SMS on Safety Motivation

Testing the hypothesis of the first to test InfluenceEffect of SMS on Safety Motivation obtained significant results since both CR and P had values above the required threshold values. The CR value in this study is 2,489 which is greater than 1,960 and the probability value that less than 0.05. Thus it can be stated that the influence of the SMS on Safety Motivation is significant. The magnitude of the coefficient of the influence of the SMS on this Safety Motivation is 0.130 so the impact or influence of the SMS on the Safety Motivation is significant at 13%.

4.7.2. The Effect of Safety Culture on Safety Motivation

The second direct hypothesis test, namely The Effect of Safety Culture on Safety Motivation, also showed positive and significant results because it was supported by a CR value less than 1.960 or a P-value greater than 0.05. these results prove that Safety Motivation is strongly influenced by the Safety Culture. The magnitude of the influence of these two variables shows the number 0.420. This figure means that Safety Motivation can be influenced by Safety organization Culture by 42%.

4.7.3. Influence Effect of SMS on Safety Performance

Subsequent tests involving SMS as an independent variable and Safety Performance as a dependent variable showed results that also statistically is not significant effect because the CR and P value meet the requirement. The magnitude of the influence of these two variables is only 0,1. This provides additional information for managers or leaders in AirNav to improve safety performance does not have to go through the SMS variables.

4.7.4. Effect of Safety Culture on Safety Performance

Testing Hypothesis number 4, namely psychological empowerment and its relation to employee
performance show positive and significant results because this hypothesis can meet the required
CR and p values. Thus, it can be stated that the effect of psychological empowerment on employee performance at AirNav is significant. The magnitude of the coefficient of the influence of psychological empowerment on employee performance at AirNav is 0.341 or 34,1%. Thus, the impact it causes to increase the influence of safety performance can be intervened through safety organization culture.

4.7.5 Effect of Safety Motivation on Safety Performance

Testing the Effect of Safety Motivation on Safety Performance shows a CR value of 17,438 and a probability of ***. The two values obtained have met the requirements for the acceptance of Ha, which is greater than 1.96 and the probability is less than 0.05. Thus, it can be stated that the influence of Safety Motivation on Safety Performance is significant. The magnitude of the coefficient of the influence of Safety Motivation on Safety Performance is 0.677 or 67.7%. Thus the impact it has on increasing Safety Motivation on Safety Performance can be done because of this significant influence.

4.8 Indirect Hypothesis Testing

4.8.1 Effect of SMS on Safety Performance through Safety Motivation

The results of indirect tests involving the effect of SMS on Safety Performance through Safety Motivation also showed significant results. This happens because the indirect hypothesis number 6 can meet the required requirements, namely, the P-value obtained from the bootstrapping test results is smaller than 0.05. The magnitude of the coefficient of the Effect of SMS on Safety Performance through Safety Motivation is 0.088 or 8.8%. Thus, the impact it has on improving the SMS through safety motivation on Safety Performance can be made because of this significant influence.

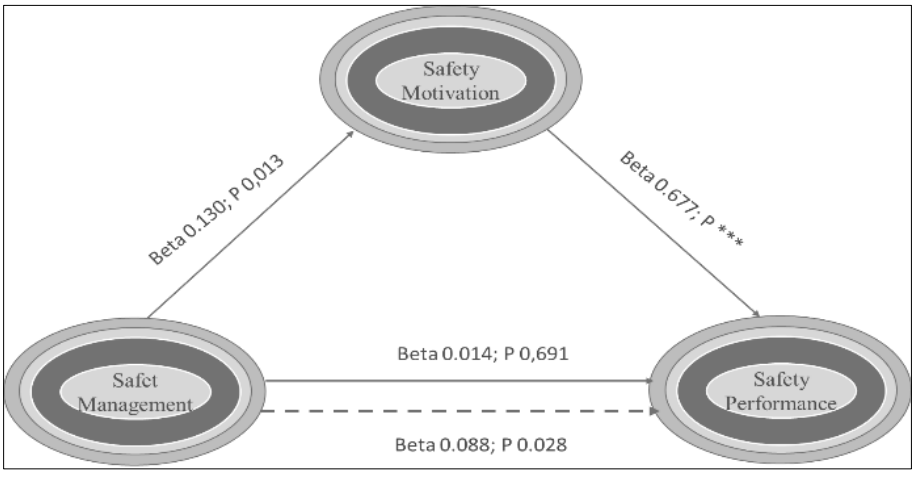


Fig 3: Effect of SMS on Safety Performance through Safety Motivation

4.8.2 The Influence of Safety Culture on Safety Performance through Safety Motivation: Testing the Effect of Safety Culture on Safety Performance through Safety Motivation shows a probability value of 0.001. This value has met the requirements for the acceptance of Ha, which is a probability less than 0.05. Thus, it can be stated that the influence of Safety Culture on Safety Performance through Safety Motivation is significant.

