The Aviation Safety Culture and The Assessment Tool: A Context of Vietnam

Thi Hai Hang Nguyen[1,#], Thi Phuong Linh Le[1], and The Hoang Nguyen[1,]

1 Vietnam Aviation Academy, Viet Nam
Corresponding Author / E-mail: hangnh@vaa.edu.vn

In aviation, safety is the highest priority. In order to yield socio-economic benefits, there is a need to carry out aviation activities safely. To ensure the aviation safety, the system and technical aspects are not enough, human factors and organizational culture have been drawn more and more attention. Thus, there is increasing interest in applying the concept of safety culture in aviation industry. Using the measurement of safety culture proposed by Association of Asia Pacific Airlines, Arab Air Carriers Organization and Airport Council International (ICAO, 2015), this study sets out to investigate the safety culture in a wide range of aviation sectors in the context of Vietnam. From March 1st to April 15th, 2019, 350 random employees in various aviation functional areas are involved in the survey measuring aviation safety culture. A number of quantitative techniques are utilized for testing the measurement and processing the collected data. The findings of the assessment reveal a generally good existing safety culture in aviation sector. However, some aspects of safety culture (e.g. communication, reporting, and commitment) are somewhat poorer than that estimated at some functional areas. In addition, safety risk management & reporting has positive relationship with overall assessment of safety culture amongst employee with 95% confidence. Although the safety culture measurement proposed by ICAO (2015) is perceived as useful for exploring and highlighting safety assessment in Vietnam, further work is required. This will involve the integration with different measurements developed and verified by other researches, and considering the national culture to ensure that it operates consistently in local setting.

1. Introduction

The term "safety culture" first appeared in the analysis of the Chernobyl disaster in 1986 (Mearns et al., 2013). Since then, the term has been used more popularly among academia as well as among practitioners but it is still difficult to have a common definition for "safety" and "safety culture" accordingly in all fields.

Within the context of aviation, "safety" is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management" (ICAO, 2014)[*]. In such a complicated, high-risk system as aviation, safety is always at the first priority of related stakeholders. It is proved that there are many determinants to the aviation safety such as technical problems, management issues, human factors, etc. It's proved that the most decisive factor to the safety is safety culture of the organization. And "safety culture" has become a recurrent theme in aviation sector all over the world, and is discussed recently in literature as well as among aviation practitioners. But while it is easy to agree on the definition of "safety" in aviation, it seems not being able to have clear definition of safety culture" as the term "culture" itself already has diversified dimensions.

For the management purpose, during the last decade, there have been many efforts to measure it (Ek & Akselsson, 2007; Gill and Shergill, 2004; McDonald et al., 2000; Cooper et al., 2004; Griffin and Neal, 2000; Zohar and Luria, 2003; Probst et al., 2006; Sexton et al., 2006). In Vietnam, the first state safety program (SSP) was officially published as a milestone of safety development in aviation sector (2013). Since then, there was not a thorough assessment on the safety culture in Vietnam to understand its circumstance for further action. It was the motivation for the author to conduct this research. The central aim of the research is to benchmark the level of aviation safety culture in Vietnam with the level of safety culture worldwide using the methodology and measurement proposed by Association of Asia Pacific Airlines (AAPA), Arab Air Carriers Organization (AACO) and Airport Council International (ACI) (ICAO, 2015).

Depending on the approach to the safety culture, there are many ways to assess it, but the research based in the context of the Vietnam is still in a very first stage, especially, this is almost the first survey in Vietnam that studies the current status of safety culture. Safety culture is a context-based issue, it needs to be embedded in specific contexts to find the practical ways to understand and implement successfully. The paper is structured as followings: The introduction provides a brief background about the study and the purpose of the study; part 2 provides an overview of Vietnam's aviation sector with its safety perspective. Part 3 is a concise literature review on safety. The methodology and the key findings and discussion are described in part 4 and part 5 respectively. Part 6 is the main conclusion, which pinpoints some recommendations for further actions to improve the level of safety culture in Vietnam as well as future research on aviation safety

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[*] https://www.icao.int/NACC/Documents/Meetings/2014/SMSF1/P02.pdf accessed on April 21st, 2019

topic.

