Factors affecting the collection of safety data for the development of safety performance Indicators in a sample of Mediterranean Aviation Service providers

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Factors affecting the collection of safety data for the development of Safety Performance Indicators in a sample of Mediterranean Aviation Service providers

By

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Certificate of Ethical Approval

Applicant:

Crystal Ioannou

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Critical assessment of the implementation of a performance based Safety Management Systems in aviation service providers

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Quotes

(3 are better than1)

“If people are good only because they fear punishment, and hope for reward, then we are a sorry lot indeed”. — Albert Einstein

“There is no such thing as an accident, only a failure to recognise the hand of fate” – Napoleon

“Whenever there is fear, you will get wrong figures”. – W. Edwards Deming

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Abstract

Subjective evidence suggests that the Safety Management Systems (SMSs) used to address hazards, manage and measure safety in aviation organizations may not be as effective as it is believed. As part of their SMS organizations use incident data to develop their Safety Performance Indicators (SPIs) to measure their performance and improve their safety levels. The use of low-quality data might lead organizations into not developing the appropriate SPIs thus resulting in misleading assessments of their safety performance. This thesis extends the work of Gerede (2015) and attempts to acquire deeper knowledge by performing, a series on in-depth interviews with participant followed by a structured questionnaire survey to obtain a better understanding of the factors impeding the effectiveness of their SMS.

Initially in the first study, five aviation service providers participated in a study aiming to identify factors that impact the development of data to be used for the development of Safety Performance Indicators (SPIs). Safety managers were interviewed, and their comments analyzed using a grounded theory approach. The hindering factors were categorized and integrated into a model showing the factors that impede the development of safety data and thus impact the effectiveness of the SMS.

Secondly, using the hindering factors derived from the preliminary study, an interview with the safety managers and safety officers from five aviation organizations was performed to investigate these hindering and underlying factors. Using thematic template analysis, their comments were categorized under main themes and subcategories. Although SMS regulations such as those in ICAO (International Civil Aviation Organization) Annex 19 are derived from the perspective of a North American and Western European Culture, the results of this thesis suggest that certain national cultural characteristics might impede the implementation of SMS in small Mediterranean countries.

Finally, in a survey study, a statistical analysis was performed to describe the perceptions of aviation organization employees which aims to confirm the findings from the previous studies. The study suggests that the identified factors, either individually or in combination may have an influence on the quality of data organizations collect for the development of their SPIs. The study suggests that there is a gap between actual performance of the SMS and reality. The results support a previous recent study regarding the effectiveness of SMSs.

Publications Resulting from this Work

Journal articles

Ioannou, C., Harris, D. Dahlstrom N., (2017). *Safety Management Practices hindering the development of safety performance indicators in aviation service providers.* Aviation psychology and Applied Human Factors 7(2), 95-106.

Industry presentations

Is it working? Challenges in training people in SMS, Flight Safety Foundation, Larnaca, 2015

The good, the bad and the ugly: The true story between SMS and reality, Middle East and North Africa Society of Air Safety Investigators (MENASASI) Dubai, 2016

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Glossary

AGFI	Adjust goodness of fit
AMA	American Medical Association
APU	Auxiliary Power Unit
ASMT	Automatic Safety Monitoring Tool
ATM	Air Traffic Management
EASA	European Aviation Safety Agency
FDM	Flight data monitoring
CANSO	Civil Air Navigation Services Organization
CASS	Flight Safety Foundation's Corporate aviation safety seminar
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CRM	Crew Resource Management
CST	Central Standard Time
DF (*df*)	Degrees of Freedom
EST	Eastern Standard Time
FSF	Flight Safety Foundation
GFI	Goodness of fit index
HSE	Health and Safety Executive
HRO	High Reliability Organizations
HSLB	Accident Investigation Board Norway

IAEA	International Atomic energy Agency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
NPP	Nuclear Power Plant
NFI	Normed Fit Index
NTSB	National Transportation Safety Board
OECD	Organization for economic co-operation and development
PCMCIA	Personal Computer Memory Card International Association
PGFI	Parsimony goodness of fit index
RAT	Risk Analysis Tool
RMSEA	Root mean square error of approximation
SMM	Safety Management Manual
SMS	Safety Management Systems
SPIs	Safety Performance Indicators
SSP	State Safety Program
TOKAI	Toolkit for ATM occurrence investigation

Chapter 1

1. Introduction

For the last five years, the accident statistics in the 2017 the International Civil Aviation Organization (ICAO) safety report show a decrease in both number of accidents and the accident rate, while at the same time there was an increase in scheduled commercial departures. This resulted in a global accident rate of 2.1 accidents per million departures, down by 25 per cent from the 2015 rate of 2.8 accidents per million departures. It all started in 2010 when at the High-Level Safety Conference it was decided that there was a need for a new annex to the Chicago Convention dedicated to safety management. The decrease in the accident rate would have been difficult to achieve without the introduction of Safety Management Systems (SMS). The conference concluded that the management of safety should fall under the responsibility of the state to monitor the civil aviation safety under a State Safety Program (SSP), covering all aspects of civil aviation and a SMS is a requirement for each organization specific to their area of activity.

1.1 Background

A number of aviation accidents, such as the Dryden accident, Air France 447, and Helios 522 accidents, seems to reflect the “Swiss Cheese” model described by Reason (1990) which suggest that these accidents were not the result of one factor but a combination of several factors. These accidents suggest that a combination of factors may be present in system several years prior to the event. This theoretical framework suggests an accident trajectory may result from a combination of organizational and managerial decisions which interact with various conditions in the workplace and with other personal and situational factors, leading to errors and violations. Only when these active and latent failures penetrate or bypass the organization’s multiple layers of defences will an accident occur.

In order to reduce the accident rate, aviation organizations are now required to have an SMS (ICAO, 2013). According to the ICAO (2013), this is a system

to ensure the safe operation of aircraft through effective management of risk. To achieve this, the SMS is designed to continuously improve safety by identifying hazards, collecting and analysing data and continuously assessing risks. The primary objective of an SMS is to contain and mitigate risks proactively and prevent resulting incidents or accidents (Stolzer et al.,2018). Arendt and Adamski (2011) state: “Sound safety planning including hazards identification, risk management and safety assurance must be based on a thorough understanding of the processes and activities of people in the system and the other components of the systems and environments in which they work.”

Organizations need to be able to determine whether their SMS is effective and working properly and to do this they need to have a reliable and valid instrument for measuring SMS effectiveness. Measuring and controlling performance is an essential part of the process. Setting goals, identifying activities to reach those goals and improving performance are all subcomponents. This requires measuring performance against pre-established performance-level expectations and implementing changes to adjust performance to acceptable levels. The size and complexity of the SMS should be scaled to suit the size of the organization and it should incorporate a mechanism for maintaining and evaluating its effectiveness based on the four components of an SMS (ICAO, 2013; FAA, 2015). These are:

1. Safety policy and objectives. The safety policy establishes senior management’s commitment to continually improve safety. It defines the methods, processes, and organizational structure needed to meet safety goals.

2. Safety risk management (SRM). SRM determines the need for and adequacy of new or revised risk controls based on the assessment of acceptable risk.

3. Safety Assurance. Safety assurance evaluates the continued effectiveness of implemented risk control strategies and supports the identification of new hazards.

4. Safety Promotion. Safety promotion includes training, communication, and other actions to create a positive safety culture within all levels of the workforce.

Although different manuals are published to assist in the implementation of the four components as mentioned in Annex 19, nevertheless, the ICAO SMS approach assumes a North American/ Western European perspective and ICAO assumes that the organizations implementing the SMS requirements are relatively large organizations with all the necessary resources. It is increasingly important that regulators understand the effects of national culture on attitudes and behaviour when designing programs in one country but which are required to be implemented in other countries. This research addresses the gap between regulatory requirements and reality, identifying the problems such organizations are facing while attempting to implement their SMS.

Successful implementation of an SMS depends on the active participation of every employee in fulfilling their designated roles and emphasizes the active engagement of the entire organization serving as one team to proactively manage safety (Chen and Chen, 2014). Organizations have to evaluate SMS performance in terms of its effectiveness. Mathis (2014) suggests early metrics for measuring the effectiveness of programs were failure metrics; that is, they were reactive and measured accidents or incidents after they occurred. To achieve the main objective for measuring safety performance, is to provide an ongoing assurance that risks are controlled.

The effectiveness of an SMS is evaluated by reviewing data and monitoring trends, and this can be performed quarterly by top management and monthly by the middle management. In some cases they will intervene when problems arise above the established acceptable levels of incidents. As long as they are not observing excessive numbers of adverse indicators, management operates under the assumption that their SMS is performing effectively (Stolzer et al., 2018). A literature review shows that some efforts have been made towards the development of SMS evaluation tools but close examination of these tools reveals short-comings. Thomas (2012) reviewed

year 2009 articles and found only 18 studies all of which used self-report metrics about the perceptions of safety within the organization to examine the effectiveness of the SMS. He also found that there was general consistency in the relationship between SMS and safety.

Deficiencies in organizations' safety management practices, may result in SMSs that are not successful, yielding misleading results and impeding the organization from improving their safety performance.

Several studies (Erikson, 2009; Oien et al., 2011b; Harms-Ringdahl, 2009; Hopkins, 2009a) have addressed the development of safety performance indicators (SPIs) and suggested what the quality characteristics of a safety performance indicator should be. ICAO (2013) defines an SPI as "*a data-based parameter used for monitoring and assessing safety performance*". Since the process of safety management involves the use of data, the quality of the data that are used to enable effective decision making must be considered throughout the development and implementation of an SMS. Unfortunately, many databases lack the data quality necessary to provide a reliable basis for evaluating safety priorities and the effectiveness of risk mitigation measures. Failure to account for the limitations of data used in support of safety risk management and safety assurance functions will result in flawed analysis results that may lead to faulty decisions and discredit the safety management process (ICAO,2013).

This may suggest that good quality data will contribute in developing more reliable SPIs, which will yield better safety performance measurement and increase the success of the SMS. The scope of the work in this thesis is to identify those factors may impede the quality of the data used for the development of SPIs, particularly in smaller Mediterranean countries. The work involves interviews from safety managers and safety department employees, and a questionnaire survey of other employees such as air traffic controllers, pilots, cabin crew and engineers in aviation service providers.

This thesis addresses the question concerning the quality of data the organizations rely on for the development of their SPIs and emphasizes the

importance of quality data in safety management systems in order to provide an accurate, reliable and representative picture of safety in the organization. The implementation of SMSs is quite recent, and organizations are still facing challenges with the collection of data to be used for the development of SPIs and measuring their performance. Hence, by using a combination of practical experience and theoretical knowledge, this thesis contributes by making a step forward towards identifying the factors may impede an organization from getting a clear image about safety in their organization. Safety performance is measured with same tools and techniques as those used in quality management and the standards by which they are measured are global in nature (Janicak, 2009). Evaluating the effectiveness of the SMS should be based on the four components of any SMS, and to evaluate the effectiveness of an SMS in aviation service providers, the audit questions developed reflect these four components of the SMS. While this thesis is concerned solely with aviation, some ideas presented in this document are applicable to other safety critical organizations such as oil and gas, and nuclear that are all required to have a safety management system for their operations.

1.2 Objectives and research questions

The objective of this PhD is to identify the factors that impede organizations from obtaining the data to be used for the development of their SPIs that they need to have as part of their SMSs for measuring and monitoring their safety performance. Particular emphasis is placed upon the implementation of SMSs in small Mediterranean aviation service providers.

The literature review presented in Chapter 2, suggested that in accidents such as that at Dryden, had the required effective and adequate resources, regulations, procedures, training and policies been in place in March 10, 1989 it is possible, and indeed likely, that the event sequence resulting in the accident would have been interrupted.

This current work extends the work of Gerede (2015) who performed a two-day workshop using nominal groups and brainstorming to identify the

problems with the implementation of the SMS. This study attempts to acquire deeper knowledge of the factors impeding the effectiveness of their SMS by performing, an extensive in-depth interview based study, followed by a structured questionnaire survey.

To address the related research questions concerning the development of SPIs for implementation in aviation service provider SMSs, the following steps were taken:

- A preliminary study which identified the factors that either individually or in combination impeded the successful collection of data used to develop the SPIs to measure the effectiveness of their SMS.
- A follow-on larger interview-based study used the findings from the preliminary study as themes for further interview questions to uncover what safety managers perceived to be the hindering factors of the quality of their safety data and the effectiveness of their SMS.
- A survey study used the theoretical framework to develop a questionnaire for aviation service providers' employees. This used Confirmatory Factor Analysis (CFA) and path analysis to validate the findings of the earlier interview-based, qualitative studies. The findings suggested that top management influenced the culture of the organization, and the presence of a just culture, resistance to change and safety culture influenced the SPI data collection of the organization.

1.3 Structure of the thesis

Chapter 1 considers the motivation for the thesis and its objectives.

Then, Chapter 2 turns to the description of the theoretical framework underlying most aviation SMSs. The chapter is introduced by the Air Ontario accident to demonstrate the effect of latent failures in a system and discusses the need for SMSs and the use of SPIs.

Chapter 3 discusses the research paradigm and the four elements that comprise the paradigm namely, epistemology, ontology, methodology and axiology.

After this, Chapter 4 introduces the preliminary study in which safety managers expressed their views about SMSs and SPIs. Based on the data derived from the interviews, using a grounded theory approach, factors impeding the development of SPIs were identified.

This is followed by Chapter 5 a larger interview study based upon the model derived in the previous chapter which identifies in depth the factors impeding the success of SMSs and the development of SPIs in aviation organizations.

Chapter 6 is a questionnaire study which surveys the views of a wider number of employees related to the success of the SMS, again building on the theoretical model developed in the preceding chapter.

Chapter 7 presents the general discussion, the Dryden accident and safety management today, and recommendations for safety management based on the findings of the accident.

Chapter 8 presents the results of all three studies, conclusions, the research contribution and the suggested further research.

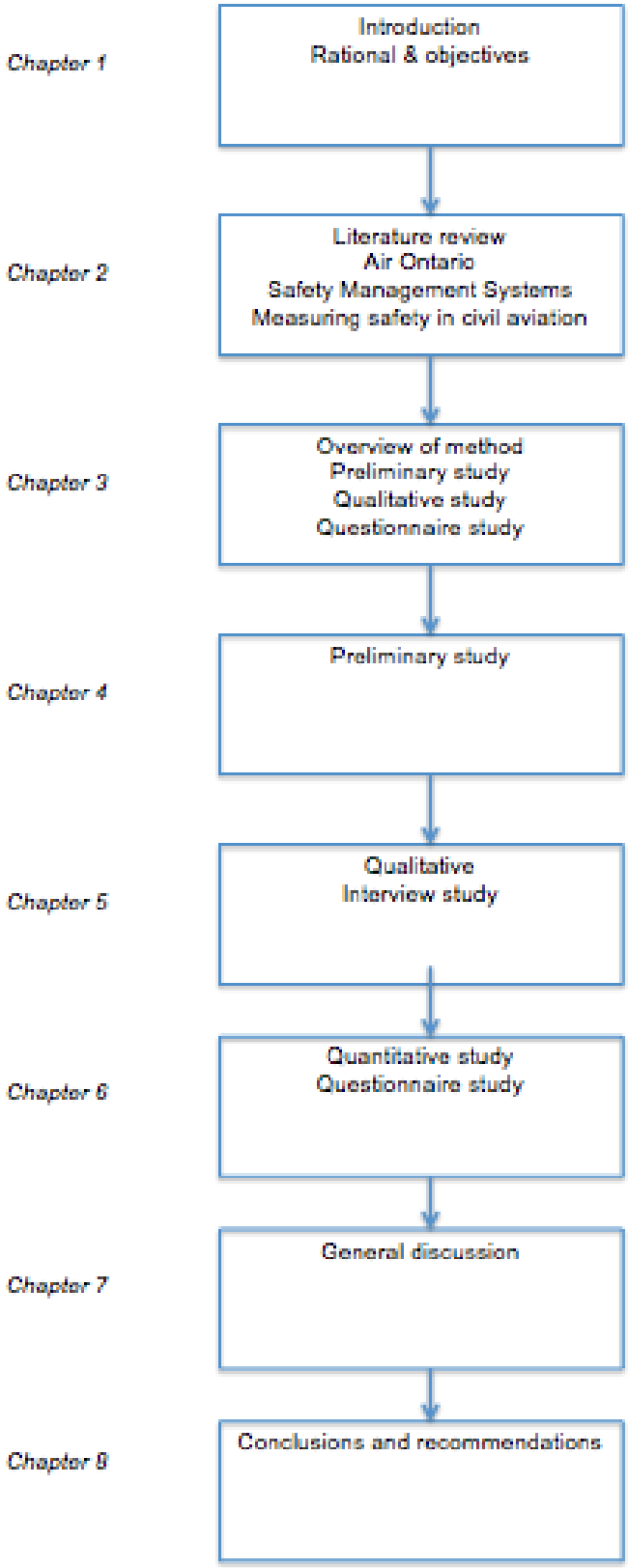

Figure 1 structure of the thesis

Chapter 2

2. Literature review

2.1 Air Ontario 1363

At 11:55 EST (Eastern Standard Time) Air Ontario Flight 1363 departed Thunder Bay about one hour behind schedule. The aircraft landed at Dryden at 11:39 CST (Central Standard Time). The aircraft was being refuelled with one engine running, because of an unserviceable APU. Since no external power unit was available at Dryden, the engines couldn't be restarted in the case of an engine shutdown on the ground. Although a layer of 1/8-1/4 inch of snow had accumulated on the wings, no de-icing was done because de-icing with either engine running was prohibited by both Fokker and Air Ontario.

At 12:09 CST the aircraft started its take-off roll using the slush-covered runway 29. The Fokker settled back after its first rotation and lifted off for the second time 5,700 feet down the 6,000-foot-long runway. No altitude was gained and the aircraft mushed in a nose-high attitude, striking trees. The aircraft crashed and came to rest in a wooded area, 3,156 feet past the runway end and caught fire. (Aviation safety network).

When someone comes across to an accident scenario like the above, it is impossible that the reader will not begin to ask questions. Why did such an experienced crew, exposed throughout their career to similar conditions like Dryden, ignore all the tale-tale indicators presented to them the day of the accident? Why did two healthy, competent and properly certified professionals allow their fully equipped aircraft head to destruction taking them with it? Why do humans make such obvious and damaging errors (Maurino et al., 1995)?

The answers to these questions will not be found by simply determining that it was human error but further away, within organizations, training departments and regulators (Maurino et al., 1995). A Commission of Inquiry was formed and the honourable Mr. Justice Virgil P. Moshanksky was appointed

commissioner. Moshansky disregarded what was considered to be obvious-human errors and asked a multi-disciplinary team of investigators, safety specialists, Human Factors specialists, pilots, researchers, engineers and regulators, over a period of 20 months, to try to find answers behind the decisions taken by the flight crew (Maurino et al., 1995).

Mr. Justice Virgil P. Moshanksky interpreted his mandate in this sense:

The mandate of this Commission was to investigate a specific air crash and to make recommendations to the interest of aviation safety. In carrying out this mandate it was necessary to conduct a critical analysis of the aircraft crew of Air Ontario, of Transport Canada and of the environment in which these elements interacted… I have adopted a system-analysis approach, with emphasis on an examination of human performance. (Moshansky, 1992, pp xxv)

The commission did not try to produce any probable cause statement, neither did it try to condense the complex processes as presented in most aviation accidents. Instead, the commission produced a report blending recommendations and the identification of the latent failures with the potential to generate accidents similar to that at Dryden. The report identified the preconditions that may trigger the active failures of operational personnel in similar contexts (Maurino et al., 1995). The investigation of the Air Ontario crash was one of the first large scale investigations to take a systemic, organizational approach to the investigation of an accident.

This statement from Moshansky reflects the analytical approach based upon Reason's (1990) "Swiss Cheese" model used in the analysis of Air Ontario flight 1363, which determined that the accident trajectory's penetration of the system's defensive layers, barriers should be kept in mind:

The pilot in command made a flawed decision but the decision was not made in isolation. It was made in the context of an integrated air transportation system that, if it had been functioning properly, should have prevented the decision to take off…there were significant failures, most of them beyond the captain's control, that had an operational impact on the events at Dryden…the

regulatory, organizational, physical and crew components must be examined to determine how each may have influenced the captain's decision (Moshansky, 1992, p. 1102).

The analysis of the accident was worked backwards: from the accident and the surrounding events to the latent failures and flawed organizational procedures. The analysis was built around four major areas: failed defences, unsafe acts, error- producing conditions and latent organizational failures (Maurino et al., 1995).

Accidents like Dryden and similar accidents, teach us that even if we remove from the accident the active failures meaning that the crash wouldn't have happened, the flawed organizational processes and the latent failures would still remain in the system (Maurino et al., 1995). Removal of active failures does not mean that the accident would not happen somewhere else, given the degree of 'sickness' and the numerous pathogens remaining hidden in the system. On the contrary, based on experience from other accidents in complex sociotechnical systems, if we remove the latent failures and the organizational pathogens, the active failures may disappear.