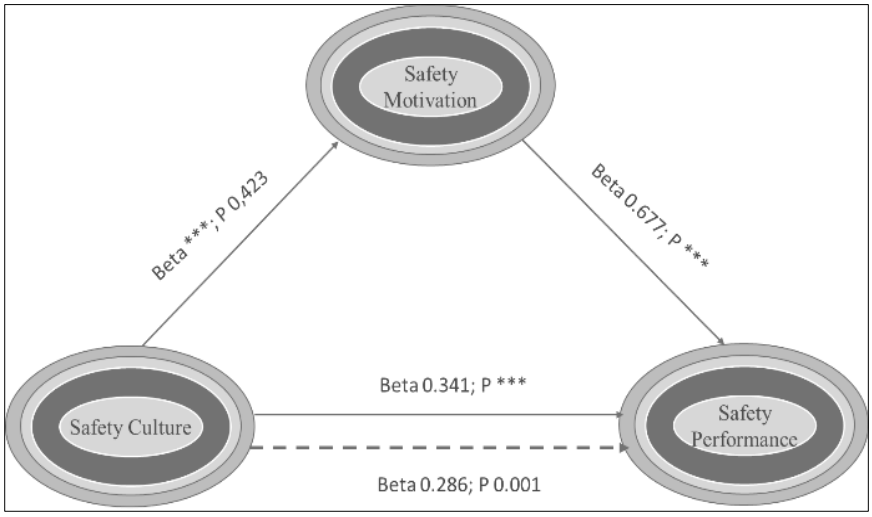


Fig 4: The Influence of Safety Culture on Safety Performance through Safety Motivation

The magnitude of the coefficient of the influence of Safety Culture on Safety Performance through Safety Motivation is 0.286 or 28.6%. Thus, the impact it has on improving Safety culture through safety motivation on Safety Performance can be made because of this significant influence.

Table 5: Coefficient of Indirect Effect

	Organization_Culture	SMS
ATC_Motivation	-	-
Safety_Performance	,286	,088

Table 6: Probability Value Indirect Effect

	Organization_Culture	SMS
ATC_Motivation	-	-
Safety Performance	,001	,028

The two tables above describe the indirect coefficient values and probability values for these two indirect hypotheses, namely the Effect of the SMS on Safety Performance through Safety Motivation and the Effect of Aviation Safety Culture on Safety Performance through Safety Motivation.

4.9 Managerial Implications

After going through a series of analyses and testing carried out to prove the hypothesis that has been built from the beginning, it turns out that the results are quite encouraging because the premises and assumptions carried out at the beginning of the study turned out to be proven after the research results were analyzed and issued using a statistical program. But, after going through a series of tests, it turns out that there are variables that show a significant effect, and some do not. Of the five (5) hypotheses tested, hypothesis no. 3, namely the Effect of the SMS on Safety Performance is not significant. The SMS does not show any contribution to increase safety performance. However, the other 3 variables show a positive and significant effect on improving safety performance.

Of the other 2 variables that have a significant direct effect on improving safety performance, it is the safety motivation variable that has the biggest influence. This is indicated by the largest coefficient, which is 67.7% compared to the safety organization culture which is only 34.1%. Meanwhile, on the indirect effect, the hypothesis of the influence of Safety Culture on Safety Performance through Safety Motivation has a magnitude greater than the influence of the SMS on Safety Performance through Safety Motivation. Thus the function of safety motivation as a mediator will play a very important role in the path of the influence of safety culture on safety performance compared to the path of SMS on safety performance.

5. Conclusion

Of the several determinant variables that have a significant direct effect on improving safety performance, it is the safety motivation variable that has the greatest influence. This is indicated by the largest coefficient, which is 67.7% compared to a safety organization culture which is only 34.1%. This means that this variable can be used as a trigger for management at AirNav to support Indonesia's aviation safety performance in the future. Meanwhile, on the indirect effect, the hypothesis of the influence of Safety Culture on Safety Performance through Safety Motivation has a magnitude greater than the influence of the SMS on Safety Performance through Safety Motivation.

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