2. Overview of Vietnam's Aviation Sector from Safety Perspective

2.1 State Safety Program (SSP) of Vietnam

According to ICAO, SSP (State Safety Program) is "a management system for the regulation and administration of safety by the State. The implementation of an SSP is commensurate with the size and complexity of the State's civil aviation system and requires coordination among multiple authorities responsible for the aviation functions of the State" (3rd edition of the ICAO SMM – Doc.9859). In 2013, the fist SSP of Vietnam was issued officially by the Decision of 1189/QĐ-BGTVT. The main content of SSP consists of:

(1)   Safety policy and objectives of Vietnam
(2)   Safety responsibilities & accountabilities
(3)   Risk management
(4)   Enforcement policy
(5)   Requirements for the service provider's SMS

CAAV establishes a framework of State safety oversight system applying top-down approach. The framework includes General Directors of CAAV, Vice Director undertaking activities of safety, and many organizations assisting with ratifying and examining the safety of aircraft, aircraft operations, air traffic management, and airport management. According to prescriptions in Decree 75/2007/NĐ-CP and other legal rule documents, CAAV is the first office receiving, analysing, storing, and synthetizing all Mandatory Occurrence Reports by service providers as required. The Ministry of Transport (MOT) empowers CAAV to be the standing office within the jurisdiction of MOT to investigate air incidents and accidents as described in Article 106, authorized by Decision number 1370/QĐ-BGTVT issued by MOT on 21 May 2009, civil aviation laws of Vietnam.

2.2 SMS and the current status of safety in the aviation sector in Vietnam

The effort of all Vietnam aviation stakeholders to strengthen the safety has got the great achievements. In 2016, ICAO implemented assessment how well the stakeholders in Vietnam complied with ICAO rules and recommendations for legal documents on aviation safety (LEG), Personnel Licensing (PEL), Air Navigation Service (ANS), Aerodromes and Ground Aids (AGA). As the result of examining those areas, AIR reached the achievement of 75%, OPS got 67%, OPS got 67%, and percentage of the rest was 68%. Remarkable, the achievements of AGA and ANS had an increase of 68% while ICAO requires the standard of 62% and CAAV's goal was 67%. And in 2018, FAA certified level 1 for CAAV as the authority has updated its complying with rules and regulations for legal documents of aviation safety (LEG), personnel licensing (PEL), airworthiness (AIR), and aircraft operations (OPS).

In every system, people who are working in it is always important. In such a complicated system as aviation, it plays a much more crucial role as it has been realized that human error, rather than technical failure, underlies most accidents and incidents in aviation. And we cannot consider people separately from the culture of the community where people live, the one of the organization where people work, and the one of the family where people were born and raised up.

In recent years, safety culture in aviation activity has received the attention of many organizations in Vietnam. In order to raise awareness of officials and employees working in the aviation industry, the Southern Airport Authority launched a key program entitled "Awareness on Aviation Safety Culture of the Southern Airport Authority: The period of 2014-2020". Vietnam Airlines is also another company that implements the activities to enhance the safety culture in their business… According to the International Air Transport Association (IATA), in 2016, a set of key indicators related to flight safety of Vietnam Airlines were outperformed compared with other airlines in the country and they were evaluated at a high level compared with other airlines in the region.

Although safety culture has initially received the attention at management level, there is a lack of quantitative research to measure the perception and its practice in the different functional sectors in Vietnam. Thus, it is necessary to conduct a comprehensive research on safety culture assessment in the context of Vietnam.

3. Literature Review

As mentioned earlier, there is still no generally agreed-on definition of safety culture. Many stated that safety culture refers to how organizational management and human factors shape safety outcomes (Flin et al., 2000). Richter and Koch (2004) views safety culture as a 'focused aspect of organisational culture' and they define safety culture as 'the shared and learned meanings, experiences and interpretations of work and safety – expressed partially symbolically – which guide peoples' actions towards risks, accidents and prevention'. According to Flight Safety Foundation, safety culture is the way safety is perceived, valued and prioritised in an organisation. It reflects the real commitment to safety at all levels in the organisation. It has also been described as "how an organisation behaves when no one is watching"*. Within the context of aviation, "safety" is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management" (ICAO, 2014).