When the time came to conclude the report after 20 months of investigation, Mr Justice Moshansky concluded:

Captain Morwood, as the pilot in command, must bear the responsibility for the decision to land and take off in Dryden on the day in question. However, it is equally clear that the transportation system failed him by allowing him to be placed in a situation where he did not have all the necessary tools that should have supported him in making the proper decision (Moshansky, 1992 p. 1131).

This statement plays an important role in the subsequent improvement of safety and effectiveness in modern, complex sociotechnical systems. The flight crew, cabin crew, Systems Operations Controls dispatchers, ground handlers any other personnel involved in context surrounding the crash of the Air Ontario failed and the last line of defence also failed to prevent the accident. But if we are seeking improvements in safety and effectiveness in

sociotechnical systems, rather than hide everything under the rug, we need to examine the organizational processes that generate the holes in these defences. The report has taught us an important lesson: although there is no substitute for a properly trained and professional flight crew, no matter how hard they try, no matter how professional they are, no matter how concerned they are and how much they care, humans can never outperform the system which bounds them and constrains them (Maurino et al., 1995). It's only a matter of time, and sooner or later system flaws inevitably will defeat individual human performance.

Moshansky (1992) in the introduction of his findings wrote:

"The accident at Dryden on March 10, 1989, was not the result of one cause but a combination of several related factors. Had the system operated effectively, each of the factors might have been identified and corrected before it became significant. It will be shown that this accident was the result of an overall failure in the air transportation system".

2.2 Theoretical framework: this "Swiss Cheese" model

A survey of the Human Factors literature (Hollnagel, 1993) revealed that the contribution of human error in the breakdown of hazardous technologies has increased to more than 80% and it has become apparent that these contributory factors were not restricted to the sharp (operational) end. Accidents such as that at Dryden indicate that the human contributions to major accidents are distributed widely within the organization as a whole and may be present several years prior to the final event. Those concerned with analysing the causes of such organizational accidents are faced with the challenge to develop a theoretical framework that could be meaningfully applied retrospectively to particular events (such as the Dryden crash) as well as proactively to complex socio-technical systems (Maurino et al., 1995).

2.2.1 The accident trajectory

Reason (1997) suggests that there are two kinds of accidents: the ones that happen to individuals and the ones that happen to organizations.

Organizational accidents are comparatively rare but when they happen, they are often catastrophic events that occur within complex modern socio-technical systems such as nuclear power plants, aviation, the petrochemical industry, marine, rail, transport. Organizational accidents have multiple causes involving many people operating at different levels within their organization. Organizational accidents may be truly accidental in the way in which the various contributing factors combine to cause the bad outcome but there is nothing accidental about the existence of their precursors nor in the conditions that created them. All organizational accidents entail breaching of barriers and safeguards.

In the 'Swiss Cheese' model (Reason, 1997), an organization's layers of defenses against failures are characterized as a series of barriers, metaphorically represented as slices of cheese. The holes in the cheese slices represent individual weaknesses in individual parts of the system that are shifting around, shrinking, expanding continually varying in size and position in all the slices. For an organizational accident to take place, it is necessary that a rare conjunction of a set of holes in successive defences (represented) as slices of cheese, allow hazards to come into damaging contact with people and assets (Reason, 1997). These "windows of opportunity" are rare because of the multiple defences and the mobility of the holes. The system as a whole produces failures when holes in all of the slices momentarily align, permitting "a trajectory of accident opportunity", so that a hazard passes through holes in all of the defenses, leading to an accident.

Active failures in the defences can create holes in at least two ways: front line personnel may deliberately disable certain defences to achieve local operational objectives or they may unwittingly fail in their role as one of the system's most important line of defence. Latent failures, such defensive weaknesses, will be present from the very beginning of a system's productive life, or will develop unnoticed or uncorrected during its subsequent operations.

The framework traces the development of an accident sequence from organizational and managerial decisions, to various conditions in the workplace and to personal and situational factors leading to errors and

violations. The Swiss cheese framework (Reason, 1990) suggests that accidents in which pre-existing and often long-standing latent failures arise in the organizational and managerial sectors, combine with local triggering conditions on the flight deck, in the air traffic control centre and/or in maintenance facilities, to penetrate or bypass aviation system's multiple defences (Maurino et al., 1995). The framework suggests that active and latent failures breach the system's various defences (or bypass some or all of the defences or safeguards) leading to an accident (Maurino et al., 1995). Researchers and practitioners are now concerned with specifying these organizational preconditions to enhance crisis management, safe performance and risk handling in complex and hazardous situations (Pidgeon, 1997). Turner's case study work (1978) revealed that there are always many preconditions in the lead up to a disaster some originating several years prior to the actual event itself.

2.3 Aviation Accident rates

Accident statistics in the ICAO 2017 Safety Report, for the last five years show, a decrease in both the overall number of accidents as well as the accident rate. In 2016 the downward trend in the number of accidents continued with 75 accidents reported, representing an 18 per cent decrease from 2015. Over the same period there was in increase in scheduled commercial departures which resulted in a global accident rate of 2.1 accidents per million departures, down by 25 per cent from the 2015 rate of 2.8 accidents per million departures.

According to Aviation Safety Network (2017) data, despite several high-profile accidents, 2016 was a very safe year, showing a very low total of 19 fatal airline accidents resulting in 325 fatalities and making it the second safest year ever, both by number of fatal accidents as well as in terms of fatalities. Commercial air transport accidents in 2016 resulted in 182 fatalities, which is a return to a similar level as 2013 when there were just 173 fatalities. The two intervening years saw a spike in fatalities due to a number of acts of unlawful interference that resulted in a large number of casualties. In 2015 Aviation Safety Network recorded 16 accidents and in 2014, 21 accidents (including

terrorism) with 990 fatalities, while in 2013, 29 accidents were recorded and a total of 265 lives were lost. Given the expected worldwide air traffic of about 35,000,000 flights, the accident rate was one fatal passenger flight accident per 3,200,000 flights (Aviation Safety Network).

The low number of accidents comes as no surprise. According to Aviation Safety Network President Harro Ranter: "*Since 1997 the average number of airliner accidents has shown a steady and persistent decline, for a great deal thanks to the continuing safety-driven efforts by international aviation organizations such as ICAO, IATA, Flight Safety Foundation and the aviation industry*." (Aviation Safety Network, 2017)

In point of fact, ICAO recognizing the need to carry out aviation activities safely and that the public's perception of aviation safety was based on the number of aviation accidents rather than the accident rate, issued a resolution in 2003 to reduce the number of accidents (ICAO, 2003:67). Nevertheless, despite the reduction in the accident rate, the expected increase in the volume of international civil aviation will result in an increasing number of aircraft accidents unless the rate is further reduced. Improvements in the accident rate will require new approaches on the part of all participants in the aviation industry, including ICAO, member states, aircraft manufacturers and operators, and in particular by adopting a pro-active, risk analysis-based approach that recognizes that the human element in the aviation system is of paramount importance to accident prevention initiatives and aviation safety (ICAO, 2003:67). As such, SMSs are expected to significantly improve aviation safety (Gerede, 2015b).

2.4 Safety Management Systems

2.4.1 Traditional safety management approaches

Based on the assumption that the aviation system operates as it should do, the traditional safety paradigm sees the world as it should be, providing a description of the ideal world and argues that aviation service providers need to comply with the prescribed order (Gerede, 2015a, b). Compliance with prescriptive regulations is the tool that is used for safety improvement (ICAO,

2009:2-32; ICAO, 2013:3-13,3-11; Zimmermann et al., 2011; Maher et al.,2011). Traditional safety management approaches that use audits in their practices to ensure compliance fail to see the system as a whole, disregard subsystem interactions and depend upon reactive tools for analysis (ICAO, 2013a: 2-32; ICAO, 2009:3-10,3-11, 3-13). Prescriptive regulations are generic tools used by all aviation service providers at regional, national and international level. Because these are generic tools, these regulations may not be able to address all the specific hazards that are likely to be present in individual aviation organizations and in different contexts and may be ineffective against the hazards that arise. Although regulatory compliance is achieved, there might still be unique organizational and contextual factors that contribute to people making errors and as a consequence, diminish safety (Safety Management International Collaboration Group, 2010).

2.4.2 Performance based approaches

ICAO realized that as the aviation system has become more complex, with human performance and limitations and the impact of organizational processes, it was no longer be possible to exert control using simple regulations that would be sufficient to ensure safety (Transportation Research Board, 2009:7; ICAO, 2009:3-13). Experience has shown that to reduce the likelihood of an accident reactive changes in regulations need to be changed to a pro-active system which attempts to anticipate potential safety risks, rather than waiting for something to happen and then developing the necessary regulations. ICAO therefore introduced Annex 19, Safety Management Systems (EU:COM/2011/0670). The civil aviation authority of New Zealand describes SMSs as a formal risk management framework to improve safety. In an SMS, organizations have systems for hazard identification and risk management, safety targets and reporting processes, procedures for audit, investigation, and implementing remedial actions to improve performance and safety promotion and training.

This relatively new safety paradigm does not prescribe how the world should be but considers how it really is. The paradigm goes beyond regulatory compliance and suggests a systems and performance-based approach

(ICAO, 2009:3-13; ICAO, 2012a: 2-5, 2-32; Oster et al., 2013; Zimmermann et al., 2011; Lofquist, 2010). The systems approach takes into consideration hazards and risks that might result from the interaction of hardware and liveware (Edwards, 1972). Using this approach, it is possible to determine the hazards and risks deriving from the interaction of systems and subsystems (Gerede 2015a; Lofquist, 2010). Seeing the world as it is also means evaluating the role of human factors, which is the most important component of the system (Lofquist, 2010). It makes it possible to detect organizational and contextual hazards and risks which go unnoticed by prescriptive regulations covering more general hazards and risks (Gerede, 2015a).

A performance-based approach combines prescribed standards with the performance standards expected from aviation organizations to demonstrate continuous improvements in safety performance but while at the same time complying to the regulations (ICAO, 2013:2-5, 2-32). Any SMS will need to provide in a timely manner accurate and rich data proactively to measure the organization's performance and for future prediction (United Kingdom Civil Aviation Authority, 2014). To be proactive, measure safety performance and make future predictions, organizations need both top-down and bottom-up organizational communication, a reporting culture, a learning culture, top management commitment, participation of employees, safety commitment and a positive safety culture (Gerede, 2015a). All of these safety management activities are important for the effectiveness of an SMS.

Although different manuals are published to assist in the implementation of Annex 19, (e.g. Safety Management Manual - SMM 3rd edition, 2013; UK CAA, CAP 795), these manuals are considered to be guidance material to be used for regulatory compliance. Practitioners in the aviation industry use these materials to comply with the regulations. Nevertheless, the ICAO SMS approach assumes a North American/ Western European perspective and it is also assumed that the organizations implementing the SMS's requirements are relatively large with the necessary resources. It is increasingly important that regulators understand the effects of national culture on attitudes and behaviour when designing programs in one country but which are required to

be implemented in other countries. This research addresses the gap between regulatory requirements and reality, identifying the problems that organizations from smaller Mediterranean countries are facing while attempting to meet these international regulatory requirements.

2.5 Safety management practices for the success of safety management systems

The use of SMS programs to manage major hazards were used in Nuclear power plants before it was introduced into aviation. The primary objective of an SMS program is to establish a safety culture which can detect and correct safety-related problems before these result in an accident (Lewis, 2008). The SMSs used in organizations comprise a set of policies and practices aimed at positively impacting workers' attitudes and behaviours with regard to risk and thereby decreasing their unsafe acts, raising awareness, and increasing understanding and commitment (Fernandez-Muniz et al., 2007).

Studies in other industries with similar safety management systems (Fernandez-Muniz et al., 2007) including construction (Aksorn & Hadikusumo, 2008; Ismail et al., 2012), shipping (Bhattacharya & Tang, 2013), hazardous chemical industries (Vinodkumar and Bhasi, 2009), have identified common critical components for improving the performance of an SMS as well as barriers to its successful implementation. Findings from studies that have demonstrated a relationship between safety management practices and safety performance, although conducted in other socio-technical systems, can make beneficial contributions to improving the performance of SMSs in aviation organizations.

Research as early as the 1970s suggested that the success of safety programs in organizations depended upon certain safety practices that could successfully deal with "people" variables. Cohen (1977), Cohen et al. (1975), DePasquale and Geller (1999), Griffiths (1985), Harper et al. (1997), Shafai-Sahrai (1971), Shannon et al (1996, 1997), Smith et al. (1975), Lee, (1998), Ostrom et al., (1993) all observed that organizations with lower accident rates were characterized by just a few factors including: management showing

personal involvement in safety activities; high quality training for new employees and re-current training for existing employees; display of safety posters for identifying hazards; daily communication between workers and supervisors; frequent safety inspections; high priority to safety meetings and decisions concerning working practices; thorough investigation of accidents; and empowerment of the workforce.

Zohar (1980) found that management's commitment to safety was a major factor influencing the success of SMSs in organizations. In the mid-1980s, after the Chernobyl accident, focus was placed on safety culture due to several safety deficiencies in the Chernobyl power plant such as ambiguous operating procedures, flawed designs and safety features, breaching of safety rules by operating staff, lack of competence, and pressures to meet production goals.

Worker involvement has been considered as a decisive factor in safety management by Lee (1998), Rundmo (1994), Dedobbeleer and Belard (1991), Shannon et al., (1996), and Cox and Cheyne (2000). There are different degrees of employee participation, ranging from no participation to full participation. Since employees are the ones who are actively involved in their work, they are also the best qualified people to make suggestions for improvements. It was suggested that management should consult with them before taking the final decision, especially for decisions that affect these employees (Vredenburgh, 2002). Employee involvement is a behaviourally-oriented technique used in the bottom-up communication and decision-making processes in an organization. Several studies (Vredenburgh, 2002; Cox and Cheyne, 2000; Mearns et al., 2003) have shown that safety performance was influenced by the level of communication within organizations and that regular communication about safety issues between management, middle management and the workforce was an effective practice to improve safety. Communication also includes feedback, hazard reporting systems, an open-door policy for safety issues, and the opportunity to discuss safety in meetings. Vredenburgh (2002) also included worker

participation, safety training, reward systems, management's commitment and communication feedback.

The use of incentives, awards and recognition to motivate employees to report and perform safely is an accepted organizational practice to improve safety management (Hagan et al., 2001). A well-designed reward system offering recognition can help to modify behaviour (Vredenburgh, 2002). This study also suggested that these safety management practices helped to improve safety performance and safety promotion policies. Rewards and incentives for reporting hazards further created employees' awareness by organizing programs, safety week promotions, and inducing healthy competition to report hazards and unsafe conditions, encouraging supervisors to make workers report safety matters.

Galotti (2006) suggested that even though it has been a number of decades since Cohen's research (1977), successful safety management programs still depend on those practices that can deal with employees' participation. One of the important ways to achieve the successful implementation of an SMS is to ensure that all employees participate in the system and fulfil their role, as the system is comprised by a set of processes which manage safety across intra-departmental boundaries (Galotti, 2006).

Findings from studies suggest that the implementation of safety management practices benefit organizations' safety performance (Vinodkumar and Bhasi, 2010). Research has been on-going in an attempt to identify all the management practices that can enhance safety management programs. There have been a number of studies attempting to identify specific safety management practices that can predict safety performance (Vinodkumar and Bhasi, 2010). Safety training provides the means to make accidents more predictable (Vinodkumar and Bhasi, 2010). Training as a safety management practice included training of new employees, recurrent training for existing employees, discussion of safety issues in training sessions, training for emergency situations, encouragement to attend training and hazard assessment training (Vinodkumar and Bhasi, 2010).

Employees' perceptions about the SMS practices of their companies can be interpreted as their insights concerning how greatly their airline (or other aviation organizations) values safety and their perceptions of the effectiveness of adopting such a proactive safety approach in the organization (Chen and Chen, 2014). Their findings suggest that the more positively the employees perceive the SMS practices within their airlines, the stronger the motivation they have to perform the required safety-related behaviours. Chen and Chen (2014) revealed that positive perceptions of their airline's SMS practices had significant and positive effects on their safety motivation, compliance and participation. This implies that the more effort aviation organizations make in the implementation of their SMS, the more likely that the employees will acknowledge the benefits that the SMS has in enhancing the organization's operational safety. When employees appreciate the efforts that their organization is making, they will work even harder to meet their job requirements and will have more incentives to participate in safety-related activities and safety programs (Chen and Chen, 2014).

A better understanding of employees' viewpoints regarding SMS practices in their organization will help to improve SMS practices. But one thing that is accepted by all is that safety management practices play a vital role in forming the safety culture in the organization (Vinodkumar and Bhasi, 2010). Zohar (2010) claims that research over the past 30 years has demonstrated safety culture is a robust predictor of safety outcomes across industries and countries.

2.5.1 Safety culture and safety relevant behaviour

2.5.1.1 Safety culture

Organizational *climate* is described as the enduring and perceived quality of the inner environment and features of an organization, which can be influenced by people working within the organization (Von Rosenstiehl & Nerdinger, 2011).

Organizational safety climate has been suggested as having a fundamental effect on safety behaviours (Cooper and Phillips, 2004; Fogarty and Shaw,

2010). Reviews of safety climate literature (Flin et al., 2000; Guldenmund, 2007) suggest that management's attitudes and behaviours to be the predominant safety climate factors.

Organizational *culture* is different from organizational climate and reflects the usual and habituated way of thinking and acting in organization.

A popular theoretical notion that arises from the world of risk management, is that of an organizational safety culture. Safety culture was first mentioned in the investigation of the Chernobyl nuclear power plant accident in 1986 where a poor safety regime was declared as a major contributory factor (International Atomic Energy Agency, 1986). The interest in safety culture can be traced back to this accident and to the human preconditions prior to that event (Pidgeon, 1991). Human preconditions that contributed in part to the Chernobyl nuclear disaster were considered by some, in hindsight to be evidence of a poor safety culture. However, some authors (Olson, 1987; Wagenaar et al., 1994) note that there are formidable measurement difficulties associated with demonstrating whether safety improvements will be unambiguously reflected in accident statistics.

Safety culture can be assessed based on the presence of a number of underlying components including: an informed workforce (shared safety information), incident/accident/hazard reporting (open communication of mistakes), just culture (fair treatment of employees), learning organisation (continuous improvement) and flexible culture (adaptation to unexpected situations), management safety attitudes (a genuine commitment to safety), safety-relevant behaviour (involvement, teamwork, responsibility) and risk perception (awareness of operational threats); (Ek, Akselsson, & Johansson, 2003; Ek & Arvidsson, 2002; Guldenmund, 2000; Hopkins, 2006; Reason, 1997; Wiegmann et al., 2002).

Good safety culture might both reflect and be promoted by at least four facets: top management safety commitment to safety, shared care and concern about hazards and a solicitude over their impacts upon people; realistic and

flexible rules about hazards; and continual reflection upon practice through monitoring, analysis and feedback systems (Pidgeon, 1997).

Organizational practices affecting the performance and reliability of safety systems are the ways in which safety is managed in aviation organizations which lead to either a positive or an apathetic safety culture (Reason 1993, 1997). Aspects of safety culture are found in the shared attitudes of care and concern throughout the organization (Pidgeon and O'Leary, 1995) and in the visible commitment to safety of senior management (Droste, 1997).

2.5.1.2 National culture in aviation

Aviation statistics suggest that more than 70% of aviation accidents are caused by human error (Helmreich & Foushee, 1993). The aviation industry has expanded human factors training beyond the human-machine interface to embrace psychological areas such as communication, leadership, performance under stress, interpersonal relations and decision making (Wiener, Kanki & Helmreich, 1993). Evidence suggests that these areas are all influenced by national culture (Bond, 1988; Hofstede, 1991; Berry, Poortinga, Segall & Dasen, 1992). National culture is defined as the attitudes, values, behaviors, beliefs, symbols and customs associated with a national group membership (Meshkati, 1994). Understanding the effects of national culture on attitudes and behaviour has always been important in global aviation. It is becoming increasingly important as international mergers become more commonplace, as more airlines employ personnel from different backgrounds and as training programs or regulations which are designed in one country but implemented in other countries (Merritt & Helmreich, 1996). Empirical findings have demonstrated large cross-national differences in attitudes regarding task performance across several work domains including aviation (Hofstede, 1980; Merritt, 1996; Merritt & Helmreich, 1996). Despite these findings, it seems that aircraft manufacturers, training organizations and airlines still operate under the assumption that the flying task is generic and that all pilots view automation and the use of automation similarly, whatever their background. Studies in aviation (Helmreich et al. 2001), more relevant to the cockpit, have shown that three sub-cultures can influence crew

performance: professional culture of the pilots, the culture of the organizations and the national culture surrounding individuals and the organizations. National culture may be responsible for differences in attitudes toward automation and as well differences in attitudes toward interpersonal interactions on the flight deck (Foslin et al.,1979; Moghaddam, Taylor and Wright, 1993; Yamaguchi,1994; Helmreich, Merritt, & Sherman, 1996; Merritt & Helmreich, 1996, 1997). The three cultures, professional, organizational and national can have both positive and negative impact on the safe operations and its responsibility of the organizations to minimize the negative components of each type of culture while emphasizing the positive. Geert Hofstede's four-dimensional model of culture was the starting point of examining the effects of national culture on behaviour. A significant amount of data suggested that there were substantial differences in the way pilots performed their work influenced by their national culture and those areas of difference had implications for safety. (Helmreich & Merritt, 1998; Johnston, 1993; Merritt & Helmreich, 1996a; Merritt & Helmreich, 1996b; Sherman, Helmreich, & Merritt, 1997). Research into the effects of Crew Resource Management (CRM) training has shown that attitudes about the conduct of flight are amendable through training but on the contrary, attitudes that are related to strong cultural norms are more difficult to modify because they are deep rooted in strong value systems (Helmreich & Wilhelm, 1991; Sherman, Helmreich & Merritt, 1997).

2.5.1.3 Attitudes and Behaviour

Major accident investigations such as the Baker report (2007) on the Deepwater Horizon, have showed that top management has a particular influence on organizational safety (Fruhen et al., 2014b). Top management can influence up to 45% of an organization's performance (Day and Lord, 1988) and can have a significant influence on organizational safety (Clarke, 1999). Other studies (Beus, et al., 2010; Christian et al., 2009) identified the perceptions of management's safety commitment as one of the most influential safety climate components in relation to organizational safety performance.

There are a number of studies showing that attitudes and behaviours are significantly associated with each other (Ajzen and Fishbein, 1980; Ajzen, 1988). Managers' attitudes affect behavioural intentions and managers' behaviour is related to the achievement of safe working practices (Rundmo and Hale, 2003). Attitudes affect the decisions of the top and middle management and also influence the conditions under which employees will take a decision. Management attitudes affect priorities, such as policy about safety, and they also affect, either directly or indirectly, employee attitudes and behaviour (Rundmo and Hale, 2003). The attitudes demonstrated by managers that are considered as ideal by Rundmo and Hale (2003) are the ones that the managers have for detecting and controlling hazards, prioritizing them, choosing good solutions, implementing these solutions, and monitoring and learning from them. They also need to have the relevant knowledge to carry out the required steps and they need to make available resources such as time, money, competence and equipment for the tasks, giving them priority and without shifting their responsibility to others. The ideal safety attitude (Rundmo and Hale, 2003) is the one that contributes to enhancing safety by encouraging appropriate behaviours. Management that is committed and involved in safety promotion leads to lowering the frequency of accidents/incidents.

2.6 Reporting culture/systems, just culture and criminalization of human error

2.6.1 Reporting systems and just culture

The main advantage of critical incident reporting is the opportunity to act to prevent accidents before losses have occurred (Tarrants, 1963). Reporting means collecting data for proactivity, which is a crucial element of an SMS (ICAO, 2013a: 2-16, 2-17). However, Hopkins (2009a) argued that there are circumstances in which there is no need to make use of precursor events to evaluate the effectiveness of an SMS. Precursor events are warning signs; companies need to seek out these warnings and act on these signs. Organizations need to develop reporting systems to capture such information. Research shows that virtually every major accident is preceded by such

warning signs and that the accident would not have occurred had the organization concerned responded to these warnings (Turner, 1978).

Gerede's study (2015b) has shown that a poor reporting culture is one possible challenge to the implementation of an SMS. If people report their honest mistakes in a just culture, they will not be blamed (Dekker, 2007b). The reason for not being blamed is that the organization can benefit much more by learning from the mistakes that were made than they can from blaming the people who made them (Dekker, 2007b). As a result, people should feel free to report. The problem is that often, they don't feel free and they don't report. This is because they perceive reporting as being risky. Many things are not clear: who is going to read the report and how are they going to report? What are the rights and obligations of the reporter? Will the reported information stay within the organization or will other parties such as media and will the prosecutor have access to it (Dekker, 2007c)? People fail to report, not because they want to be dishonest, but because they fear the consequences, or they believe that nothing meaningful will be done as a result. Other reasons why people fail to report may be that either people do not know the consequences of reporting, fear of the unknown, or the consequences of reporting really can be bad and people fear invoking such consequences. Alternatively, people know the consequences but feel that there is no point in reporting because the organization will not do anything with the report anyway.

In the aftermath of an incident, judicial proceedings can make people stop reporting incidents. Dekker (2007c) discusses the instance where an air traffic service provider reported a 50 per cent drop in reported incidents in the year following the criminal prosecution of the Controllers involved in a runway incursion incident. The threat of criminal prosecution can make people hesitant about coming forward with safety information and this can create a climate of fear, making people reluctant to share information. Judicial proceedings can help to stigmatize personnel and present an incident as something shameful. This sends the message to everyone in the industry that

incidents are something professionally embarrassing and if it is not possible to avoid them, they should be hidden (Dekker, 2007a).

Challenges related to reporting can also become an obstacle in organizational learning. To be able to learn from lessons in the past and to assure safety in the future, it is necessary to collect safety-related data and extract information from this data (Gerede, 2015b). Incident data is an important element of an SMS as from incident data, safety metrics can be derived and quantitative risk assessments can be conducted (Wilke et al., 2014). Yet, the quality of the incident data resident in an organizational database influences the results. The output of any data analysis is limited by the quality of the data collected (Wilke et al., 2014). Unsuccessful reporting is likely to hinder hazard identification and risk analysis, risk mitigation measures the measurement of safety performance (including safety performance monitoring over time), finding root causes of factors that compromise safety, predicting the future, and taking measures for the management of change (Gerede, 2015b). The most significant challenges are those affecting reporting which are derived from a poor reporting culture.

Sagan (1993) suggests that there is a catalogue of political barriers to active learning, as parochial conflicts lead to faulty reporting of incidents, secrecy and the normalization of errors in the face of external accountability (Rijpma, 1996). What seems to be at the centre of this issue is the institutional notion of ‘blame’. Douglas (1992) pointed out that ‘danger’ and ‘blame’ have been ubiquitous features in societies over the years used as a means to defend favoured institutional arrangements. Ironically, nowadays, risk management and its assessment are also concerned with the possibilities for blame (Pidgeon, 1997). Knowing that responsibility brings accountability, consequently blame for accidents will be apportioned with possible legal sanctions invoked; organizations and individuals might need to examine their activities and act in good faith. On the other hand, if a “culprit” has to be found whenever an error has occurred, the process of political sensemaking will emphasize the avoidance of blame rather than open critique and honesty. Therefore, efforts to motivate people to act safely through sanctions may be

self-defeating and result in poor or incomplete information, which is a precondition to vulnerability. If politics and blame do corrupt the possibilities for organizational learning, then the most important challenge resides in the ways by which such actions might be counteracted (Sagan, 1994). The question is how to embed successfully into a reporting system the social, political organizational and national context (Pidgeon, 1997).

Beck (1992) suggested that there has been a reduction in the acceptance of risk altogether, with the expectation that some safety-critical activities are accident free, with zero tolerance of failure. The increasingly flawless performance of some systems may have created a societal belief in their infallibility and intolerance of failure (Amalberti, 2001). Experts are expected to analyse and make accidents comprehensible, which often means explaining which factors were not controlled and by whom. The accident has to go on to someone's account (Douglas, 1992).

2.6.2 Criminalization of error

Aviation and healthcare sectors are both reporting an increase in the criminalization of human error (Michaelides-Mateou and Mateou, 2010; Michaels, 2008; Pandit, 2009; Ter Kulle, 2004; Thomas, 2007) and automatic criminal prosecution after an aviation accident has become a common practice in most countries (FSF, 2006; ICAO, 2007). In aviation, the criminal prosecution (mostly of front line operators) after an aviation accident has occurred in the Netherlands (Ruitenberg, 2002), England (Wilkinson, 1994), Spain (Brothers and Maynard, 2008), France (Esler, 2009), Italy (Learmount and Modola, 2004), Greece, Cyprus (Mail, 2009), the United States (Michaels, 2008) Taiwan (Thomas, 2002) and as well in other countries (Dekker, 2011). Dave Adams, a partner at Chicago-based aviation litigators Prangle & Schoonveld said in a speech to the Flight Safety Foundation's Corporate Aviation Safety Seminar (CASS) in San Antonio, "Since 1955, there have been 55 accidents resulting in criminal trials." However, 28 of them have occurred since 2000, confirming this increase. A major percentage of those prosecutions have taken place in Europe, Asia and Africa (AIN online, 2012)

In the aftermath of several accidents and incidents (Wilkinson, 1994; Ballantyne, 2002; Ruitenberg, 2002), the people involved (pilots and air traffic controllers) were charged with criminal offences such as professional negligence or manslaughter (Dekker, 2003). Criminal charges differ from civil lawsuits mainly because the target is not an organization but individuals (e.g. flight crew, air traffic controllers, mechanics) who were involved in the accident or incident (Dekker, 2002). The fear and threat of criminal charges will make employees stop sending safety related information and incident reporting will then stop (Ruitenberg, 2002; North, 2000). In fact, blaming and punishing individuals does not make the individual act more safely; indeed, the very idea that vicarious learning or redemption through criminal justice is universally controversial (Dekker, 2003).

After the Valuejet accident (NTSB, 1996), it was believed that the failure to put caps on the oxygen generators constituted wilful negligence and prosecutors were right to bring charges (Dekker, 2002). North (2000, p.66) suggests that there has to be some fear that not doing one's job correctly could lead to prosecution. Human Factors research agrees (Reason, 1997; Palmer et al., 2001; Woods and Cook, 2002) that progress on safety depends on taking a systems perspective: accidents are not caused by failures of individuals but are the result of an alignment of contributory system factors. The route of the accident is in the system, not its component parts. Progress in safety depends upon moving beyond blame: blame leads to defensive behaviours, obfuscation of information, protection of oneself and mute reporting systems.

As Sidney Dekker (2002) said: *"You can either learn from an accident or punish the individuals involved in it, but is probably very difficult to do both the same time".*

Wilkinson (1994) presents a case study where a pilot, after allegedly narrowly missing a hotel at Heathrow in thick fog, was the subject of criminal proceedings. The authorities subsequently determined that this pilot would need to be punished, demoted. To make it even worse, the media, had a large share in dramatizing the case and promoted the captain's

dehumanization to the point where his suicide was the only way out (Dekker, 2003).

2.6.3 Media and populism

The media doubtlessly plays a strong role in promoting certain accidents, while being able to ignore others (Dekker, 2007b; Ditton and Duffy, 1983; Ödegård, 2007; Palmer et al., 2001). A study (Miyazawa, 2008) linking cultural and political populism to the punitiveness of a country's criminal justice system and media coverage of an event has been shown to animate social reactions to the point of construction anti-heroes (Elkin, 1955; McLean and Elkind, 2004) and their crimes (Dekker, 2007b; Ericson, 1995; Innes, 2004; Jacobs and Henry, 1996; Tuchman, 1978). The coverage of and discourse surrounding social issues such as hate crime, recently extended to accidents and human error, has been linked to political populism, judicial responses and criminalization of new categories of human action (Blackwelder, 1996; Engbersen and Van der Leun, 2001; Husak, 2008; Jacobs and Henry, 1996; Phillips and Grattet, 2000).

This study attempts to identify the factors that impede the collection of quality data used for the development of SPIs, which are developed based upon the information derived from reporting systems. The role of the media in aviation accidents, cultural populism and the punitive system of each country, criminalization of human error and social issues surrounding an aviation accident can all have an impact on the quality and quantity of reports an organization collects through its reporting system. Fear of punishment and the feeling of being stigmatized will result in a decrease in the number of reports and a lower quality of data that do not provide insight or useful information.

2.6.4 Interference with safety reporting and disclosure of errors

The negative consequences of the criminalization of safety, particularly its detrimental effects on honest disclosure (Berlinger, 2005) and incident reporting (Ruitenberg, 2002) has been observed more in healthcare and aviation than in other contexts. The biggest concern with judicial action after

accidents in aviation and healthcare has focused on how it interferes with independent safety investigations and destroys the willingness of people to voluntarily report errors and violations (Berlinger, 2005; Brous, 2008; Chapman, 2009; Dekker, 2007a, 2009, 2011; FSF, 2006; Thomas, 2007). Willingness to report their errors and violations is a critical ingredient for the creation of a safety culture, an organizational culture which encourages the honest disclosure and open reflection on their own practices with the aim to constantly improve quality and safety of their products and services (Lauber, 1993). Learning from failure is encouraged across industries through independent safety investigations and is hampered when a professional mistake is criminalized (Dekker, 2011). Professionals seem to face two alternatives: either they report a mistake and get into some kind of trouble for it (stigmatized, reprimanded, fired or even prosecuted) or they do not report the mistake and keep their fingers crossed that nobody else will do so either (Dekker, 2007b). When a professional mistake is criminalized, a common response enacted spontaneously by individuals is to become better at making the evidence disappear and not to report errors (Dekker, 2011): “practicing under the threat of prosecution, can only serve to hide errors” (Chapman, 2009).

2.6.5 Consequences of criminalizing human error

Criminalization typically leads to detrimental psychological consequences for the people involved (Dekker, 2011). The memory of an error stays with the individual for many years (Serembus et al., 2001). Guilt and self-blame are very common, with professionals denying the role and contribution of the system or the organization to their error and blaming themselves entirely (Meurier et al., 1998; Snook, 2000). This sometimes includes hiding the error from their family, thereby distancing themselves from any possible support (Christensen et al., 1992). Criminalization might also have consequences for the person’s livelihood, as a license to practice may be revoked automatically which in turn can generate a whole new layer of anxiety and stress (Dekker, 2011). Naturally, victims may derive some sort of consolidation, if not a sense of retribution, with the criminalization of professional mistake (Dekker, 2011). From the victim’s point of view, criminalization of an individual can also be

seen by them as being unfair, counterproductive or as scapegoating (Mellema, 2000). Even victims might interpret this as getting the organization or government regulators off the hook and oversimplifying the complexity of contributory events (Dekker, 2011). This is also covered in the safety literature (Perrow, 1984) where condensed explanations of failure and associated criminalization are used to protect elite interests (Levack, 1987) and help avoid fixing a system (Goode, 1994). Criminalizing an individual will not give the confidence to the victims that a similar incident will be prevented in the future (Dekker, 2007c; Dekker and Hugh, 2009; Merry and McCall Smith, 2001).

2.7 Measuring safety in civil aviation

Safety margins within the Norwegian air transport sector had been significantly reduced, therefore the Norwegian Ministry of Transport instructed the Norwegian Accident Investigation Board to conduct a review of the civil aviation industry (Lofquist, 2010). The study was entitled "*Safety in Norwegian Civil Aviation during Change Processes*" (HSLB, 2005). The study concluded that safety levels were "high" but the report also included this conclusion:

"*The generally high safety level and the correspondingly low number of accidents and serious incidents, makes it difficult if not impossible on a national level to utilize accident statistics to 'measure' or prove that flight safety has become better or worse due to the prior years of reorganization/changes. Research and experience from other countries show that eventual negative effects of flight safety-related consequences seldom materialize in the form of accidents for several years after changes are implemented. It is, therefore, necessary to use as a basis, other types of indicators to be able to evaluate how flight safety is evaluated*" (HSLB, p. 6).

Considering that the likelihood of a serious accident today is approaching an ultra-safe level, with the accident rate currently one fatal passenger flight accident per 3,200,000 flights (Aviation Safety Network), providing a meaningful measure of safety becomes a difficult task (Amalberti, 2001, p. 111; Lofquist, 2010). The problem is summarized by Reason (1990) who

stated that "*safety is defined and measured more by its absence that its presence*". When accidents happen, there is a measurable indication that things are not safe, but where nothing happens or there is nothing to pay attention to (Weick, 1987; Weick and Sutcliffe, 2001), it is unknown if this is due to properly functioning safety processes or due to good fortune (Lofquist, 2010). Nothing to measure, at least by current industry metrics, equates to the notion that there is no change to safety. This is contrary to the common-sense expectations, since in this environment examples are known of organizational change contributing to a sudden and unexpected system failure (Weick, 1993; Vaughan, 1996; Gehman, 2003; Johnson, 2004).

2.7.1 Safety Performance Indicators

Major hazard organizations, including nuclear industries, oil and gas, hazardous chemical plants, shipping and the aviation industries have been required to develop SPIs to provide assurance that major hazard risks are under control and that systems and procedures continue to operate as intended. Safety performance evaluation is an essential part of SMSs since it provides the organization with information about the system's quality in terms of development, implementation and results (Sgourou et al., 2010). An indicator can be considered as any measure, quantitative or qualitative that seeks to provide information on an issue of interest. SPIs are needed to be able to monitor the current level of safety in safety critical organizations such as aviation organizations, hospitals, refineries and nuclear power plants. These are needed to follow the proactive safety work as well as to anticipate emerging vulnerabilities within the system (Reiman & Pietikäinen, 2012). All these organizations rely heavily on failure data to monitor their safety performance. The consequence of this approach is that improvements or changes are only determined if something has gone wrong. Often the difference between whether a system failure results in a minor or catastrophic outcome is purely down to chance. Data derived from such auch accidents would be characterized as lagging indicators. On the other hand, effective management of major hazards requires a proactive approach to risk management, so information to confirm critical systems are operating as intended is essential. The development of leading indicators aims to confirm

that risk controls continue to operate as intended and are an important step towards the management of major hazard risks (HSE, 2006).

2.7.2 Lagging indicators

The traditional approach to evaluate safety performance is through the measurement and statistical analysis of incident-related data, such as the number of injuries, accident frequency and severity rates, accident costs, number of near misses or of the damage associated with poor safety performance. These are often referred to as lagging indicators (Sgourou et al., 2010). Lagging indicators are a form of reactive monitoring requiring the reporting and investigation of incidents and events to discover weaknesses in the system (HSE, 2006). Lagging indicators show when a desired safety outcome, has failed or has not been achieved (O'Connor et al., 2011). Lagging indicators have been criticized as measuring failures without revealing the cause-effect relationships that would contribute to system improvement, therefore, they appear to have little predictive value (Carder and Ragan, 2003; Cooper and Phillips, 2004).

2.7.3 Leading indicators

Indicators should be able to identify organizational practices and processes that antecede (lead) change in the safety performance of the organization. Leading indicators are a form of active monitoring that require a routine systematic check that key actions or activities are undertaken as intended (HSE, 2006). The leading indicator helps to identify the "holes" (see the Swiss Cheese model) in vital aspects of the risk control system discovered during routine checks on the operation of a critical activity within risk control (HSE, 2006). Hale (2009,) emphasized that an indicator was leading or lagging in respect of whether "it leads or lags the occurrence of harm, or at least the loss of control in the scenario leading to harm".

When the indicators depend on injury rates as a measure, under reporting can lead to minor events not being reported to appear to maintain performance. Additionally, as safety has improved and the frequency of undesired events has declined, accident or incident rates have ceased to be a useful metric of

safety performance (O'Connor et al., 2011). In an attempt to improve safety performance even more, given the low numbers of accidents that occur in High Reliability Organizations (HROs), these organizations started to develop "leading indicators" (O'Connor et al., 2011). Leading SPIs such as safety inspections, audits, behavioural observations and safety culture/climate surveys provide information that does not necessarily result from accident and incident-based measurements. These keep the organisation up to date with organizational and safety measurement trends. Leading indicators reveal how well the organization is performing with respect to those safety management activities that prevent injuries. Safety management activities include audits, hazard identification, training, employee activities (such as observable safe behaviours), supervisor activities (such as communicating safety, conducting inspections) and management activities (such as management commitment and involvement in safety; Sgourou et al., 2010). Leading indicators provide a more proactive way to gain insight into the safety performance of the organization, identify the areas in which efforts should be made to improve safety, and are more responsive to change (O'Connor et al., 2011).

2.7.4 The accident trajectory and leading/ lagging indicators

In the Swiss Cheese model, (Reason, 1997) an organization's layers of defense against failures are modeled as a series of barriers, metaphorically represented as slices of cheese. Each slice represents a risk control system, an important barrier or safeguard. The system as a whole produces failures when holes in all of the slices momentarily align, permitting "a trajectory of accident opportunity", so that a hazard passes through holes in all of the defenses, leading to an accident. For each slice or barrier, the leading indicator identifies failings or "holes" in vital aspects of the risk control system discovered during routine checks on the operation of a critical activity within the control system. A lagging indicator reveals failings or holes in that barrier discovered following the incident or adverse event.

2.7.5 Functional areas and purpose of safety performance indicators

International Atomic Energy Agency (IAEA) embarked on developing an SPI system for use at Nuclear Power Plants (NPPs) in the 1980s. In this initiative,

IAEA held many consultant and Technical meetings and came up with an SPI framework. The development of the IAEA framework began with the consideration of the concept of NPP safety performance. The objective of the IAEA framework was to manage safety at individual NPPs in accordance with their vision of excellence. SPIs, if properly developed and analyzed, are a good input to the decision-making process. Using these attributes as a starting point, each attribute's overall indicators were established. (IAEA, 2000).