Many studies have investigated the elements that construct the safety culture. According to Reason (1997), safety culture includes communication on safety within an organization, incident reporting systems, apportionment of blame, managing and learning from incidents, investment in safety systems, emergency management procedures, and training and awareness of human factors. Sorensen (2002) stated that a safety culture includes elements such as good communication, organizational learning, senior management commitment to safety, and a working environment that rewards the identification of safety issues. Efficient and successful safety management depends largely on the attitudes and the commitment to safety that exist in the organization, especially on the management level (Bailey, 1994; O'Toole, 2002). Education and training in safety are also emphasized by Schwartz (1999) as one of the components of safety culture. Risk consciousness plays a prerequisite role for understanding the need to take safety precautions (Enander & Johansson, 1999). Lack of knowledge of safety or misjudgements of risks may cause risk behaviour and inappropriate decisions with regard to safety measures (Ek & Akselsson, 2007).

All of these studies had been made before the ICAO published a report (APRAST/7–WP/12) on overall assessment of safety culture, where the components and elements of a safety culture to be implemented in the aviation industry was defined (ICAO, 2015). The report of APRAST/7–WP/12 stated that safety culture is assessed by 7

factors namely Safety Policy, Safety Commitment, Safety Communication, Safety Training and Promotion, Safety Risk Management, Safety Management & Reporting, and Working Environment. Each of them is measured by a set of items that have high correlation and reliability amongst each other. According to the knowledge of the author, not many researches have been conducted based on this document. Thus, it will be more useful for researchers, policy makers and other stakeholders to specify safety problems regarding the components and elements suggested by this ICAO report: the APRAST/7–WP/12. The present study intends to evaluate the overall safety culture in aviation industry in Vietnam, specified in the APRAST/7–WP/12 (ICAO, 2015).

4. Methodology

The central aim of the study is to assess the aviation safety culture in Vietnam. In order to achieve it, there are objectives that need to be achieved, including:

• Objective 1: Study the assessment of employee to each factor of safety culture;

• Objective 2: Investigate the factors that significantly influence on the overall assessment of safety culture amongst employee.

It should be noted that this work only focus on a wide study carried out to construct a broad view on how safety is perceived, implemented and managed in Vietnamese aviation industry. It does not provide a detailed description of activities pertaining to technical aspects of aviation safety, but presents an overview of organizational processes affecting safety.

4.1 Conceptual framework and Hypotheses

As mentioned above, not many of the recent studies were based on APRAST/7–WP/12 (ICAO, 2015) reference document. In addition, according to the authors' knowledge, there is a lack of aviation safety research in Vietnam, where the aviation industry has been grown up very quickly in recent years after Doi Moi period. On the other hand, it should be noted that the study of ICAO (2015) only focused on the single assessment of employees to single areas of safety culture. However, it has not fully studied the dimensions that significantly influence on the overall assessment of safety culture amongst employee. Therefore, they are the motivations that encouraged the author to conduct the research.

To narrow this gap, the author suggested a model (Fig. 2) that employed the questionnaire developed and verified by AAPA, AACO and ACI (ICAO, 2015), following hypotheses were developed:

4.2 Sampling & data analysis

Convenient sampling method was employed for respondent selection. Employees working at different companies/airports, at different functional areas (e.g. Administration, ATC, Engineering & Maintenance, Flight Crew, Ground Service, Management), having different types of labour contract and involving in different working time are invited to engage in the safety culture survey. A total 350 samples from more than 40 organizations/companies are available for further analysis. Data collection was conducted from March 1st, 2019 to April 15th, 2019.

The authors used quantitative method to analyse the collected data. Firstly, the average ratings for each of some 30 questions in different functional areas were calculated to find out which areas, e.g. safety

commitment, were best or worst viewed by employees. Secondly statistical correlation analyses were done to identify which areas were more related to the overall assessment of safety culture (ICAO, 2015). Liner multiple regressions analysis and other related techniques (e.g. reliability test, factor analysis) were used to examine these hypotheses described above.