Øien et al., (2011a) suggested that leading indicators should be established in the following functional areas:

1. Management, organization and administration
2. Design of facility and processes
3. Training and qualification
4. Operations
5. Maintenance
6. Emergency preparedness planning

These indicators will also change over time, which means that it is necessary to re-evaluate them regularly. Identification of new indicators should be based on assessments of existing operational experience and research concerning the underlying causes to unwanted events that have occurred (Øien et al., 2011b). IAEA (1999) suggested the following quality characteristics for SPIs:

1. Direct relationship between indicator and safety
2. Necessary data should be available or capable of being generated
3. Able to be expressed in quantitative terms
4. Unambiguous
5. Significance should be understood
6. Not susceptible to manipulation
7. Meaningful
8. Able to be integrated into normal operational activities
9. Able to be validated
10. Able to be linked of the cause of a malfunction

11. Accuracy of the data at each level to be capable of quality control and verification
12. Local action able to be taken on the bases of the indicators

The main purposes of performance indicators are (Øien et al., 2011a):

1. To monitor the level of safety in a system (or a department, a site or an industry)
2. To decide where and how to take action and
3. To motivate those in position to take the necessary action to actually do it.

In addition to these characteristics, IAEA (2000) suggested that indicators chosen to support an operational safety monitoring program should include a combination of lagging indicators that reflect actual performance and leading indicators that provide an early warning of declining performance. Specific indicators should capture lower level problems to allow for timely identification and intervention that can prevent more significant events. When properly used, indicators are a valuable tool for controlling hazards and managing risk. Improper use of operational safety performance indicators can result in actions that are not in the best interests of reactor safety. The effectiveness of managing SPIs as a tool for improving the organization's performance is vital to the success of any operational safety performance-monitoring program.

According to HSE (2006) organizations that have developed and implemented SPIs have reported that they have:

- Increased assurance on risk management and protected reputation;
- Demonstrated the suitability of their risk control systems
- Stopped collecting and reporting performance information which was no longer relevant, thereby saving costs; and
- Made better use of information already collected for other purposes, for example quality management.

OECD (2008) guidance suggests the following steps for establishing an SPI program and for evaluating the effectiveness of its initial implementation,

including how to adjust an SPI program to incorporate new knowledge and meet changing requirements. The process of establishing a SPI program includes seven steps:

1. Establish an SPI Team;
2. Identify the key issues of concern;
3. Define relevant outcome indicator(s) and related metrics;
4. Define activities indicator(s) and related metrics;
5. Collect the data and report indicator results;
6. Act on findings from SPIs;
7. Evaluate and refine SPIs.

The effort required to complete these steps and implement an SPI Program will vary depending on a number of factors specific to organization, including the nature of the hazards, the roles within the organizations for managing safety, the availability of data and the degree of precision required for the indicators to be useful. The challenge might be whether in a specific timeframe, there are enough instances of the events being counted to be able to talk meaningfully about a rate (Hopkins, 2009a). If there are, then developing indicators over time will provide evidence of whether the SMS is performing as required. On the other hand, if after a number of years the occurrence of only a single countable event is recorded, it will not be possible to include the event in a meaningful annual rate, nor possible to conclude from one occurrence that safety is deteriorating.

Using the “zoom” effect as Hopkins (2009a) defines it, regulators can treat the fatality rate as an indicator of how well safety is being managed in that industry and seek to drive it down by encouraging generalized, industry wide safety initiatives. It may be observed that some organizations can go for years without a fatality. Under these circumstances, it will not make sense to treat the fatality rate of that site as an indicator of safety. Management in such organizations needs to identify more frequently occurring events to be able to judge how well they are managing safety over time.

Hopkins' (2009a) analysis of SPIs clearly demonstrates that the ideal indicator(s) have yet to be found. In short, where harmful events are occurring frequently enough to be able to talk about a rate, this rate can measure safety; where harmful events are rare, more frequently occurring precursor events need to be found to be able to measure safety (Hopkins, 2009a). Researchers (Guastello, 1993) have tried to establish general relationships between safety performance and contributing factors, such as the quality of the safety management elements or the adequacy of the safety climate. However, any positive relations between these have been weak because of the general nature of contributing factors and the high level of aggregation of accident data.

2.8 Safety management practices creating challenges in the production of data to be used for the development of safety performance indicators

A successful SMS based on a performance-based approach will need a great deal of quality safety-based data. Fear of punishment and doubts about the usefulness of their report will inhibit staff reporting. The reporting culture of the organization may be weakened by a poor just culture and hamper the production of timely, adequate and well-qualified safety-related data. Problems associated with the lack of a just culture may result in a lack of data for hazard and risk analysis, which are proactive tools and hence cause measurement problems and impair the management of change. As a result, it will be difficult to detect organizational factors and any underlying issues in a timely and appropriate manner. Lack of reporting will have an impact on safety measurement, hazard and risk analysis, mitigation of risks, learning from the past and organizational learning. In such cases, it will be impossible to produce information that will permit the organization to improve safety proactively or measure accurately their safety performance (Gerede, 2015b). Feedback problems reduce the success of the reactive and proactive hazard analyses and risk management, result in safety measurement problems, avoid safety assurance activities and inhibit the identification of chronic or underlying latent problems in the organization (Gerede, 2015a).

Measuring safety as an outcome variable within the ultra-safe civil aviation industry during periods of organizational change is a difficult and often fruitless task (Lofquist, 2010). Anticipating the erosion of safety processes based on measuring nothing happening over time does not actually capture the true state of an evolving safe system (Lofquist, 2010). Gray and Wiedeman (1999) suggest the inherent difficulty with indicators is that they are selective. This means that there is always room for discussion and even disagreement about whether they really represent what one wants to measure; whether all people want to measure the same thing; and whether the measure is understandable to non-experts. No single indicator is able to express all relevant aspects of health, environment and safety. Sometimes there is the misconception that it is possible to express risk levels through a set of indicators in a fully objective way (Skogdalen et al., 2011). This implies that expressing the "true" risk level is just a matter of identifying the right indicators. However, it is argued that there is no "true" risk level (Aven and Vinnem, 2007; Vinnem, 2007).

2.9 And what's next?

Accidents such as that at Dryden, or in other industries including in oil and gas, for example the BP Deepwater Horizon or in the nuclear industry, Chernobyl, indicated that had signals or early warning indicators been detected and managed in advance, the accident would have been avoided. High Reliability Organizations (HRO) were required to implement a Safety Management System to use effectively process safety indicators that provide ongoing assurance that risks are controlled. Similarly, ICAO with the publication of Annex 19 requires States and organizations to implement an SMS to monitor proactively their performance. Organizations are required to develop leading and lagging indicators to measure and improve their performance. Flight data monitoring (FDM), statistics from monitoring trends, audits, training and surveys are sources of data that can be used by organizations when developing their leading indicators. Other sources of data are human generated data of a qualitative nature that can support quantitative data. This research focuses on such human generated data, as these capture

challenges not reflected in quantitative data. These are considered to be more difficult to collect and can give an insight into the safety perceptions of employees. The success of SMSs in organizations depends on certain safety practices that could successfully deal with such “people” variables. It was for this reason this study focused on human generated data.

As presented in the ICAO 2017 Safety Report, both ICAO and IATA continue to work closely together and, through their respective expert groups, provide greater alignment in their analysis methods and metrics for the future. This ongoing work will be shared with the Global Safety Information Exchange participants, States, international organizations and safety stakeholders in the interest of promoting common, harmonized safety reporting at the global level. Regulators and international organizations work closely on an international level to suggest better ways for improving safety and measuring performance. To be able to share the success stories about safety management systems that are capable of yielding benefits and find ways to better measure their performance, organizations first need to understand the factors that impede them. ICAO requested that the states and organizations comply with the requirements of Annex 19, and the publication of the Safety Management Manual (SMM) assists in its implementation. Nevertheless, standards and recommended practices (SARPs) are regulatory requirements and do not consider the challenges small countries face when implementing Annex 19. This study attempts to fill in the gap between regulatory practice and the challenges related to the implementation of SMS as faced by small Mediterranean organizations. By using interviews and questionnaires it identifies the factors that impede the performance of an organization’s SMS and the factors that become an obstacle to the collection of the data to be used for the development of their SPIs. Knowing the factors that can become an obstacle to the performance of an SMS, especially in small countries, and sharing this information with the regulators, gives the regulators and international organizations the opportunity to develop better guidance on SMS development.

Chapter 3

3. Overview of Methodology

3.1 Introduction

This chapter presents an overview of the research paradigm and follows with a description of the three main components to the thesis. Chapter 4, describes a preliminary pilot study. Chapter 5 expands upon this with a large-scale qualitative interview-based study which was developed based on the findings of the preliminary study. Chapter 6 presents a questionnaire-based study developed from the findings of the previous interview-based, qualitative study.

3.2 Research Paradigm

In The Structure of Scientific Revolutions, American philosopher Thomas Kuhn (1962) first used the word paradigm to mean a philosophical way of thinking. Lather (1986) explains that a research paradigm inherently reflects the researcher's beliefs about the world that s/he lives in and wants to live in. The researcher's worldview suggests that a paradigm constitutes the abstract beliefs and principles that shape how a researcher sees the world, and how s/he interprets and acts within that world. It is the lens through which a researcher looks at the world and how they examine the methodological aspects of their research project to determine the methods that will be used and how the data will be analysed. A paradigm comprises four elements, namely, epistemology, ontology, methodology and axiology (Lincoln and Guba,1985).

3.2.1 Epistemology of a paradigm

In research, epistemology is used to describe how there is knowledge about something, whether that's the truth or reality and how a researcher can possibly acquire such knowledge so as to be able to extend, broaden and acquire a deeper understanding of the research field in question. Schwandt (1997) defines it as the study of the nature of knowledge and justification.

When considering the epistemology of the research the researcher should reflect whether knowledge is something acquired or experienced, and what may be the relationship between the researcher and the field of study.

In the epistemological paradigm for the current research, knowledge is something to be acquired. The implementation of an SMS is a regulatory requirement and aviation organizations are required to implement and monitor the effectiveness of their SMS. The aviation industry lacked the knowledge about the difficulties aviation organizations, and especially those from small countries, were facing with the implementation of their SMS. The researcher used interviews and questionnaires to uncover the employees' perceptions about the effectiveness of their SMS and the factors impeding the collection of quality data for the development of their SPIs. Although the implementation of the regulations ensures regulatory compliance and seems straightforward, it also seems that the regulator does not take into consideration any problems organizations are facing when implementing these regulations. These problems might be having an impact on the effectiveness and performance of the SMS.

3.2.2 Ontology of a paradigm

Ontology is a branch of philosophy concerned with the assumptions we make in order to believe that something makes sense or is real or assess the very nature or essence of the social phenomenon we are investigating (Scotland, 2012). It is the philosophical study of the nature of existence of reality, of being or becoming, as well as the addressing basic categories of things that exist and their relations. It is concerned with the assumptions we make in order to believe that something makes sense or is real, or the very nature or essence of the social phenomenon that is being investigated. Philosophical assumptions about the nature of reality are crucial to understanding how the researcher will make meaning of the data gathered. These assumptions, concepts or propositions help to orientate the researcher's thinking about the research problem, its significance, and how the researcher might approach it so as to contribute to its solution. Ontology is essential to a paradigm because it helps to provide an understanding of the things that constitute the world, as

it is known (Scott and Usher, 2004). It seeks to determine the foundational concepts which constitute themes that are analyzed to make sense of the meaning embedded in research data. In the process of this research, the researcher was asking herself the question, it the SMS too good to be true? Is it as good as the regulatory authorities are suggesting, is it the perfect system that can deliver the safety outcomes and manage safety as it is suggested? Can it actually measure performance and does the measurement reflect reality, the actual safety level of the organization? Does the SMS actually do what it says? All these assumptions and concepts oriented the researcher's thinking about the research problem and the approach towards the research problem to answer the research question. In order to address this question, the questions in the interviews were oriented towards finding the factors that impeded the quality of human generated data, used by organizations when developing their SPIs. It was assumed that low quality and quantity data will impact the quality of any output from these data, thus the organization might be receiving misleading results about their performance. The aviation industry lacked the knowledge about the difficulties aviation organizations and especially small countries were facing with the implementation of their SMS. The researcher used interviews and questionnaires to uncover the employees' perceptions about the effectiveness of their SMS and the factors impeding the collection of quality data for the development of their SPIs.

3.2.3 Methodology of a Paradigm

Methodology is the broad term used to refer to the research design, methods, approaches and procedures used in an investigation that is well planned to find out something (Keeves, 1997). For example, data gathering, participants, instruments used, and data analysis, are all parts of the broad field of methodology.

The methodology articulates the logic and flow of the systematic processes followed in conducting a research project, so as to gain knowledge about a research problem. In considering the methodology for the research, the researcher needs to ask himself/herself the question: How shall I go about obtaining the desired data, knowledge and understandings that will enable me

to answer my research question and thus make a contribution to knowledge? The following section explains which research methodologies were believed to be appropriate for each part of the study to answer the wider research question and make a contribution to the knowledge.

The scientific paradigm rose to prominence during the Enlightenment. Comte popularized the term positivism (Crotty, 1998, p. 19) when the scientific paradigm, which originated studying the natural world, was applied the, to the social world (Cohen et al., p. 9).

The ontological position of positivism is one of realism. Realism is the view that objects have an existence independent of the knower (Cohen et al., 2007, p. 7). Thus, a discoverable reality exists independently of the researcher (Pring, 2000, p. 59). The positivist epistemology is one of objectivism. Positivists go forth into the world impartially, discovering absolute knowledge about an objective reality. The researcher and the object of the research are independent entities. Meaning solely resides in objects, not in the conscience of the researcher, and it is the aim of the researcher to obtain this meaning. (Crotty, 1998, p. 8). Thus, phenomena have an independent existence which can be discovered via research. Positivistic statements are descriptive and factual. The scientific paradigm is foundational as scientific propositions are founded on data and facts (House, 1991, p. 2).

Positivist methodology is directed at explaining relationships. Positivists attempt to identify causes which influence outcomes (Creswell, 2009, p. 7). Their aim is to formulate laws, thus yielding a basis for prediction and generalization. In this positivist methodology, the model produced in the qualitative research represents and abstraction of reality, identifying the causes that influence the outcomes. This model allows a generalized application that may apply in aviation organizations, in different geographical locations but with these relationships between the factors may have varying magnitudes for each organization. A second data collection and analysis of interviews was performed to verify the findings of the first qualitative study. Correlation and experimentation are used to reduce complex interactions their constituent parts. Verifiable evidence sought via direct experience and

observation; this often involves empirical testing, random samples, controlled variables (independent, dependent and moderator) and control groups.
Similarly, post-positivists seek to understand causal relationships; thus, experimentation and correlational studies are used. However more than sense-data is collected, participants' perspectives are often sought. The scientific paradigm seeks predictions and generalizations; thus, methods often generate quantitative data such as the closed ended questionnaire (Pring, 2000a, p. 34). Inferential statistics allow sample results to be generalized to populations.

The findings of the initial qualitative studies were used to develop a questionnaire to capture employees' perceptions about the SMS in their organizations. Results were then built into a statistically verifiable model demonstrated how a hypothetical construct influences other hypothetical constructs. The numbers on the links are just a representation of the strength of the relationship. Furthermore, as knowledge is tentative, hypotheses are not proven but simply not rejected (Creswell, 2009, p. 7).

Research is deemed good if its results are due to the independent variable (internal validity), can be generalized/transferred to other populations or situations (external validity), and different researchers can record the same data in the same way and arrive at the same conclusions (replicable and reliable). Several of the features of the model were consistent with the findings of Gerede (2015 a,b). Additionally, the model produced is a generic model representing the views of many of the participants and it is unlikely to represent the view of any one person. The current research suggests that this model may apply in other geographical locations but the strength between the relationship of the constructs may vary.

3.2.4 Axiology

Axiology refers to the ethical issues that need to be considered when planning research. It addresses the question: What is the nature of ethics or ethical behaviour? What ought to be done to respect all participants' rights? What are the moral issues and characteristics that need to be considered? How shall I

secure the goodwill of participants? How shall I conduct the research in a socially just, respectful manner? (ARC, 2015). In order to demonstrate best ethical conduct by showing an understanding of the ethical considerations, a research approval was required (see Appendix F). Implementation of ethical considerations focuses on four principles which are required to uphold when dealing with participants and their data: privacy, accuracy, property and accessibility. In this respect participants were assured that any discussions with the researcher would not be passed on to their organization. Data would be safeguarded and will be analyzed in such a way as to maintain the anonymity of the interviewees. Participants were asked to feel free and answer in a manner that made them comfortable, without the researcher exerting pressure for an answer.

Accuracy considers the authenticity and accuracy of information. Participants felt comfortable to participate in the interview knowing that the researcher was external to the organization and they felt they could trust the researcher. The interviewees were reassured that their data would not be distributed to the management.

Property of the data considers the question of who will own the data? The participants were informed that the researcher will own the data as part of their research data collection and anonymity of the participants would be maintained. The research findings will be shared with the participants of the research and all data are de-identified to preserve anonymity.

Accessibility considers the question of who will have access to the data. The participants were reassured that only the researcher will have access to the data and the data are stored in a manner that they are de-identified.

3.3 Preliminary study

In research, epistemology is used to describe how there is knowledge about something, whether that's the truth or reality and how can a researcher can possible acquire so as to be able to extend, broaden and acquire a deeper understanding of the research field in question. It has been suggested that SMS can significantly reduce aviation accidents and compliance to the

regulations can improve the performance of aviation organizations. In the epistemological paradigm for the current research, knowledge is something to be acquired. The implementation of an SMS is a regulatory requirement and aviation organizations are required to implement and monitor the effectiveness of their SMS. The aviation industry lacked the knowledge about the difficulties aviation organizations and especially small countries were facing with the implementation of their SMS. To broaden this knowledge, participants from aviation service providers were asked to participate in an in-depth structured interview followed by a semi-structured interview session. In the ontological paradigm of the current research the philosophical assumptions that some small countries might be facing challenges with the implementation of their SMS contributed in understanding the data gathered, the significance of the problem and the approach to be taken to contribute to the solution. For this reason, the preliminary study a grounded theory approach was decided to be used for the analysis of the narrative data derived from the interviews with the safety managers. As defined by Strauss and Corbin (1990b) the theory is derived from the study of the phenomenon it represents. The researcher does not begin with a theory and then attempt to prove the theory. Instead, the theory is discovered, developed and verified through systematic data collection and analysis of data pertaining to that phenomenon. The research begins with an area of study and what is relevant to that area is then allowed to emerge. The preliminary model derived from the data analysis of this study identified the factors that could impede the quality and quantity of data, delay and/or mislead an organization in creating their lagging SPIs.

3.4 Qualitative Interview Study

Using the research epistemology, the preliminary study, described the knowledge that there are challenges organizations in small countries are facing when implementing their SMS and monitoring their performance using SPIs. The research epistemology of the second, in-depth study was used to extend, broaden and acquire deeper knowledge, building on the previous knowledge from the preliminary study. During the preliminary study

(presented in Chapter 4), the participants were informed during their interviews that there would be a second phase of interviews would take place in the near future and they would be invited to participate if they wished. The qualitative in-depth interview study was based on the themes elicited from the preliminary study. Participants were asked to participate in a semi-structured interview session. The aim was to provide further insight into aviation organization's SMSs and discover the factors that impeded the production of quality data used for the development of SPIs. Interview data were elicited from safety managers and personnel from the safety departments of aviation organizations. Building on existing theory and the output of the preliminary study, and developing ideas from linked pieces of research, this study used these *a priori* themes that can ensure focus on key areas relevant to a study. The ontology of the paradigm for this study, helped to provide an understanding of the things that constitute the world, using themes that are analyzed to understand the meanings of embedded research data. Thematic analysis, used to analyze the interview transcripts, encompasses a broad category of approaches to qualitative analysis that sought to define themes within the data and organize those themes into some type of structure to aid interpretation (Brooks et al., 2015). Template Analysis has been used in qualitative psychology research from a range of epistemological positions (Brooks et al., 2015) and can be used in research concerned with "discovering" underlying causes of human action and particular human phenomena, an analytical approach which fitted with the objectives of the second study.

3.5 Questionnaire study

The two previous studies provided a theoretical framework describing the relationship between the factors that can directly influence the performance of the SMS in aviation service providers. The questionnaire items were constructed based on the findings of the two previous studies. The main focus of the set of items in the questionnaire was to capture the respondent's perceptions regarding the role that top management played in safety management activities, their demonstration of commitment to ensure safety,

and their perceptions about the safety culture and the reporting systems in their organization.

Structured questionnaire data were collected in this study, which described the perceptions of aviation organization employees. This was developed into a statistical model to validate the findings of the previous qualitative studies.