5. Key findings and Discussion

5.1 Overall assessment of employee towards safety culture (Objective 1)

The point averages are above 4 on a 5-point scale (with 5 being "Strongly Agree" and 1 being "Strongly Disagree") in most of the questions on the survey. The standard deviations are at the low level, mostly below 1 point, which implies that the responses are close to the averages; majority of respondents "Agree" that safety culture is adequate at workplace. The respondents agree (1) safety training is very helpful to our practical working circumstances, (2) compliance with safety requirements is viewed as essential in maintaining a good safety culture, and (3) they are willing to learn from the experience of other organizations.

In terms of lowest average, on contrast, the respondent doesn't agree that their co-workers work continuously to identify and overcome threats to safety; (2) they don't have enough manpower and resources put into safety; (3) and the safety culture in their organization is not excellent and exemplary. Especially, the research's results indicate that the respondents in general do not agree and satisfy with the safety culture in their organizations. The findings will provide useful insight on how safety culture can be improved more effectively.

5.1.1 Significant Factors in Safety Culture

The correlation analysis indicates that certain factors (There is enough manpower and resources put into safety, Safety facilities in the workplace are well installed and maintained, and my co-worker fully understand the hazards risks of their own operation) with higher correlation to overall assessment of safety culture, are considered to have more significant influence on how workers perceive the general state of safety culture in workplace. In contrast, other factors show less significant correlations with it. According to the highest correlation value, the more manpower and resources put into safety, the more safety facilities in the workplace are well installed and maintained, and the more respondent's co-workers fully understand the hazards and risks of their own operation, the more respondents feel confident on the company's safety culture. In other words, these factors help to shape the company's safety culture. On the other hand, some factors do not indicate the strong relationship with overall assessment of safety culture. "The compliance with safety requirements", "Co-worker regularly informed about "lessons learnt" from incidents or near misses", and "The safety training at the workplace" have a little bit weaker influence on their assessment about overall safety culture despite the common understanding of the importance of these safety aspects.

5.1.2 Primary concerns

According to ICAO (2015), the primary concerns that require particular attention are the safety aspects, which have larger influence on overall safety culture assessment but received lower evaluation. In this study, the findings also reveal that these factors have major effect

on workers' awareness about safety culture, but it seems that their companies and their co-workers are currently less well equipped with safety features. The factors confirm that in their companies, there is not enough manpower and resources put into safety. In addition, safety facilities in the workplace are less well installed and maintained, and their co-workers do not fully understand the hazards and risks of their own operation as expectation in the safety requirement.

Furthermore, the result illustrates that the shortage of manpower and resources is felt more strongly by air traffic controller, flight crew, engineering & maintenance staff and even management staff, who score lower than the average in contrast to those in management and administration. The findings are a bit different with those of ICAO (2015), which reports that workers in the frontline, namely flight crews and ground crews, and training personnel give lower scores for this, but it might be appropriate with the local setting in Vietnam. In fact, aviation industry grows fast in recent years leading to the fact that air traffic controller, flight crew, engineering & maintenance staff, and management staff have to work overtime, which is the preliminary reasons for work-related stress and the safety shortage. For example, in order to meet the huge travel demand of citizens, many airlines increase their number of flights that exceed the regulation of civil aviation authority. Consequently, ATC, flight crew and engineering & maintenance staff must work with extra time under low physical and mental health conditions, which in turn is harmful to aviation activities.

Currently, manpower and resources put into safety are provided to contract labour, full time staff and part time staff. However, some workers that are not listed here in the study also expressed the need for additional support with manpower in comparison with their colleagues (contract labour, full time staff and part time staff). Furthermore, the data shows that fulltime staff perceived they get the lowest manpower support than contract labour and part time employee. The fulltime employee has the major responsibilities in handling the jobs; therefore, they must be provided with sufficient supports of safety. The gaps between different functional groups and contract types should be recognized in order to adequately allocate human resources to areas where needed. It also shows that both the contract staffs and full time staff are less confident if the safety risks are properly identified and analysed compared to part time staff and others.