Chapter 4

4. Preliminary study

4.1 Introduction

The ICAO states that as aviation systems are becoming more and more complex, human performance will no longer be able to be controlled using simple regulation intended to ensure safety. As a result, in 2011, the ICAO mandated the introduction of Annex 19, Safety Management Systems (EU: COM/2011/ 0670, ICAO, 2009, 2013). A safety management system (SMS) is a formal risk management framework for enhancing safety. An SMS should contain systems for: hazard identification and risk management; safety targets and reporting processes; procedures for audit; investigations; remedial actions to improve performance; and safety promotion and training. The size and complexity of an SMS should be tailored to suit the size and activities of each organization (Civil Aviation Authority New Zealand, 2015). However, implementing SMSs is not straightforward and there are often organizational obstacles (Gerede, 2015a).

SPIs are an important part of the SMS as these allow for the establishment, implementation, and follow-up of policies related to safety (Øien, Utne, Tinmannsvik, & Massaiu, 2011). Organizations have to set targets and need to evaluate and manage the outcomes of their safety-related activities in order to be able to anticipate any vulnerabilities in their system (Hollnagel & Woods, 2006). Traditionally, safety performance measurement is achieved through the collection of data such as near misses, incidents, or damage associated with poor performance. These data are used as SPIs (Sgourou, Katsakiori, Goutsos, & Manatakis, 2010). These safety outcomes are known as lagging (or reactive) indicators, providing historical information, such as accident frequency and severity rates (one accident, 150 fatalities in 2015) or near misses (11 serious incidents in 2015; European Aviation Safety Agency [EASA], 2016; Sgourou et al., 2010; Toellner, 2001). Owing to the nature of lagging indicators, they cannot predict future performance, nor do they give sufficient information as to why something happened. In contrast to lagging

indicators, leading (or proactive) SPIs can be used to identify underlying causes and contributing factors of accidents, such as inappropriate or inadequate training or a lack of resources and can be used as predictors or early warning indicators (Hinze, Thurman, & Wehle, 2013; Øien et al., 2011; Sgourou et al., 2010). The Organization for Economic Co-operation and Development (OECD) uses the term “indicators” for the observable measures that provide insight into concepts that are related to safety and are difficult to measure directly (Harms-Ringdahl, 2009; OECD, 2014).

Management activities, guidelines, industry standards, organizing, planning, audit, performance measurement, and quality principles are the basic components in any SMS (Santos-Reyes & Beard, 2008). The effectiveness of any SMS depends on the strength and the maturity of the system (Civil Air Navigation Services Organization [CANSO], 2014; Heese, 2012). An organization’s safety culture and management’s commitment to safety are the driving forces behind an effective SMS (CANSO, 2009; European Commission, 2012; Flemming, 2000; Parker, Lawrie, & Hudson, 2006; Schwarz & Kallus, 2015; Zohar, 1980).

Challenges identified as impeding the successful implementation of an SMS are the absence of a positive safety culture and the presence of a blame culture and punishment following error, which results in a lack of reporting. Although improvements in these areas can be a step forward for the management of safety, they are not sufficient for an SMS to be effective. Studies in other industries with similar systems have identified critical components for improving the performance of an SMS as well as barriers to its successful implementation (Aksorn & Hadikusumo, 2008; Bhattacharya & Tang, 2013; Fernandez-Muniz, Montes-Peon, & Vazquez-Ordas, 2007; Ismail, Doostdar, & Harun, 2012), although, there have been very few studies related to SMSs in the aviation industry (Gerede, 2015b). Gerede (2015a) found that the most significant challenge for the successful implementation of an SMS is the problem of establishing a just culture. He further discusses the challenges resulting into a poor safety culture and the consequences if these problems are not addressed.

Studies have demonstrated a relationship between safety management practices and safety performance. Safety management practices can include, but are not limited to: management showing personal involvement in safety activities; provision of high-quality training for new employees and frequent training for existing employees; safety promotion for identifying hazards; higher priority for safety in meetings and in decisions concerning work practice; in-depth investigation of accidents; empowerment of the workforce (Vinodkumar & Bhasi, 2011). When employees are involved in safety matters and are encouraged to work safely, this approach to managing safety at work may improve the desired outcomes (Vinodkumar & Bhasi, 2011).

Hopkins (2000) and Baker et al. (2007) expressed the need for the industry to develop and implement improved SPIs. There are various reasons as to why such indicators are required. One of the reasons is to shape the behavior of management and staff. Effective indicators can drive the required performance while ineffective indicators will lead to misleading figures in performance measurement and may not give information concerning the real issues under consideration (Hudson, 2009). Valid safety knowledge is derived from data collected from appropriate SPIs, hence reliable and valid indicators (both prospective and retrospective) need to be identified and implemented for any SMS to be effective. Indicators should be both valid, that is, measure what we want them to measure, and reliable, that is give the same measurement result when used in the same situation but by different people (Hale, 2009).

Øien et al. (2011a) suggested the different functional areas that the leading indicators should be established in the International Atomic Energy Agency (Hale, 2009; IAEA, 1999) suggested that SPIs should possess a number of characteristics (see Chapter 2).

SPIs need to be carefully selected and reviewed and re-evaluated over time. Manipulation of indicators by managers was evident in the Baker report for the BP refinery accident in Texas, contributing to a false sense of security. Manipulation implies changing the indicator to show a better score but without changing the underlying situation the indicator reflects (Hale, 2009).

Inconsistencies and incoherence can exist in the approach taken for the selection of indicators. Two problems can be linked to the choice of SPIs: either too many possible indicators are utilized, reducing the mapping of safety-critical activities, or there is a failure to select correct and useful indicators. A systematic approach needs to be used to identify the proper indicators and how we can use these indicators to drive the SMS toward achieving its safety goals (Hudson, 2009).

The objective of this PhD is to identify the factors that impede organizations from obtaining the data to be used for the development of their SPIs, which are required as part of their SMSs for measuring and monitoring their safety performance. This preliminary study was performed to identify the key organizational factors in a number of small aviation companies in the Mediterranean that may play a role in promoting or hindering the implementation of an SMS and the collection and analysis of data for the development of SPIs. A qualitative approach was utilized as the emphasis was on insight, discovery, and development of a theory rather than the testing of a hypothesis (Cronbach, 1975; Merriam, 1988; Silverman, 1993).

4.2 Method

4.2.1 Participants

Interview data were elicited from safety managers from different aviation organizations from Mediterranean countries. Involvement of these managers in the development and selection of the organization's SPIs was used as a criterion. Another criterion was to select safety managers from aviation operations of different kinds. The sample consisted of the safety managers from five aviation organizations (two medium – large airlines, two airports, and one navigation service provider). All participants were trained in the operation of SMSs.

4.2.2 Data Gathering

An introductory letter was sent to the participants by e-mail to inform them about the research, with a follow-up telephone call before the commencement of data collection. They were informed that the objective of the study was to

investigate the effectiveness of the implementation of their SMSs and the factors that might have an impact on the data collection for the development of effective SPIs. Participants were asked to participate in a semistructured interview session. The in-depth semistructured interview contained 33 questions: three to learn and know about the organizational factors that affect the safety of the organization; five to learn and know about the safety knowledge of the participants; 14 questions about their SMS; and 11 questions about SPIs. Examples of questions included: “How do you think the top management of an organization can affect the safety of an organization?” and “How does management promote the safety policy and the SMS?” (these examples were derived from the section of the interview related to safety). An example from the part of the interview related to the SMS was: “How are the employees trained in identifying hazards?” An example from the part of the interview related to SPIs was: “Does the reporting system give a clear picture of the most important risks in your work and does it help you manage them effectively?” The interview questions from the preliminary study are provided in Appendix A.

The data collection was performed in two phases between June 2014 and August 2014. The duration of the semistructured interviews was approximately 2.5–3 hr. During the interview, the interviewer took notes of the interviewees’ answers. At the end of each interview, the interviews were transcribed and saved into word processor files for subsequent analysis. The data were then coded by hand. Data were treated ethically, maintaining the confidentiality of the participants.

4.3 Analysis

A grounded theory approach was used for the analysis of the narrative data derived from the interviews with the safety managers in the five aviation organizations, using the procedures and techniques described by Strauss and Corbin (1990a). Strauss and Corbin (1990b) defined grounded theory as:

One that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed and provisionally verified

through systematic data collection and analysis of data pertaining to that phenomenon... One does not begin with a theory then prove it. Rather, one begins with an area of study and what is relevant to that area is then allowed to emerge. (p. 23)

The collection and method of analysis of the data are outlined in the following steps (Strauss & Corbin, 1990a):

- Data gathering
- Open coding
- Axial coding
- Selective coding

Each interview report was broken down into individual sentences or small groups of sentences that referred to a single observation from each interviewee.

4.3.1 Open Coding

Open coding was defined by Strauss and Corbin (1990a, p. 61) as: “The process of breaking down, examining, comparing, conceptualising and categorizing data.”

The comments produced by the line-by-line analysis of transcripts were analyzed to generate categories into which they could be grouped. Concepts were developed using a continuous dialogue with the empirical data. Concepts are ways of summarizing data and they should be adapted to the data (Becker, 1998, p. 109). The application of this method to the set of comments yielded an initial set of coding categories or dimensions. The comments were then re-coded using these categories to check for interrater reliability. Differences in coding were discussed and resolved to produce an agreed list of categories.

4.3.2 Axial Coding

Strauss and Corbin (1990a, p. 96) defined axial coding as: “A set of procedures whereby data are put back together in new ways after open

coding, by making connections between categories."

This stage of analysis yielded a set of higher-order categories describing the connection or common properties between the lower-order categories. Comments were then re-evaluated within each category.

4.3.3 Selective Coding

Selective coding was defined by Strauss and Corbin (1990a, p. 116) as: "The process of selecting the core category [and] systematically relating it to other categories."

Strauss and Corbin (1990a) pointed out that this process is essentially similar to axial coding, but was conducted at a higher level of abstraction. A core category that emerges is the overarching phenomenon or concept that links each of the categories or phenomena that are developed during axial coding. After the core category was identified, further analysis of the comments in each category revealed the links between the categories identified during axial coding. Once all the categories were linked together to form a complete model, a narrative description was developed.

4.4 Data Analysis and Model Development

Open coding identified 15 dimensions containing factors that can influence the production of high-quality data to be used for the development of SPIs and hinder the performance of the SMS grouped under three properties.

Following up on the process of open coding, the comments produced from the line-by-line analysis of interview narrative data were grouped into three emergent main categories, namely, "Top management's decisions influencing safety"; "Lack of safety culture"; and "Impractical and fearful data collection approach" (see Table 1).

Table 1 shows that the broad category "top management's decisions influencing safety" includes one property namely "management's decisions" with six dimensions. Management's decisions influence the allocation of resources (either financial or human resources), the allocation of time, and

removing the safety officers from the roster to perform the safety activities. Management's decisions influencing safety also includes the dimension "failure to participate in the safety activities" and "not interested to know anything related to safety" as it is for the management to decide whether they want to be involved or not. Delay in the investigation of accidents was a dimension placed under the management's decision property as it is for the management to decide how and when to remove the safety officer from the roster in order to conduct the incident investigations.

Seven dimensions were grouped under the property that reflected a lack of safety culture. Lack of safety promotion, lack of safety training, lack of just culture, luck of mutual trust between employees, lack of what the employees are saying, lack of encouragement to report and resistance to change all were thought to contribute to a poor safety culture.

The third and last broad category in the table, was "impractical and fearful data collection approach" which included one property, namely "reporting system". This had dimensions namely "fear of punishment that impairs reporting and "impracticality of reporting system that hinders the reporting process" both of which might influence the quality and quantity of data collected in reporting system.

4.5 Top Management's Decisions Influencing Safety

During axial coding "allocation of resources," "allocation of time," "failure to clarify safety commitment," "failure to participate in safety activities," "not interested to know," and "reluctance of management to allocate human resources for the investigation of incidents" were placed in the "managements' decisions" category (Table 1).

4.5.1 Allocation of Resources

From the interviewees' transcripts it was observed that some safety managers shared the perception that management would not allocate the money, extra working hours, or resources for hiring additional personnel:

In order to perform the investigations people should be removed from

the roster or work during their days off and this causes a delay in the investigation of incidents.

4.5.2 Allocation of Time

Based on the following comment it was noted that the management of some aviation companies would not allocate time for the risk assessments and employees needed to work on their days off in order to complete the risk assessments:

Risk assessments are not effectively performed; they are problematic as there is a delay because people need to be removed from the roster or work during their days off or work overtime.

4.5.3 Failure to Clarify Safety Commitment

On the basis of the comments, it was noted that interviewees perceived that management was not committed to safety as the company management did not show that they were at all interested in safety:

When it comes to (top) management's commitment to safety they don't want to know, they don't have the knowledge or they don't want to show that they are interested.

4.5.4 Failure to Participate in the Safety Activities

On the basis of the following comment, it was perceived that management does not show an interest in the safety activities or want to know about these activities, and it was middle management who handles the safety issues:

When it has to do with needs in the safety department, they [top management] don't want to know, they don't want to show they are interested. Only middle management handles operations and safety.

4.5.5 Not Interested to Know or Learn Anything About Safety

From the next statement, it was indicated that middle management perceived that top management did not care and at the same time top management does not prioritize safety issues within the organization:

(Top) management either doesn't want to know, or they do not have the knowledge, or they do not want to show the least interest in safety matters. It's the middle management who handles the safety issues.

From these statements, it was indicated that the middle management from some aviation service providers perceived that top management did not care and at the same time top management did not prioritize safety issues within the organization.

4.5.6 Delay in the Investigation of Accidents

On the basis of the following comment, "delay in the investigation of accidents" was placed in the top management's decisions category as this could have facilitated investigations and made the findings available sooner (Table 1).

In order to perform the investigations people should be removed from the roster or work during their days off and this causes a delay in the investigation of incidents.

Table 1 Dimensions of the impeding factors of data collection used for the development of SPIs derived from the Open Coding process.

Broad categories	Property	Dimensions
Top management's decisions influencing safety	Management's decisions	Allocation of resources
		Allocation of time/roster
		Failure to clarify safety commitment
		Failure to participate in safety activities
		Not interested in

		knowing/learning anything related to safety
		Delay in the investigation of accidents
Lack of safety culture	Just culture	Lack of safety promotion
		Lack of safety training
		Lack of just culture
		Lack of trust between personnel
		Lack of attention to what workforce is saying
		Lack of encouragement by top management to report
		Resistance to change
Impractical and fearful data collection approach	Reporting system	Fear of punishment that impairs reporting
		Impracticality of reporting system that hinders the reporting process

4.6 Lack of Safety Culture

During the axial coding stage, “lack of safety promotion,” “lack of safety training,” “lack of just culture,” “lack of trust between personnel,” “lack of attention to what personnel is saying,” “lack of encouragement by top management,” and “resistance to change” were all placed in the “safety culture” category.

“Lack of just culture” was identified as a common property, which hindered the successful collection of safety data from the reporting system. To illustrate, one interviewee commented:

> *[Employees] don’t know what is acceptable and unacceptable in terms of judicial authority taking over.*

4.6.1 Lack of Safety Promotion

On the basis of the following comment from one participant, it was noted that top management was not promoting the SMS:

> *The [top] management doesn’t really promote the SMS...*

The following comment indicates that the organization did not promote the safety policy and SMS to their employees, and the employees have asked from the safety manager to make a presentation.

> *Employees do not completely understand the safety policy. We know because they asked the safety manager for a presentation. SMS and Safety Policy, is very little promoted by top management.*

4.6.2 Lack of Training

The following statement implies that the employees did not receive training to identify hazards and employees were required to use their common sense to identify hazards:

> *Employees were not trained to identify hazards, this is based on their instinct and their common sense.*

The next statements indicate that some organizations pre- sent an overview of how the SMS works and do not provide recurrent training to their employees even if it is stated in the manuals that the employees need to receive recurrent training.

> *Training in safety and SMS, an overview how the system works [is provided], we still have room for improvement. Recurrent training is only written in the manuals.*

The following statement indicates that some organizations do not use the information from the reporting system to train employees and it depends on the manager of each unit to feed back the information given to him/her by the safety manager.

> *We don't have an official 'lessons learnt' process; it depends on the manager of each unit to inform the people.*

4.6.3 Lack of Trust Between Personnel

On the basis of the following comment, it was regarded that the employees might be reluctant to report anything because they do not trust their colleagues since other employees might be able to identify the reporter.

> *Reporting is not encouraged because other employees can identify the reporter especially if one or two people were working on that particular shift the time when the event took place.*

4.6.4 Lack of Attention to What the Employees Are Saying

Lack of attention to what aviation service provider's safety managers were saying was identified as a common component in the "safety culture" and "reporting systems" categories (see Table 1).

> *Every time we ask them to give a campaign on reporting they keep saying that they will do it the following week and they never do it.*

The employee in the statement above believed that top management did not care about what they were asking, and this has a great effect on safety

culture. Management did not care and they showed it. This is even more obvious from the following comment from one employee:

> *What management shows us is that we will do something if we have time, when we have time.*

As implied, in some organizations, management was not regarded as promoting the SMS and also did not provide training for the identification of hazards. Workers needed to use their common sense, but this of course depended on the perceptions of each individual concerning what he or she considered to be a hazard. Lack of training also resulted in a lack of knowledge of the benefits of making contributions to the reporting systems. In addition, if personnel were trained more on how they could benefit from the reporting hazards and how this could reduce the rate of incidents, they would have cared more about reporting the hazards and cared less about who did what.

The following comment indicates that when middle management wanted to discuss the safety needs of the organization, top management did not want to know and they did not show any interest.

> *When it has to do with needs in the safety department, they don't want to know, they don't want to show they are interested. Only middle management handles operations and safety.*

4.6.5 Lack of Encouragement to Report by Top Management

After discussion it was decided that "lack of encouragement to report" was best categorized under "safety culture" because encouragement can be a characteristic of the safety climate and a feature of the organization that can be influenced by the people working within the organization (Schwarz & Kallus, 2015; von Rosenstiel & Nerdinger, 2011).

Several statements indicate that employees are not encouraged to report issues, and they only receive an overview of how the SMS works. It was indicated that although recurrent training is mentioned in the manuals, the organization does not give recurrent training to employees to encourage them

to report.

> *When it comes to reporting there is no encouragement and there are bureaucratic procedures.*

The next statement indicates that the actions of top management fail to encourage employees to report.

> *Instead of using the reporting system for improvement, they are using it to penalize.*

The next statement indicates that when the organization was not in the same facility, some departments might have received less encouragement to report, especially if the safety department was not located in the same facility in order to promote reporting. Bureaucratic procedures might also cause lack of encouragement and this is emphasized when the organizations are in different locations.

> *There are units that are isolated from the whole system, without any information on reporting, there are bureaucratic procedures.*

4.6.6 Resistance to Change

Resistance to change was found to be one of the dimensions best placed under the “safety culture” category. Interviewees expressed their opinion that remedial actions became a difficult task as it involved a number of people and sometimes the action to be taken depended on other people.

> *It is a matter of how easy something can be done and you have to wait for the others; it’s not that easy, it has to do with the number of people involved.*

4.7 Impractical and Fearful Data Collection Approach

Comments about reporting systems were further decomposed into “fear of punishment that impairs reporting” and “impracticality of reporting systems that hinders the reporting process” (see Table 1).

4.7.1 Fear of Punishment That Impairs Reporting

The following statement indicates that when personnel worked by themselves, knowing that no one saw them committing an error, they would not report because they were afraid of punishment.

> *The disadvantage of reporting is that sometimes you work by yourself, so in that case you would not report yourself.*

The next statement indicates that in the organization of this interviewee, higher management is using the reporting system to penalize the reporter or to ask for explanation.

> *Instead of improvement, they use it to penalize or ask for explanations.*

4.7.2 Impracticality of Reporting System That Hinders the Reporting Process

The following statement demonstrates the impracticality of one particular reporting system.

> *Reporting is not encouraged because other employees can identify the reporter especially if one or two people were working on that particular shift the time when the event took place.*

The following statement again implies there is a lack of just culture that affects the reporting system and as a result the organization lacks safety-critical information used for the development of SPIs.

> *The reporting system is just a book in the other room where the employee would go and report the event.*

The previous statements are indications of the impracticality of the reporting system. In these two cases, workers were effectively discouraged or even embarrassed to report because this action would be obvious and at the same time, they could be identified by the other workers because of the small number of people who were working on the same shifts.

4.8 A Model of Factors Impeding the production of quality data for the Development of SPIs

Selective coding is the process by which all the categories are combined around a single “core” category that represents the central phenomenon or that can be identified by asking the question, “What is the main analytic idea presented in this research?” (Strauss & Corbin, 1990). The main objective in this study is identifying factors that can influence the reporting systems and the collection of quality data used the development of SPIs and hence hinder the performance of safety management systems in aviation. The importance of this stage of grounded theory development is the development of an overall model. The core category identified was the “obstacles in developing SPIs.” The connection between “top management decisions influencing safety,” “lack of safety culture,” and “impractical and fearful data collection” may be summarized as follows: The decisions of top management influenced the safety culture of the organization and the lack of a safety culture has a subsequent impact on the reporting systems making them impractical to use and creating a fear of reporting in employees. The model in Figure 2 suggested that top management’s attitude toward safety has an impact on the decisions taken about the allocation of resources for the provision of training to clarify to employees what was considered as acceptable and unacceptable behaviour. For this reason, and because of the fear of being punished by the management, employees choose to hide their errors, and hence these unsafe acts go unnoticed, not reported and the organization does not know about the presence of the hazard. Top management also demonstrated resistance to change and did not encourage the employees to report. Top management influences the culture of the organization and because of the culture of the organization, acceptable and unacceptable behaviour is not understood by the employees. There is a fear of punishment, people hide their errors and unsafe acts remain unnoticed. As a further aspect of the culture, there is resistance to change and employees are not encouraged to report, resulting in a low quantity of data. As a result, the reporting system fails, hazards remain hidden and there is no mutual trust between employees. Figure 2 suggests that these factors, either individually or in combination, influence the

quality and quantity of data organizations are required to collect and analyze for the development of their SPIs.

4.9 Results and Discussion

The purpose of this study was to identify and describe factors that may promote or impede the production of quality data used for the development of SPIs in small Mediterranean aviation organizations and service providers.

Figure 2 shows the model derived from the interview data and grounded theory analysis of the factors that can impede, delay, and/or mislead an organization in creating their SPIs. Several features of the model were consistent with the findings of Gerede (2015a), who also showed how the success of the safety management systems could be impeded. Gerede (2015a) identified the failure of the reporting system, acceptable and unacceptable behavior not being distinguished, fear of punishment, and hazards that remain hidden as the main factors contributing to the success or failure of an SMS. Gerede's study (2015a) used a two-day brainstorming workshop to identify the factors impeding the performance of SMSs. This current study built on the work of Gerede, expanded this work and also attempted to acquire deeper knowledge by performing individual, three-hour, in-depth interviews with each participant to gain a better understanding of the factors impeding the effectiveness of their SMS. The model developed in the current study also suggests that top management, culture, and data collection processes are significant factors that could either individually or in combination influence the success of the SMS by impeding the development of the appropriate practice.

4.9.1 The Perceived Role of Top Management

While attempting to uncover the factors that impede the production and collection of the quality data required for the development of SPIs, it was found that the perception of the interviewees was that management showed little or no interest in knowing about safety issues was one such factor (Table 1). The interviewees reported that employees said that management led them to understand that they (management) will take action about an issue only

when and if they have time. The employees' perception about management was that they do not prioritize safety actions, and on the contrary they would only take an action at their convenience. However, for top management to demonstrate commitment to safety the manager will be required to possess high levels of safety knowledge to act appropriately with respect to safety matters and communicate the facts to the personnel. As a result, the safety knowledge will enable managers to understand safety-related information, draw meaningful conclusions from it, and then demonstrate their commitment to safety by their actions (Fruhen, Mearns, Flin, & Kirwan, 2014a).

Figure 2 Factors impeding the production and collection of the quality data required for the development of SPIs showing the gaps between SMS and actual performance

Employees feel that when it comes to safety, management does not want to know, does not have the knowledge, and/ or is not interested in knowing. Because of this, it would seem that management does not prioritize safety. Neal and Griffin (2004, pp. 15–34) define the safety commitment of management as, "the extent to which management is perceived to place a high priority to safety and communicate and act on safety issues." Zohar (1980) also found that management's commitment to safety is a major factor that can affect the success of an organization's safety management system.

Studies have shown that senior management can influence 45% of the organization's performance and have a significant influence on organizational safety (Clarke, 1999; Day & Lord, 1988; Fruhen et al., 2014b).

If sufficient resources are not allocated, SPIs cannot be developed. Personnel in the interviews said that management would not allocate the necessary funds for increasing the number of personnel. This meant that people had to divide their working time between working their shift and performing SMS activities. Lack of available personnel was forcing people to concentrate on their primary job, having no time to perform SMS activities. As a result of this, incidents were not investigated, analyzed and assessed in a timely manner and hazards remained hidden, often until an employee was able to perform the work during their day off. The success of the SMSs declines when management fails to allocate resources or show a willingness to improve the system (Gerede, 2015b).

On a related topic, delays in the performance of risk assessments and incident investigations were also related to the development of SPIs (Table 1). Employees said that risk assessments were also not effectively performed. This again means that hazards and risks remained in the system until they were eventually identified and addressed. SPIs were not developed as soon as the hazards and risks were identified; they had to wait until the safety team was removed from the roster or worked overtime or during their own free time, meaning that there was a gap between the hazard identification and the development of the SPIs, leaving the system exposed to these hazards. Even if all the other components of the SMS are working effectively, if risk management fails, then it is likely that the SMS will be unsuccessful (Gerede, 2015b).

Another important factor contributing to an unsuccessful SMS was lack of promoting the SMS. Interviewees said that management does not promote the SMS and they have to use their instinct and common sense to identify the hazards. This means that what constitutes a hazard for someone might not necessarily constitute a hazard for someone else, leaving this to the subjective opinion of each individual. As a result, hazards can be left

unreported, because the individual might not have considered the event as hazardous. Various studies have identified that specific safety practices, such as initial and recurrent training for employees, display of safety posters for identifying hazards, communication between workforce and managers, personal involvement of management in safety issues, and making a high priority of safety in meetings predict safety performance. Organizations having these safety practices have lower accident rates (Cohen, 1977; Cohen, Smith & Cohen, 1975.; DePasquale & Geller, 1999; Griffiths, 1985; Harper et al., 1997; Shafai & Shahrai, 1971; Shannon et al., 1996; Shannon, Mayr, & Haines, 1997; Smith, et al.,1975).

Employee involvement in safety activities is a key element for the success of an SMS. But to achieve this, people first need to be trained. In the current study, it was found that people did not receive training on the SMS. Interviewees reported that they did not receive SMS training, and they were not trained to identify hazards. They used only their common sense for their identification. As previously mentioned, not knowing what a hazard can be means that hazards go unnoticed, not reported, and not developed into SPIs. A key element for the success of an SMS is effective safety training. Safety training provides the means for making accidents more predictable (Vinodkumar & Bhasi, 2010). Studies have shown that organizations that do not receive adequate training on risk assessment do not perform it adequately (Gerede, 2015a).

Another finding was the lack of attention by top management to what the workforce was saying. Interviewees have been asked by the workforce to provide them with training on reporting systems or launch a campaign about reporting. The interviewees reported that every time they ask top management for these courses for the employees, management tells them that they will give them training but they never do. This gives employees the impression that management does not pay attention to what they are asking, and this can have a negative effect on the organization’s safety culture and discourage people to adopt a safe behavior. Regular communication about safety issues between top management and the workforce is an effective

safety management practice that can improve performance (Vinodkumar & Bhasi, 2010). Studies by Cohen (1977), Cox and Cheyne (2000), Mearns, Whitaker, and Flin (2003), and Vredenburgh (2002) all showed that the safety performance of an organization is influenced by the level of communication.

Lack of encouragement by top management to report issues was another factor that was mentioned in the study. Participants said that they were not encouraged to report issues. One reason was because they felt that other people could identify them. Another reason was that because they did not know what was acceptable and unacceptable, they were afraid to report. A third reason was that they felt that the reporting system was impractical, allowing other people to identify the reporter. Such a lack of encouragement impairs the reporting system and safety data collection of the organization, leaving hazards unidentified and not investigated. The use of incentives and recognition in motivating personnel to perform safely can add interest to the hazard control program of an organization (Cohen et al., 1975; Hagan, Montgomery, & O'Reilly, 2001). Vredenburgh (2002) also recognizes that safety promotion in terms of creating awareness for reporting hazards encourages workers to report safety matters.

4.9.2 Lack of Safety Culture

The findings also suggest that there may be a lack of just culture. Employees reported that it is not clear what should be acceptable and unacceptable behavior. Because it was not clear for them what the organization and juridical authority considers as being acceptable and unacceptable, they were reluctant to report their actions for fear of prosecution. As a result, occurrences that should have been investigated to find out what happened, why it happened, and how to prevent it from happening again now go unnoticed. The biggest concern with judicial action following an aviation accident or incident was focused on how it interfered with independent safety investigation and undermined the willingness of people to voluntarily report errors and violations (Berlinger, 2005; Brous, 2008; Chapman, 2009; Dekker, 2007, 2009, 2011; Flight Safety Foundation, 2006; Thomas, 2007).

A lack of trust between personnel was also reported as a factor impeding

reporting and thus the production and collection of data to be used for the development of SPIs. Interviewees said that reporting was not encouraged because other employees could identify the reporter, especially if it was only two people working on the shift when the incident took place. Because people were reluctant to report occurrences, this inaction gave the opportunity for hazards to remain unreported. A common response of professionals was to become better at making the evidence go away and not reporting errors: “Practicing under the threat of prosecution can only serve to hide errors” (Chapman, 2009, pp. 57–59; Dekker, 2011).

Certain characteristics of the national culture of the participants, such as the lack of trust between employees or demonstrating resistance to change, suggest that these may influence the safety culture of the organization. Research suggests that beyond human factors, social psychological areas such as communication, leadership, interpersonal relationships and decision making are all influenced by national culture (Wiener, Kanki & Helmreich, 1993; Berry et al., 1992; Bond,1988; Hofstede, 1991).

Resistance to change was also found to be a factor delaying the development of SPIs. Employees interviewed stated that even if things or situations could easily be changed the situations would still not change because they had to wait for someone’s approval or because other people were involved in the change. Depending on others to make changes, or having a large number of people involved to approve the recommendations, allocate resources, or communicate with other parties, involved delays in the improvement of the situation. In fact, this can be a long process and take time until some action is taken. An SMS will not be implemented successfully in organizations where there is a culture of only acting through habit and where there is resistance to change (Gerede, 2015a).

4.9.3 Impractical and Fearful Data Collection Approach

Fear of punishment was identified in this study as a factor impeding reporting processes and the data collection, which is required for the development of SPIs. Employees said that reporting is not encouraged by management as they were not given training on the reporting system including acceptable and

unacceptable behavior. This meant that because people were not informed of what was acceptable and unacceptable behavior and because they were afraid that reporting their error could result in their prosecution, they were reluctant to report their errors.

Findings suggest that the impracticability of the reporting system can hinder the reporting process and the production of quality data to be used for the development of SPIs. Employees said that in several cases the reporting system was merely a book in which the employee would report the occurrence. Because of the nature of the reporting system, the person reporting could be easily identifiable especially in the case where only two people were working on a shift. Employees knew that others could trace the reporter by checking the roster system. This impracticality of the reporting system hinders its success because employees are reluctant and discouraged from reporting. Incident data are a key element for the function of the SMS. From the data on incidents taken from the reporting systems, safety metrics can be derived and risk assessment can be conducted; however, the quality of the data can influence the results (Wilke, Majumdar, & Ochieng, 2014).

4.10 Conclusion

On the basis of interviews with safety managers in the aviation industry about safety practices in their organizations, a model of factors that may impede the effective functioning of an SMS and the SPIs was developed (see Figure 2). The main factors in the less-than-optimal functioning of an SMS may be: the role of top management, the lack of safety culture, and the effectiveness of the data collection approach, either individually or in combination. When present in aviation organizations, these factors are believed to impede the production and collection of data required for the development of SPIs and thus the effectiveness of the SMSs. Organizations should use both leading and lagging SPIs to measure their safety performance. The reported factors may be indicative of practices in other aviation service providers as well. Knowledge of these impeding factors may help organizations to improve the quality and quantity of safety data required for developing their SPIs and for measuring the success of their SMS. Addressing the factors that impede the

development of quality data required for the development of SPIs can help organizations measure safety in a way that reflects its true performance.

Chapter 5

5. Interview Study

5.1 Introduction

The present study aims is to investigate the factors that hinder the production and collection of the good quality safety data, in sufficient quantities, for the development of SPIs in aviation service providers. Dey (1993) suggests that qualitative research is an attempt to discover the meaning that people attribute to events using their subjective perspective. Creswell (2013) stated that qualitative research is used to explore a problem or a subject. Qualitative research was preferred for this part of the study, since it attempts to explore the explanations that safety managers and employees (part of the safety team) attribute to the possible difficulties in producing and collecting safety data.

The main purpose of the study was to validate in a larger sample the main factors that hindered the production and collection of data used for the development of SPIs in aviation service providers and the factors hindering the performance of the SMS. Another aim was to identify the central problem and the underlying factors deriving from the main problem. Table 1 (in the previous chapter) shows the categories, themes and subcategories of the factors that were thought to hinder the production of safety data used for the development of the SPIs.

The preliminary study reported in the previous section was the framework for this study and the basis on which the interview questions for this study were developed. In the preliminary study, a model of factors that may impede the effective functioning of an SMS and the SPIs was developed based upon interviews with aviation safety managers about the safety management practices in their organizations. The main factors that were believed to be an obstacle in the effectiveness of the SMS were: the role of top management, the lack of safety culture, and the effectiveness of the data collection approach, either influencing individually the effectiveness or in combination.

When present in aviation organizations, these factors are believed to impede the production of safety data for the development of SPIs and thus the effectiveness of the SMSs. Figure 2 in Chapter 4 shows the model derived from the preliminary study and interview questions were formed for each main category (top management, culture, data collection, just culture, resistance to change, reporting systems)

5.2 Method

5.2.1 Participants

In qualitative research, the aim is to collect in depth data from events or people that constitute the topic of research. The scope of this study covers five aviation organizations, including two airlines, three departments of air navigation services providers and two airports. Interview data were elicited from safety managers and safety officers from five aviation organizations (airlines, air traffic service providers, airports). The 23 participants in these organizations, selected through purposive sampling, were the safety managers of these organizations, employees of the safety department and employees responsible to assist the safety manager in the activities of the SMS. Another criterion was to select employees involved in the safety activities from different kinds of aviation operations.

A letter was sent to the participants explaining to them the purpose of the research and asking the participants if they would be interested in participating. Participants who demonstrated an interest in participating were contacted further and a meeting was arranged for the interviews. In order to preserve the anonymity of the participants, it is sufficient to mention that participants came from the smaller Mediterranean countries, with small to medium air navigation providers and airports; a medium to large European Airline and a medium sized Middle Eastern airline.

5.2.2 Data Gathering

During the preliminary study (presented in Chapter 4), the participants were informed during their interviews that there would be a second phase of interviews that would take place in the near future and they would be invited

to participate if they wished. A month before commencing the second phase of the data collection, an introductory letter was sent to the participants by e-mail to inform them about the research, with a follow-up telephone call before the commencement of data collection. They were informed that the objective of the study was to investigate the effectiveness of the implementation of their SMSs and the production of safety data used for the development of effective SPIs and that this research was based on the results derived from the preliminary study.

Participants were asked to participate in a semi-structured interview session. The interview questions were printed on a set of papers (one set for each interviewee) with sufficient space left for the purpose of taking notes during the interview. The in-depth semi-structured interview contained 21 questions: four questions to learn about what do these safety managers/ officers think about the effectiveness of the SMS; four questions to learn and know about the safety commitment of the top management, involvement and safety knowledge; three questions about top management and just culture; one question about the safety culture based on Reason's (1997) definitions of safety culture; three questions about culture and resistance to change; three questions about the data collection process; and three questions about the reporting culture and data collection. Examples of the interview questions from the qualitative study are presented in Appendix B.

The data collection was performed between June 2015 and December 2015. The duration of the interviews was approximately 2.5–3 hr. During the interview, the interviewer took notes of the interviewees' answers. At the end of each interview, the interviews were transcribed and saved into word processor files for subsequent analysis. The data were then coded by hand. Data were treated ethically, maintaining the anonymity of the participants. The Ethical Approval is provided in Appendix F.

5.3 Analysis

Thematic analysis encompasses a broad category of approaches to qualitative analysis that seek to define themes within the data and organize

those themes into some type of structure to aid interpretation (Brooks et al., 2015). Template Analysis is a form of thematic analysis which emphasizes the use of hierarchical coding but balances it with a relatively high degree of structure in the process of analyzing textual data with the flexibility to adapt to the needs of a particular study. What is important in this technique is the development of a coding template, usually on the basis of a subset of data, which is then applied to further data, revised and refined. It encourages the researcher to develop themes more extensively where the richest data in relation to the research question are found. The data involved in template analysis are usually interview transcripts but may also include any kind of textual data. Template Analysis can be used in qualitative psychology research from a range of epistemological positions (Brooks et al., 2015). The flexibility of the technique allows it to be adapted to the needs of a particular study and that study's philosophical underpinning. Template Analysis can be used in research concerned with "discovering" underlying causes of human action and particular human phenomena. When used in this way, one could expect to see the use of strong, well-defined *a priori* themes in analysis and concerns with reliability and validity prioritized and addressed. This current study uses the themes that emerged from the preliminary study upon which this study is based on. The use of *a priori* themes can ensure focus on key areas potentially relevant to a study, building on existing theory (such as the one developed in the preliminary study) and developing ideas in linked pieces of research.

5.4 Data analysis and model development

The main procedural steps in carrying out Template Analysis are outlined below as described by King (2012).

The first step was to become familiar with the accounts to be analyzed. The interview answers were read and then cut into pieces and were placed in a box.

The second step was to carry out the preliminary coding of the data by highlighting anything in the text that might contribute toward the researcher's

understanding. Using the *a priori* themes derived from the preliminary study, a set of carton boxes was prepared representing each factor (see Figure 2).

The third step was to organize the emerging themes into meaningful clusters, and begin to define how they related to each other within and between these groupings. This included hierarchical relationships, with narrower themes nested within broader ones. Within each of the broader categories, representing a factor in Figure 2, a number of boxes with themes derived from each question were prepared.

The fourth step was to define an initial coding template. Based on the themes derived from the preliminary study a coded label was prepared and attached to each box. Then each piece was read to decide into which box representing a theme was most appropriate for it to be placed. Taking one theme at a time, the pieces of paper were removed from the boxes one by one, read and the quotes derived from the interview were written under each theme. The main themes included “top management’s attitude towards safety”, “safety culture”, “reporting systems/ data collection” and “external factors”.

The fifth step was to re-read the extracts from the interviews and decide whether the content could also represent another themed category. In the cases in which a quote was considered appropriate to fit in more than one theme, the codes of the other theme(s) were written on the piece of paper and it was then placed in the most appropriate themed box. This was performed for all pieces of paper containing more than one theme until all of the quotes were placed under all of the appropriate themes into which they could fit. Themes that included fewer than five quotes were deleted and some themes, which were considered similar to other themes, were merged.

The last step was to finalize the template and apply it to the full data set. To finalize the template a paper scroll was prepared and each theme and subcategory was written on the scroll to represent the full data set. Once all the quotes were mapped down under the themes and subcategories, there was a further refinement merging some themes together and placing them under one chosen theme.

After this stage, the quotes underwent the process of triangulation. Three independent people (two having an engineering background and one being an aviation professional) were asked to select quotes, read them and provide feedback about the placement of that quote under the category. The people read the quotes and were asked if they agreed with the decision to place the quotes they read under that category. A table classifying the quotes either as "negative", "neutral" or "positive" for each interview question is provided in Appendix C. Since this thesis aims in identifying the challenges in implementing an SMS, quotes chosen in the analysis were derived from the neutral and negative categories.

Table 2 shows how the quotes from the interviews were mapped under the main themes and subcategories of each theme. The broad category "top management's attitude towards safety", includes two properties namely "top management's commitment to safety" and "allocation of resources". The first property, top management's commitment to safety" has three dimensions namely "management not interested to know anything about safety", failure to participate in the safety activities, and "failure to understand risks". It was decided that these dimensions be placed under this category as they reflect the top management's attitude towards safety. The second property (allocation of resources) in the broad category "top management's attitude towards safety" includes three dimensions: "lack of financial resources", "lack of staff", "lack of time". These were grouped under this broad category as it was management's decision to allocate the resources.

The second broad category includes the properties "just culture" and "resistance to change". Out of these properties, "just culture" has two dimensions namely "blame culture" and "fear culture". These were grouped under the broad category of "safety culture" as these properties and dimensions reflect the elements of a positive safety culture: blame and fear culture might suggest a lack of a just culture and resistance to change suggests a lack of flexible culture.

The third broad category is "Reporting systems/data collection" and includes two properties: "deficient reporting system" and "selective reporting" There are

only two dimensions namely “impracticality of the reporting system or reporting process” and “insufficiency of the reporting system” under the property “deficient reporting system”. These were placed under this broad category as they reflect the reasons that influence data collection and reporting systems.

External factors is the last broad category and five properties are placed under this category: government, outsourcing, media, legal system, national culture. National culture is the only property that has a dimension namely “family effect”, this was a characteristic of the national culture of one of the Mediterranean countries. These properties were placed under this category as it was suggested that there were the factors outside an organization’s SMS, but which could influence the effectiveness of the SMS.