In terms of the statement "Safety report are regularly feedback to frontline staff so that everyone learns the lesson", in the ICAO investigation, only contract labour is not well updated with the safety report; however, in this research, both groups of staff agree less that safety reports are regularly feedback to frontline staff so that everyone learns the lessons. It could be the case that the safety-related matters are not evenly communicated with everyone in the workplace; it is needless to say that all the employees in charge should be equally entitled to be kept updated with the latest safety situations in order to share safety risks and maintain high safety standards in workplace.

5.2 Investigate the factors that influence overall assessment of safety culture amongst employee (Objective 2)

5.2.1 Reliability analysis

Cronbach's alpha is a measure of internal consistency, which is, how closely related a set of items is as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Cronbach's alpha is not a statistical test – it is a coefficient of reliability (or consistency).

The safety culture dimensions are evaluated for reliability using the Cronbach's alpha measures. The coefficients indicate that the items of 7 factors are reliable as the Cronbach's alpha values exceed 0.6, which is an acceptable reliability value (Byrne, 2010).

5.2.2 Factor analysis

In this study, factor analysis is used to identify related items (Randheer et al., 2011) and analyse the underlying factors in safety culture. Factor analysis is conducted '…using the principal components method with varimax rotation to determine the validity of the items comprising the questionnaire developed to measure the relationship amongst the variables whose relationship in the conceptual model is being investigated…' (Vilakazi & Govender, 2014). The results of factor analysis that performs on 7 factors show that these factors explain 73.299% of the cumulative variance amongst the factors.

Next, the rotated loading values are examined to define which items are not loading on the factors and could therefore be eliminated from the dataset. The output of the above-mentioned procedure is reflected in Appendix B. The extracted factors and their individual items have a relatively high correlation because most of the factor loadings are greater than 0.50. Based on the factor analysis result, 3 new factors are computed namely: Safety policy, Safety commitment, communication & training, and Safety risk management & reporting).

The hypotheses were updated as follow:

• Hypothesis 1: Safety policy has positive relationship with Overall assessment of safety culture of employee.

• Hypothesis 2: Safety commitment, communication & training has positive relationship with Overall assessment of safety culture of employee.

• Hypothesis 3: Safety risk management & reporting has positive relationship with Overall assessment of safety culture of employee.

5.2.3 Model and hypotheses testing

The result indicates that Adjusted $R^2 = 0.544$, F value = 139.877 and Sig. = 0.000 < 0.05. These demonstrate that the liner multiple regressions analysis between factors and overall assessment of safety culture of employee could be used. Through the value of R^2, the explanatory level of the model is 54.4%. It means that 54.4% of overall assessment of safety culture amongst employee could be explained by the 3 independent variables.

With standardized coefficients of 0.734 and the Sig. = 0.000 < 0.05, the factor of Safety risk management & reporting has significant impact on employee's overall assessment of safety culture.

Hypotheses testing

• Hypothesis 1: Safety policy has positive relationship with Overall assessment of safety culture of employee

The standardized regression coefficient of safety policy on overall assessment of safety culture of employee is 0.021 (sig. = 0.723 > 0.05). This means at the level of confidence of 95%, safety policy does not

contribute to the explanation of overall assessment of safety culture of employee. Therefore, the hypothesis 1 is rejected.

• Hypothesis 2: Safety commitment, communication & training has positive relationship with Overall assessment of safety culture of employee

The standardized regression coefficient of safety policy on overall assessment of safety culture of employee is -0.01 (sig. = 0.910 > 0.05). This means at the level of confidence of 95%, safety commitment, communication & training does not contribute to the explanation of overall assessment of safety culture of employee. Therefore, the hypothesis 2 is rejected.

• Hypothesis 3: Safety risk management & reporting has positive relationship with Overall assessment of safety culture of employee

The standardized regression coefficient of safety risk management & reporting is 0.734 (sig. = 0.000 < 0.05). This means that safety risk management & reporting is directly impact on overall assessment of safety culture of employee with 95% confidence. Therefore, the hypothesis 3 is accepted.

Although Safety risk management & reporting has strong impact on the overall assessment of safety culture amongst employee, findings show that employees are generally less satisfied with Safety risk management & reporting in the workplace compared to other factors (mean scores ranging from 3.882 to 4.168). For example, training staffs agree much less that their co-workers fully understand the hazards and risks of their own operation or part time employees, contract labour and other staff give lower scores for the statement "Safety reports are regularly feedback to frontline staff so that everyone learns the lessons". This raises the concern that solutions need to be developed to deal with the problems of management & reporting.

6. Conclusion and recommendation

6.1 Conclusion

The findings of the research reveal that the overall assessment of safety climate provides us with a broad picture on the current situation of risks and actions in different organizations in Vietnam. Also, the proposed model also reveals which factor with their single items contributes the most to the workers' satisfaction on safety culture. Based on that analysis, some recommendations are also given.

Further research should be conducted with the integration with different measurements developed and verified by other researches, and considering the national culture to ensure that it operates consistently in local setting. Also, it is important to collaborate with Aviation Authority and other stakeholders to develop the Safety performance measurement framework for better evaluation of safety culture practices and proactive actions that deal with risks and safety issues in various functional areas (workplaces).

6.2 Recommendation

6.2.1 Improve the communication & giving a chance to learn lessons from safety reporting to everyone

Our analysis indicates that currently, the safety risks are not properly identified and analysed. In addition, shortages of prompt feedback on safety reports for everyone to learn lessons still exist that make workers feel less confident in safety culture. It is needless to say

that safety issues should be communicated mutually amongst workers and the entire employee regardless of positions and types of employment should be equally entitled to be kept updated with the latest risks to maintain high safety standards in workplace. Prompt response to reports of safety hazards and concerns improve the perception of safety culture by employees and it seems to be a good way of reinforcing reporting and safety culture, not only enhancing employee morale (ICAO, 2015).

6.2.2 Everyone needs a chance to receive an equal power

Efficient safety management depends largely on manpower and support from the company. Currently, air traffic controller, flight crew, engineering & maintenance worker and even management staff are unsatisfied with the support from high-level manager. In addition, some other workers also express that they are left behind and do not have fulfil support with manpower compared with their counterparts. In aviation industry, where safety is the first priority, everyone must have an equal power and support. Having enough manpower and support make employee feel confident in dealing with risks. Lack of manpower and support may cause risk behaviour and inappropriate decisions with regard to safety measures.

6.2.3 Senior staff gave the lowest evaluation throughout the questionnaire

In this study, over 50-year-old respondents give the lowest evaluation throughout the questionnaire while the middle-aged group (30-39 years old) gives the highest scores in most of the questions. It is important that not only young workers are qualified with safety knowledge in the workplace, but the senior counterparts are also being communicated equally. It is the responsibility of managers to appropriately provide support where needed in order to make sure that nobody is left behind in the workplace.

6.2.4 Training is not enough to raise safety awareness

Apart from Communication, Training plays a crucial role in constructing the safety culture in any workplace. However, the study reveals that there is a gap between training provided and its effectiveness in raising safety awareness. In fact, the training has a little bit weaker influence on worker's assessment about overall safety culture. In order to overcome this problem, training team at the workplace should spend more time on developing an appropriate safety program for targeted learners working at various functional areas. They had better seriously take into account the purpose of the training and define clearly how the training can support their counterparts in day-to-day operational practice.