Table 2 Categories and subcategories of the factors impeding the performance of the SMS

Broad categories	Property	Dimensions
Top management’s attitude towards safety	Top management’s commitment to safety	Management not interested to know anything about safety
		Failure to participate in the safety activities
		Failure to understand risks
	Allocation of resources	Lack of financial resources
		Lack of staff
		Lack of time
Safety culture		
	Just culture	Blame culture

		Fear culture
	Resistance to change	
Reporting systems/data collection	Deficient reporting system	Impracticality of the reporting system or reporting process
		Insufficiency of the reporting system
	Selective reporting	
External factors	Government	
	Outsourcing	
	Media	
	Legal system	
	National culture	Family effect

5.5. Top management's attitude towards safety

5.5.1. Top management's commitment to safety

During the thematic analysis it was discovered that "top management's commitment to safety was one of the factors impeding the production of safety data required for the development of SPIs and thus the effectiveness of the SMS and this was reflected on eleven comments (see appendix C).

This was exemplified by one interviewee who commented that he perceived that management took no action from the reports and people felt discouraged

seeing that management wasn't involved in the safety activities of the organization. To illustrate this perception, an interviewee commented:

> *"… it's difficult to say that they are involved; when you do the reports and then nothing happens, people get discouraged". (Air Traffic Service provider employee)*

Employees also felt that the top management was not making any effort to promote safety and that the dissemination of safety information and encouragement to report was only performed by the middle managers, without any support from top management. The employees perceived that there was either a lack of (or insufficient) involvement in safety activities, and they perceived that the management was not leading by example. Instead, it was only the middle management who was trying to engage employees in the safety activities of the organization. A participant commented that:

> "…*they are trying only for the basics, only the safety manager informs people, but top management has nothing to do with it; One person is trying to inform [the employees] without any support*". *(Air Traffic Service provider employee)*

Interviewees also expressed the opinion that every time they asked the management for a change or safety improvement, the management replied by saying that there weren't any resources to accomplish it. This was considered by the interviewees as simply an excuse for not wishing to allocate resources and proceed with the change, or to avoid taking some action to improve safety. The employee's perception is illustrated by the following comment:

> "*they use the phrase 'we lack resources' as an excuse of doing nothing. Management has to cover their own back" (Air Traffic Service provider employee).*

According to one participant, failure by top management to take responsibility for their errors yet expecting workers to take responsibilities for their own demonstrated a lack of safety commitment that could be discouraging for the work force. As implied, the top management needed to demonstrate

leadership by example. Failure to take responsibility for their actions reflects on the actions of their employees who would also avoid taking responsibility and concealing their errors. As explained by the participant in the following comment:

> *"We don't want to take responsibilities of our errors, even management will not take the responsibilities of their errors; [top] management needs to be an example"* said another interviewee". (Safety Manager of airline)

Based on the following comment from a participant, it was perceived that after the completion of a safety survey, the management did not take any actions to change the culture of the organization. The participant explained that when the safety survey was completed, the results were not released to the employees because the management perceived that the results derived from the survey were negative. The participants explained as follows:

One of the interviewees commented that *"I believe there are no actions to change the culture*" and the other interviewee commented "*management takes no action to change the culture of the organization"; "after the safety survey there were no results and they have done nothing". (Air Traffic Service provider employees)*

The comments from these participants suggest that they perceived that the management in their organization was not committed to safety. Top management safety commitment plays an important role in establishing a safety culture in the organization and a failure to demonstrate safety commitment will discourage and hinder employee's own safety commitment. Poor safety commitment demonstrated by the top management reflects on the employees and results in difficulty engaging employees with the SMS.

5.5.2. Management not interested to know anything about safety.

Comments about the lack of safety commitment by the management were decomposed further into "management not interested to know anything about safety"; "failure to participate in safety activities"; and "failure to understand

risk". The dimension of "not interested to know anything about safety" was placed under this category as this also suggested that a management that demonstrated a lack of interest in safety that was perceived as lacking safety commitment (see Table 2).

Participants explained that they perceived that when the management was not interested in safety, this lack of interest in the safety of the organization was one of the contributing factors that affected the performance of the SMS.

One participant explained as follows:

> *"[…] but sometimes they don't want to understand some things" (Air Traffic Service provider employee).*

The previous statement suggested that workers believed that although the management understood risks, they chose to present to employees the impression that they did not understand risks to avoid taking any actions. When pretending that everything was working well, as it should have been, there was no reason for making changes. Workers perceived that when the top management actually understood the risks but chose to pretend ignorance about them, the management's actions made employees perceive that they were not committed to safety.

Another participant believed that the top management in his organization was not involved in the safety activities of the organization. They felt that the middle management understood the risks better and were more encouraged to discuss these with them*:*

> *" …we usually go to the manager of the department [to discuss] the top management is never involved" (Airline employee)*.

The previous comment indicated that employees always preferred to discuss their concerns with the manager of their department (the middle management) rather than address them to the top management. Their decision to exclude top management from sharing their concerns could suggest a number of reasons: that workers perceived the management did not care about safety;

the management had showed in the past that they never listened to what employees had to say; the employees did not trust the management, or that employees knew that even if they approached the management to discuss their concerns the management was not going to take any action.

Other participants explained it in the following comments:

> "… *we have meetings [with the top management] every three months to discuss the problems of the organization (Airline employee)"*

The comment from this participant suggested that they had the expectation that meetings would be held more often than every three months, and there would be the opportunity to discuss other themes besides just problems. While another participant added that:

> *"we have meetings only when is needed" (Airline employee).*

Participants perceived that the top management was not open for discussion about safety issues. Failure by management to discuss safety issues in meetings made employees perceive that the matters of safety were not as important as the other organizational problems hence resulting in second place in the discussion board.

Issues related to safety should be discussed daily. Employees should be encouraged to report as data gathering is an important element of the SMS and an SMS can't be efficient without data. In organizations suffering from a poor safety culture, and especially in the cases where national culture influences the safety culture of the organization, there will be an impact on the reporting culture of the organization. The following comment implied that in addition to having a culture in which employees were encouraged to report and were not afraid, the organization needed to demonstrate to employees that there was an open-door policy. A participant explained this need as follows:

"If you were in another country [In Europe] and in another company, you could talk more openly to the management" (Air Navigation Service Provider employee).

5.5.3 Failure to participate in the safety activities

The thematic analysis based on the interviewees' comments showed that in some aviation organizations there was a failure of the management to participate in safety activities. This category was believed to be best placed under the property of "top management commitment to safety". Failure of the top management to participate in the safety activities of the organization, while asking employees to be engaged in the safety activities of the organization but top management not leading by example, was perceived by the participants as a lack of safety commitment by the management. Twelve participants perceived that the management was not interested in participating in the safety activities (see appendix C).

A participant explained this as follows: *"I am not sure if they take part in safety or read the reports"* (Air Traffic Service Provider employee).

Another interviewee commented that "*they are involved in the safety process at the very end" (Air Traffic Service Provider employee).*

The comments, suggested that the employees of the organization had doubts concerning whether management read the reports or participated in safety activities. These doubts suggested that they believed that management was demonstrating a lack of commitment, which discouraged the employees. Lack of commitment and failure to encourage workers to participate in safety activities resulted in a reduction in reports by the employees and impacted the safety behaviour of the employees.

An interviewee stated that: "*they [top management] are only there to give directions" (Airport employee).*

The previous statement indicated that the employees perceived that the management was not contributing to safety. Employees perceived that the management was asking employees to participate in safety activities while

they themselves did not express a willingness to contribute to the safety activities causing segregation between “them” and “us”.

Workers perceived the lack of top management support as a demonstration of a poor top management safety commitment. They perceived that a lack of safety commitment by top management was having an impact on establishing a safety culture, impeded the development of a just culture and reporting culture, and affected the flexible culture of their organization.

5.5.4 Failure to understand risks

The interviewees commented that they felt that the management did not understand the risks or they felt that the management did not perceive the severity of some outcomes related to operations. Fourteen participants expressed their belief that the management did not understand risks to the extent they should. One participant commented as follows:

> *“Management does not understand the risks to the extent they should” (Airline employee).*

Similarly, another employee commented:

> *“We see that people that came from the same environment don’t understand risks and this is a very negative aspect” (Air traffic service provider employee)*

Failure to understand risk by the management may cause them to underestimate risk and influence their decisions about the corrective actions. Interviewees felt that it was disappointing that the people who had worked in the same position and understood the risks while working in those positions, after their promotion, demonstrated a lack of understanding of the risks or forgot completely about these risks.

Another interviewee suggested that promotion to a higher position caused management to view risks with a different perspective or caused them to have a different appreciation of risk. Workers needed to discuss and communicate information clearly in order to make top management understand:

“They have different appreciation of the risk but you need good communication to convey and convert information to make them understand.” (Air Traffic Service provider employee)

Another interviewee commented that the management in his organization understood risk but due to external influences, the management had to prioritize corrective actions:

“*they understand but they face their own needs. So it’s like they have never existed in this environment. They have to do their own things. They have to serve their needs or themselves first and the responsibilities of their positions.” (Air Traffic Service provider employee)*

This interviewee explained that he perceived that the management is his organization did not appreciate risks, and did not mirror the expectations of the employees. Employees perceived that the top management understood the risks, as before being promoted to managerial positions these people were working in the same position where these employees were currently working. The interviewee believed that the management in his organization, may understand risks, but they chose to pretend that they did not to avoid taking corrective actions as he perceived that there might be other external factors exerting pressure to the management.

A participant explained in the following comment that top management and workers in the organization perceived risk in a different way. When management had a different appreciation of risks, employees perceived that there was a difference of understanding between them. Workers perceived that the top management was demonstrating a lack of safety commitment since they felt that the top management was not willing to learn more about the risks employees were facing in operations.

“There are conflicts between employees of the organization and management because they have a different appreciation” (Air Traffic Service provider employee).

Failure by top management to understand risk can be an obstacle in establishing and maintaining a positive relationship between top management and employees. Employees will perceive that there is a lack of safety commitment by the management and a failure to understand risks influences the decisions of the top management for the allocation of the resources needed corrective actions. Lack of appreciation of risk by top management may be perceived by the employees as resistance to change.

5.5.5 Allocation of financial resources

The implementation and operation of any SMS will require human, financial resources, time and equipment. Lack of any of the above may pose challenges in the operation, effectiveness and safety performance assessment of the SMS.

One participant explained in the following comment that management wouldn't allocate resources easily and employees needed to convince top management to allocate the resources. The interviewee commented that whenever an employee asked for a change to be made, if the management estimated that it was not costly and did not require financial resources, it was more likely to happen. In contrast, if the change was perceived by the management as expensive it was probable that the management would not allocate the resources required for the change.

An employee commented that *"it's a lot of work to convince them; depends on the money you want to spend; cheap things change easily" (Air Traffic Service provider employee).*

Another interviewee commented that *"things can change but you need to fight a lot" (Air Traffic Service provider employee).*

Participants explained that every time they needed a change, convincing the management to allocate the resources was not an easy task. Employees perceived that the top management was demonstrating resistance to change by refusing to allocate financial resources. Employees also perceived this response as a lack of safety commitment since the management was not

willing to allocate the resources for the changes and resisting the changes demonstrated a failure of the top management to understand risks.

Interviewees implied that although sometimes the organization was willing to make some changes, they could make changes only based on the available resources. Based on the comments that follow, it was believed that the organization was willing to make any required changes but due to the lack of resources the organization was not financially able to do so. Lack of, or constrained resources require organizations to prioritize changes. An organization will prioritize the actions to take, with preference given to the actions required for regulatory compliance and high-risk situations. Cultural transformation, safety training and promotion might not be considered as a priority.

> *"We change things to the degree our resources allow us. The organization is willing to adopt a positive safety culture but "I want to" and I can do" are two different things." (Air Traffic Service provider employee)*

> *"Depends on the funding, since we are in the public sector, training is not a priority for example we need to get an approval for training for a specific task" (Air Traffic Service provider employee).*

The previous comments imply that organizations in the public sector have to depend on the government for the allocation of financial resources. The challenge lies in the fact that if the government fails to appreciate the risks correctly, this may influence their decisions about the allocation of resources. Failure to allocate the resources to the organization impedes the organization from accomplishing their safety outcomes or their safety performance measurement and hence the success of their SMS.

Another participant made the following comment, that when the organizations were part of the government, the insufficient allocation of resources impacted their operations causing an inflexible culture, resistant to change and which resulted in a delay in corrective actions, prioritizing only the actions that were needed to meet the regulatory requirements.

"We don't have a flexible culture because we depend on the ministry and there is bureaucracy" …"We cannot need something and have it exactly when we want it [bureaucracy makes us wait]…" Under the circumstances, everything is subject to the approval of funds" (Air Traffic Service provider employee)

"We work in the framework of what we can do [with the available resources]. Something cannot be done if there are no resources, for example a unit might need more experts but there is no one available or no resources" (Air Traffic Service provider employee).

The participant explained that due to the nature of the reporting system, the organization was suffering from a reduced number of reports. The interviewee explained that he asked the top management to allocate resources to promote the reporting system and emphasize the just culture of the organization in order to increase the number of reports. The interviewee added that the top management would not allocate the resources for improving the reporting system, but instead they suggested that the manager of each department should be willing to train his employees. Employees perceived this response as a lack of safety commitment by the management. They perceived that the management was not committed to allocate the resources for improving the reporting system, hence increasing the number of reporting and establishing a safety culture.

One safety manager of an organization commented that *"we don't have enough reports and because of the lack of resources, we have other things to prioritize. In the past we asked if someone can come and do a presentation* (also mentioned by another interviewee in the pilot study in the previous chapter) *and explain things, but this depends on the good will of the manager of each station".*

The following statement indicated that the organization had limited resources and were trying to accomplish a cultural transformation within a framework of limited resources:

“We promote culture change under limited resources” (Safety Manager of Air Traffic Service provider).

Another safety manager stated that: *“we have priorities, first is what is imposed by regulations” (Airline Safety Manager)*

Due to insufficient resources the organization had to prioritize corrective actions and only change what was required for regulatory compliance. Actions that could have increased the levels of safety performance were secondary in the priorities list.

5.5.6 Lack of staff-human resources

Similar to the previous challenge “lack of time”, lack or insufficient human resources may impede the timely accomplishment of tasks. Lack of human resources resulted in prioritizing tasks and so some tasks were left unaccomplished.

The following comments imply that the shortage of staff impacts on every day work. Employees have to take on additional tasks to compensate for the lack of staff. An employee commented as follows:

“Shortage of staff is reflected everywhere” (Air Traffic Service provider employee).

Additionally, employees need to prioritize tasks and perform those of highest importance first, such as the tasks assigned to them in their job description and only then work on additional tasks in their free time.

The organizations that are understaffed might demonstrate a delay in the accomplishment of certain activities. People working in these organizations were required to perform their primary job and in addition to that, also perform safety activities. This caused a delay in the timely identification of hazards and in taking remedial actions. This was explained as follows by another participant:

“A lot of hazards remain hidden because we have a shortage of staff. We cannot do [because of the lack of staff] a risk assessment” and

another interviewee commented that: *"data collection consumes a lot of resources (time and people)." (Air Navigation Service provider employee)*

The safety activities of an organization such as data collection and risk assessment, consume resources. Risk assessment requires human resources and time. Workers in organizations that are understaffed and without dedicated personnel for safety activities needed to perform their primary job first and then safety activities. Due to the fact that they could only perform a limited number of tasks within a shift, employees perceived that there were delays in the accomplishment of safety activities. Lack of human resources and lack of dedicated personnel may result in additional workload, pressure on employees and exposure of the organization to the hazards until corrective actions are taken. There were delays in risk assessments and corrective actions and which may also contribute to misleading results in safety performance measurement.

One participant explained in the following comment, that although the organization was willing to take corrective actions, it was the lack of staff that impeded them from taking the corrective actions.

"[…] only for a few circumstances, actions are taken to correct the situations because of the lack of personnel, not because there is no will." (Airline employee)

The following comment indicated that the shortage of staff did not permit the employees to perform risk assessments, and the people in the organization continued to work using outdated practices that were no longer appropriate and safe for the volume of traffic the organization was handling.

"Shortage of staff: They cannot do the risks assessment. People are stuck in common practices, which are not always the safest. Procedures on towers Vs the volume of traffic: now the procedures don't work because they introduced new risks. Complex airport traffic/ volume and the procedures and the environment do not contribute in the safe flow of traffic". (Air Traffic Service provider employee)

5.5.7 Allocation of time

As previously commented on by the participants, insufficient resources had an impact on the performance of the safety activities of the organization. This meant that aviation organizations lacked dedicated personnel resulting in additional workload for employees. Employees had more tasks to accomplish in less time, hence they had to prioritize between their primary job and the additional activities assigned to them. As explained in the previous comment, due to the fact that the employee had to prioritize their normal duties for their job, they could only perform safety activities, such as accident investigation, whenever they had free time, resulting in a delay in the accomplishment of the tasks:

> *"For example, if you have an investigation to do, you need to do it immediately, you cannot wait for another 9 months. It is important to do things on time." (Air Navigation Service provider manager)*

This comment implies that lack of dedicated personnel may result in a delay in the accomplishment of safety activities; hazards remain hidden, remedial actions are not taken, and misleading results are provided in safety performance measurement.

Lack of dedicated personnel for the accomplishment of safety activities may also cause a delay in their performance. As a result, employees had to work overtime or work during their days off which could have demotivating effects. Delay in the accomplishment of the safety activities implies that until the hazards were identified and analyzed, the organization remained exposed to the hazards that remained hidden. This is illustrated in the comment below:

> *"There should be a dedicated safety manager not someone who works on shifts". (Air Traffic Service provider employee)*

Another interviewee expressed his concern about the bureaucratic ways of doing things in the cases where the aviation organizations were influenced or operated by the government:

"Things are even slower in the government, there is resistance from the government or public sector". (Air Traffic Service provider employee)

The participant explained that when the aviation service provider was part of the government or operated by a government agency, this caused a delay in taking decisions on the remedial actions and releasing a budget for the actions due to the fact that everything was subject to approval. It was possible that the government showed resistance for these reasons: because they did not understand the risks and the importance of the remedial actions; and secondly because they were trying to minimize costs.

Lack of resources, (human, financial, time) results in the delay of certain tasks that are important to be accomplished on time, hence hazards will remain longer in the organization and the organization cannot improve its performance.

5.6. Lack of safety promotion

5.6.1 Lack of encouragement

The following comments from interviewees implied that it was perceived by employees in the organization that the top management was not promoting the safety culture of the organization and it was only the safety manager who was making all the efforts to promote safety. The employees perceived that the top management was not leading by example and this was demotivating for the employees, as they perceived that the management was not taking part in promoting the safety culture. Eleven participants felt that the management was not promoting the safety culture (see appendix C). The participant explained this as follows:

"But the management has nothing to do with the safety culture. Only the safety manager informs the people. One person is trying to inform everyone without any support". (Air Traffic Service provider employee)

"*Only the safety manager and the investigation team encourage reporting" (Airline employee).*

The next comment implied that the safety culture was not promoted equally throughout the organization. In some departments, the organization was not promoting they safety culture. Lack of safety promotion impeded employees from taking part in safety related activities such as reporting. Lack of safety promotion will also have an impact on the just culture, on the reporting culture and the safety culture of the organization as a whole, resulting in a reduced number of reports.

> *"In the office they don't see the benefits [of reporting] they don't have a safety culture. They don't see that their report is used to create a better workplace" (Airline employee).*

Based on the next comment it was perceived by the employees that the management did not practice what they preached and was not taking any actions to change the culture of the organization.

> *"Management said they encourage the change of the culture of the organization but I don't think they are taking any measures" (Air Traffic Service provider employee).*

The following comment implied that the management did not encourage reporting and every time the employees had the opportunity to avoid reporting they would take that opportunity. The interviewee commented as follows:

> *"Management does not encourage reporting. If you are not obliged or you have another choice you will not report" (Air Traffic Service provider employee)*

As implied in the statements, the employees felt that top management to did not encourage them to report and they perceived that the top management was not committed to safety. Lack of encouragement to report contributes to a lack of safety promotion, impacts the reporting culture of the organization and the effectiveness of the SMS.

5.6.2 Lack of training.

Providing training to employees is essential for their day to day work and as well to increase the participation and commitment of the employees in the safety of the organization. Lack of training implies that the employees don't possess the required skills for the task, or ignorance, uncertainty and fear might also impede them from participating in the safety activities.

Based on the comment below it was perceived that the organization was not promoting safety: the employees felt that in their organization, the top management provided them with less training than was provided in most organizations. The fact that the organization was reducing training time, from one year to a few weeks was perceived by the employees of the organization as a lack of safety commitment. The participant commented as follows:

> *"Instead of giving us radar monitoring training which is in most organizations approximately one year, they give it to us in a few weeks".* Commented an air traffic service provider employee. (Air Traffic Service provider employee)

5.6.3 Just culture

The dimensions "blame culture" and "fear culture" were placed under the property of "just culture". This part discusses how employees perceived that they were blamed directly or indirectly in their organization and expressed a concern that they were working in an atmosphere of fear. This fear culture may have a direct impact on the reporting system, impeding reporting.