6.2.5 Continuous commitment is required to keep high safety standards

Continuous commitment at any level of management is very important in raising awareness on safety and motivating the precaution of risks amongst employees. Continuous commitment can be seen in many ways, from the first step of developing safety policy, to daily and frequent mutual communication by many channels with employees regardless of their jobs, their positions, and spending efforts on well installed and maintained safety facilities in the workplace as well as paying continuous attention to prevailing risk situations to take

preventive and corrective actions to manage safety at high level all the
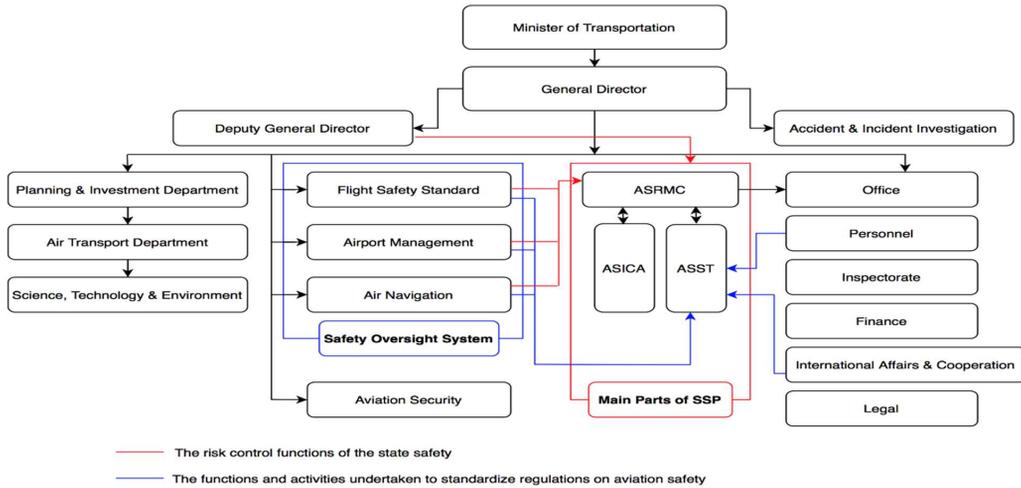time (ICAO, 2015).

Fig. 1 Organization structure of safety oversight system of CAAV - Source: Vietnam's SSP
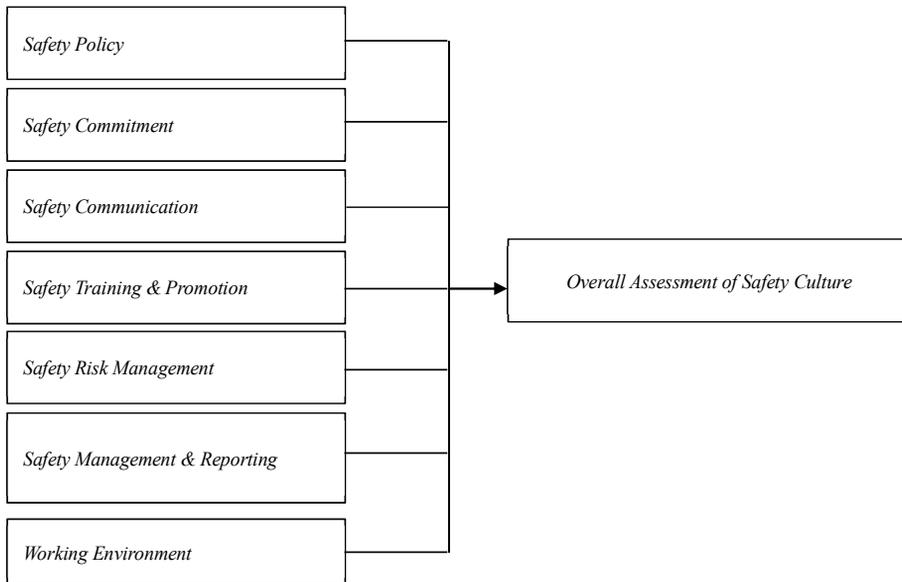

Fig. 2 Proposed research model

Table 1 Model testing

Variables	Standardized Coefficients	t	Sig.	Collinearity Statistics	
	Beta			Tolerance	VIF
(Constant)		2.04	0.042		
Safety risk management & reporting	0.734	9.434	0.000	0.216	4.631
Safety commitment, communication & training	-0.01	-0.113	0.91	0.164	6.085
Safety policy	0.021	0.355	0.723	0.363	2.757

Dependent Variable: H31 - Overall Assessment of Safety Culture

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