5.6.4 Blame culture

One interviewee suggested in the following comment that employees got into trouble when they made a voluntary report. Blaming employees was discouraging, especially when they voluntarily made a report to improve the safety performance of the organization. It was implied that this might have an impact on the reporting system, as more and more employees would be discouraged to report especially if there was peer pressure: for example, a person who was already blamed and ended up getting into trouble

encourages another person not to report. This resulted in the organization missing important information from both mandatory and voluntary systems. Employees would choose not report in the voluntary system just to minimize the possibility of getting blamed and they would also try to avoid reporting in the mandatory system. This is illustrated in the next comment:

> *"Something that has to do with you and you end up into trouble just because you made a voluntary report". (Airline employee)*

Based on the comment below it was perceived that the management indirectly blamed the employees who reported using the voluntary reporting system. This action discouraged employees to report and the employees who were blamed advised other employees intending to report, not to report to also avoid being blamed. Employees perceived that their efforts and willingness to report was not appreciated by the management and instead they were accused that they were only reporting to create a problem to the management.

> *"If it's a voluntary report they will say that you are doing it on purpose just to create an issue". (Airline employee)*

As implied by the comments in the next sub-section, it was perceived that some employees would only report because they were afraid that a failure to report would have got them fired. It was implied that the employees did not trust the management and they were afraid that when they reported, the management wouldn't understand the circumstances underlying the event and blame them.

5.6.5 Fear culture

Fear culture is an obstacle impeding the reporting and safety culture of the organization. The organization's approach to handling errors can result in fear and uncertainty which will make employees reluctant to report.

> *"[They are] willing to do the reports because they might be afraid that they will lose their jobs. Yes there is lack of trust [this is why] they don't report". (Airline employee)*

"For some cases you wouldn't do a report, you are not sure if they will understand you". (Airline employee)

Based on the comment from the manager below, it was implied that although the organization never punished any of the employees, the employees were still afraid of punishment. It was perceived that the employees did not trust the management. One participant explained this in the next comment:

"They don't trust us they think that we will use their report to punish them although we have never done this. But this is what they think. They will also involve their union and their union will come against us". (Air Traffic Service provider manager)

5.7 Resistance to change

Employees and top management in aviation organization demonstrated resistance to change for different reasons. Seventeen participants commented that the organization was demonstrating a resistance to change toward the adoption of a positive safety culture (see appendix C).

The employees refused to change their working practices to adopt those that were safer and more appropriate for the task. Outdated practices, no longer appropriate for the operations of the organizations might imply that there were hazards that were hidden. An interviewee explained about the resistance to change commented as follows:

"No I cannot do it and I don't want to do it." (Airline employee)

"*Habits do not change easily, they are deeply rooted."* (Airline employee)

As illustrated below, one employee commented that the middle management was making efforts to change the habits of people in the organization but employees resisted these changes:

"Small efforts but they find resistance from people." (Airline employee)

Another employee commented that:

"When you are working don't change anything, until they tell you to change." (Air Traffic Service provider employee)

As implied, employees sometimes acknowledged that their working practices were not safe nevertheless, they continued to work with these practices just to avoid the hassle of changing the way the worked (see Appendix C). This continued until someone asked the employees to correct their working practices. Bringing the wrong working practices to the attention of the safety manager would have meant that the manager would need to change the procedure and as a consequence ask them to change them. Keeping quiet implied that the safety manager would not ask them to change the way they worked.

The following comment illustrates the perception that employees in the organization were afraid to change things that were deeply rooted in that organization.

"In the past there was the fear of changing things that were established." (Air Traffic Service provider employee)

Fear of changing things may result from the perception that time would be required to adjust to the new conditions, constant reminders that the working practices have changed and fear of uncertainty. Moving towards uncertainty causes fear of the unknown so people tend to prefer to choose the safe route, the one they know. For this reason, according to their experience, they do not want to change anything since they already know that they can make it work that way.

Based on the comment that follows, some departments of the organization showed resistance to change, as they perceived that if they changed their way of working, the new working practices could cause their performance to drop. The fear that their performance would drop caused these particular departments to resist the changes. This was illustrated in the next comments:

"The organization is willing [to change] however there are departments that have resistance because they have learned to work in a specific

way and it's difficult for them to change the mentality or way of thinking and to a small extend the fear that their performance will drop". (Airline employee)

As the comments suggest, both the management and the employees may demonstrate resistance to change. It is possible that the management may not have asked for changes to be made because changes require the allocation of resources for employee's overtime, new equipment and new training. Employees avoided asking for changes so they would avoid the hassle of retraining, examination and adaptation. If everything was working, the employees felt that there was no reason to ask for any improvements. One participant commented as follows:

"The things are stable. We don't ask, they don't ask". (Air Traffic Service provider employee)

Resistance to change has caused a hindrance to changing things for a significant period of time in the next participant's organization. Only during the last year with the development of the SMS requirements things started to change in that organization. To illustrate this one employee commented that:

"It has been 15 years things do not change. Only the last year things change." (Airline employee)

In the next comment one employee perceived that working habits only changed because the management impressed on the employees that they had to change. It was perceived that employees resisted the changes because they didn't understand the reason of change and thus refused to change their working habits. When employees felt that management, without any justification or explanation, was imposing on them a change in the way they worked they resisted. They exhibited a negative reaction because they felt that they did not want someone to impose on them the way of doing their job. This participant explained this in the next comment:

“Different habits change by imposing:” I want it this way. Because I am using this method and I get what I want”. (Air Traffic Service provider employee)

One participant explained in the following comment that in his organization, employees had to accept how things were, and do their work without asking for anything to change. Employees perceived this absence of change as an unwillingness to improve. They perceived that resistance to change was deep rooted in the culture of the organization. Resistance to change became embedded in the culture of the organization (“*this is the way we work here*”) and employees had to accept that things were this way and the organization couldn’t do anything to change them. To illustrate this an interviewee commented:

“*The culture of “accept how things are and mind your own business”. (Air Traffic Service provider employee)*

As implied by the following comment from an interviewee, it was perceived that it was not easy to change the habits of employees because they are deeply-rooted and efforts were needed to change these habits.

“It needs efforts to change habits” (Air Traffic Service provider employee).

Comments from the interviewees indicated that national culture (the culture from the small Mediterranean countries they came from) might have affected the organizational culture. The next comment implied that the national culture of the employees had an impact on the organizational culture. The employees perceived that it might have been ethically wrong to comment on someone who was more senior than them. Another explanation is that the employees might have perceived that it would have been difficult to change the way a senior employee worked, as working all these years in a specific way would be difficult for them to change that way of work. Not informing a senior employee about his incorrect work practice meant that the employee continued to work in this way (since no one was correcting him) until when a specific working practice had to be put into practice, this became evident and

was identified during a simulator session. As implied in the comment from the interviewee, in their organization they identified mistakes during the simulator session and tried to change the habits in training courses. Nevertheless, because simulator examinations were not conducted often (usually once or twice a year) this implied that for almost one year – or even more - errors remained in working practices. This continued until the person was asked to put in practice the specific procedure which was incorrect during the simulator. The fact that simulator examinations were not undertaken often made identifying errors more difficult.

> *"If there is someone who is senior in terms of more years at work, I cannot change his mistakes." (Airline employee)*

> "*Different ways to change habits: the first time with the refreshing courses. Bad habits come to surface. Only in the simulator mistakes will be discovered." (Airline employee)*

When a safety manager interviewee was asked how they changed habits in their organization, they commented that they were changed through training. Feedback given to them on their performance or feedback during work supervision by the safety manager was not taken into consideration and was thought to be insufficient to change the habits of the employees. This was illustrated in the following comment:

> "*Training. Feedback but they don't take them too much into consideration". (Air Traffic Service provider employee)*

This participant in his following comment implied that the organization was avoiding changes by changing only what was required in the safety assessment. This implied that the organization was trying to reduce changes to the minimum.

> *"[We] Avoid changes, we do not change things other than those in safety assessment." (Airport employee)*

As a specific example, in the following comment, the employees perceived that the management did not give them the opportunity to express their opinion in this matter even if it was the employees who were actually going to use the headsets. These actions made them perceive that the management is not thinking of their employees:

> *"For example, it was decided that we were going to use headsets. From EASA they gave us the choice whether to use the single or the double. We were thinking to buy a single headset and a double, so each person would use the one he wanted. Although EASA gave us enough budget to buy both of them for each person, the management imposed to is that we will use the double". (Air Traffic Service provider employee)*

One participant commented that the management was trying to make changes in the organization. However, it was perceived by the employees that the changes the management were making were not made in a way to please the employees. The changes were seen more like a punishment.

> *"They try to change but not in a way to please the staff. Not corrective meaningful corrective actions but [actions] to punish the staff." (Air Traffic Service provider employee)*

5.8 Deficient reporting system

Problematic reporting systems will yield low quality data that are not suitable for the development of SPIs. Poor and insufficient reporting can be a result of an insufficient and impractical reporting system.

5.8.1 Inadequacy of the reporting system

As implied by the following comment, the interviewee perceived that the reporting system was insufficient and did not give a complete picture of the hazards. Twenty-one participants commented that the reporting system didn't give a clear picture of all the hazards (see appendix C). As a result it would not give indications of the existence of hazards until they were realized. The participant commented as follows:

"The reporting system is reactive, indicates the trouble areas". (Airline employee)

Based on the following comment, the reporting system by itself was not thought to be sufficient to identify all the problematic areas of these service providers. Hence this implied that organizations that relied only on the reporting system for data were not getting the complete picture of the hazards and there were hazards that remained unidentified (see Appendix C). Only when the reporting system was used in combination with other data collection systems could the organizations have had a more complete picture. The participants commented as follows:

"Other safety tools used to have a clear picture (TOKAI, ASMT RAT)". (Air Traffic Service provider employee)

"Reporting is incomplete. Most important is FDM" (Airline employee)

"Does not take into consideration all the hazards of an airport. It needs to be expanded". (Airport employee)

"Gives a good picture but not the whole picture". (Airline employee)

"For example, unstable approaches: the picture does not come from the reporting but from the FDM". (Airline employee)

"It depends, ex bird strike. If you have a bird strike you don't require additional information. If there is not only [external] damage because of bird strike, and maintenance is involved, maybe you need more info from the maintenance to classify the event in order to know what action to take". (Airline employee)

Based on the next comments, it was perceived that by only using the reporting system, the organization was not able to get a clear picture where the risks were. Hazards were in some cases unidentified and not reported because the employees might not have realized that their working practices were not correct but these hazards could have only been identified through other activities. One interviewee commented as follows:

"There is a blurred, not clear picture where the risk is. [We] Find out [where the risk is] through other activities: capacity exercises, failures, during the investigation you identify other failures". (Air Traffic Service provider employee)

5.8.2 Impracticality of the reporting system/process

All twenty-three participants commented that there were cases where hazards were not captured through the reporting system but were discovered by chance (see appendix C). One interviewee commented that due to the manner in which the reporting system worked the safety manager was not the only person to know about the occurrence; the top management was also informed about it. When management was informed about the occurrence, they removed the employees from their duty. As a result, other employees were able to know if an employee was removed from duty. Removing employees from the roster gives the impression to other employees that the person removed was involved in an occurrence. Employees perceived that the reporting system and the process were impractical as it permitted employees to identify the reporter as a consequence of the actions taken by management. Employees felt embarrassed when removed from their duties and from the roster as the felt that other workers discussed this behind their backs, resulting in discouragement from using the system. Employees felt that the nature of the reporting system was resulting in a lack of trust, as they were afraid of the unknown (for example: *Who is going to read my report? I am going to get into trouble?*). It was perceived that there was a lack of trust between employees as they thought that they could become the subject of discussion and gossip when someone read their report due to the nature of their reporting system. Employees knowing what could follow on after their report preferred not to report, rather than reporting and being the subject of gossip in the organization. One participant explained in the next comment:

"They are afraid of the psychological exposure to the colleagues due to the employee's withdrawal from duty by the board". (Air Traffic Service provider employee)

As implied by the following comment it was perceived by the employees that their reporting system was impractical. By perceiving that the reporting system was impractical, the employees were discouraged to make reports. Instead they preferred to write about an occurrence in the logbook. The impracticality of the reporting system contributed to employees avoiding making a proper detailed report and instead making a less detailed report in the logbook.

> *"A bit reluctant they are bored with the whole process. It might be easier to write the occurrence in the logbook rather than do a report. It's more practical". (Air Traffic Service provider employee)*

Based on the following comment it was perceived that from the impracticality of the reporting system other employees knew who made the report. Employees knew that other employees could read their reports, and feared that other employees would discuss and gossip about them. There was a lack of trust in the reporting system which discouraged them from reporting. This was illustrated in the next comment:

> *"Every time there is a report this [the report] goes out". (Air Traffic Service provider employee).*

5.8.3 Selective reporting

The following comments implied that employees selected what to report and who to report.

As implied by the following comment, it was perceived that when the employees were working with their friends, they did not report when their friend was involved in an occurrence. The employee seeing his friend committing an error would just advise him not to do it again. These errors went unnoticed since neither of them reported the occurrence.

> *"If it's between friends we will tell him not to do it again and not report him. If it's a shift manager he can say "this will stay between us"". (Air Traffic Service provider employee)*

The danger lies in the fact that the employee who committed the error, risked committing the same error again if he was working alone. If the error was not reported this could mean that the organization would be unaware and be unlikely to correct the employee's knowledge.

Based on the following it was found that when the employees reported, they selected what to report. Employees would not report an event in which they were involved. It was perceived that the employee only presented his/her version but often without mentioning his/her contribution to the event. This is illustrated in the next comment:

> *"We report others. For example, "the pilot of that XXXX airline did this, this, this and this but we are not saying [reporting] that we made the pilot's life difficult so when we report, we don't mention our contribution to the event so the report has a gap". (Air Traffic Service provider employee)*

The following comment indicated that employees would report others but not themselves unless it was for their own benefit. In addition, when an interviewee was involved in an occurrence he would only report if he perceived that the other employee involved came from a company with a positive safety culture, which meant it was more likely that the other person would also report. However, if the interviewee thought that the other employee wouldn't file a report, then the interviewee wouldn't report either. The participant explained as follows:

> *"We don't report ourselves. We don't want to report our errors. I only do the report if it's for my own benefit. If I knew that the pilot wouldn't report I wouldn't report either. For example, the other day I was involved in an incident with a pilot of xxx airline and because I knew they have a mature safety culture, I knew the pilot would report; that's why I reported as well. But if I knew that he wouldn't report I wouldn't have reported either". (Air Traffic Service provider employee)*

Based on the following comment it was perceived that reporting depended on each individual and was subjective. There were individuals that might not

perceive an event as something that needed to be reported, while others might feel that they needed to report something minor. The danger behind this rests in the fact that the event could have gone unnoticed when the potential reporter worked by himself, assessed the event as minor and was not advised by someone to report. One participant explained in the following comment:

> *"They will assess the seriousness [of the event] depending on Eurocontrol. For example, I might not consider something as important [and not report it] but someone else might tell me that I need to report it". (Air Traffic Service provider employee)*

5.9 External factors

An overview of the external factors is given in the following sub-section. External factors influencing the performance of the SMS may include the government, the media, the legal authorities and national culture (including the dimension "family effect"). These are all factors that can have an impact on aviation service providers.

5.9.1 Government

The following comment implied that the employees in the organization were willing to make changes in the organization. However, in some cases, the organizations who were financially dependent on the government or who were managed by the government, perceived that the government demonstrated resistance when allocating resources. The government resistance to allocating resources to aviation organizations had a negative impact on the organization's SMS as it delayed the organization taking corrective actions or delayed the efforts to change the culture. Participants explained as follows:

> *"Things are slower in the government. Managers and staff are capable and willing, but find obstacle [from the government]". (Air Traffic Service provider employee)*

> *"Things are moving slower in the government, there is resistance form the public sector/government." (Air Traffic Service Provider employee)*

"The organization is willing to change towards the adoption of a positive safety culture. Positive but because we are part of the government there are restrictions. You cannot make easily steps forward". (Air Traffic Service provider employee)

"They are trying but there is resistance from the ministry". (Air Traffic Service provider employee)

The following comments implied that external factors, such as financial dependence on the government, exerted pressure on organizations to prioritize certain actions taken in the organization. Due to restricted financial resources, the organizations were required to choose between regulatory compliance and safety performance. Restricted resources caused a need to prioritize what was required for regulatory compliance and to delay changes for cultural transformation. Organizations had to wait to become private organizations (not part of the government) to address safety issues. Delay in this may also cause delays in the implementation, effectiveness and performance of the SMS. Participants explained as follows:

"We are waiting for the company's privatization to change the culture- we belong to public sector and we are waiting to become private". (Air Traffic Service provider employee)

"They don't change. They are waiting for prioritization". (Air Traffic Service provider employee)

"The private company will deal with the actions to change the culture of the organization. The private company will deal with this". (Air Traffic Service provider employee)

One participant explained in the following comment that when an organization is part of or managed by the government it was perceived that bureaucracy and waiting for approvals for the allocation of resources caused delays. Employees perceived the failure to allocate the resources needed to the organization as resistance to change from the government. This demonstrated to the employees that there was a lack of flexible culture in the

organization, introducing delays in managing changes and promoting the safety culture.

> *"Not that flexible culture because we depend on the ministry and on the bureaucracy. We cannot want something and be able to have it immediately [when we want it]". (Air Traffic Service provider employee)*

The following comment indicated that the Ministry showed a resistance in allocating resources to aviation organizations. The organizations were facing difficulties in managing changes in their organization, which made it difficult to manage safety. This was illustrated in the next comment:

> *"Not willing to do anything related to safety there is resistance from the ministry". (Air Traffic Service provider employee)*

The following comment implied that when organizations were part of or managed by the government, a lack of resources and operating within a budget had an impact on training. Because of restricted resources, training was not considered to be a priority. Employees explained that although the use of radar was required by the organization to be able to deliver services, lack of resources caused a delay in training people to use the radar.

"Depends on the funding from the government, since we are in the public sector, training is not a priority, for example we need to get approval for radar training". (Air Traffic Service provider)

5.9.2 Outsourcing

As explained by interviewees in the next comments, when organizations outsource activities, unsafe acts by the people from the outsourcing organization have an impact on their SMS. Organizations were able to change the habits of their employees, but it was more difficult to change the habits and monitor the corrective actions taken for organizations outside their SMS.

> *"Great difficulties with the influences of people or organizations that are outside our SMS but we still have to deal with them." (Airline employee)*

Resistance to change has also been found in cases where an outsourced organization was been asked to perform a task in specific way but because the employees of the outsourced organization did not know how to perform the task in the way requested by their customer, they did not perform the task at all. Resistance to change was perceived from the fact that the outsourced organization did not know how to perform the task, but they did not make any efforts to learn how to do the task. Put more simply, when they did not know how to do the task, they would not do it at all. This was illustrated in the next comment:

> *"Maintenance is performed by another company we outsource to another airline. We identified bad habits with the maintenance organization because they were not trained to do a task the way we asked them to do. When they didn't know how to do it they would not try to do it at all. If they knew to do a task a certain way they would do it the way they knew, and they would not try to do the task the way we were requesting. For example, the PCMCIA cards. This issue was improved with good with communication". (Airline employee)*

5.9.3 Media

The media was one of the external factors that was perceived to have an impact on the organizational culture, influencing the safety culture of the organization.

The following comment from one interviewee implied that the national culture of the small Mediterranean country the worker came from had an impact on the organization in which the employee was working as it was not ready to accept errors by professionals. As explained, because of the national culture, the legal authorities and media were not ready to treat reporters ethically and this fostered an atmosphere of fear and blame in the organizations. The employees perceived that due to the national culture, the media was looking for every opportunity write a headline where employees are blamed and punished.

"It has to do with the national culture. For example [a service provider which is] in the Netherlands whenever there is an incident, they will investigate it and they will say "there was an incident for example loss of separation, we have contacted the airline and the airline is taking their measures in order to avoid this from happening again" and the story ends there. If this happened here, the media would have jumped on us saying that we are not doing our job well". (Air Traffic Service provider employee)

The participant explained in the following comment that if the reporting system was breached and information about the event reached the media, any just culture would have been compromised and employees would stop reporting. Perceiving that external factors, such as the media and the legal authorities, were not ready to accept professional error, this may have reduced their confidence in the reporting system of their organization:

"There is an unofficial anecdotal agreement for data that says that if any external organization gets data the reporting system [of the organization], the reporting process and route will get a downward route will start from the moment the external organization gets the data. [we are concerned about the] treatment of data, external influences are the media, legal authorities. Because these entities are not ready yet for the fair treatment of reporters". (Air Traffic Service provider employee)

5.9.4 Legal authorities

The following comments implied that the legal authorities had an impact on the organization's safety culture and the performance of the SMS. Employees perceived that their national culture was not mature enough to accept professional error without blaming, targeting and punishing workers who committed an error. A disciplinary system that fosters an atmosphere of blame, punishment and fear will reduce the confidence in reporting. The employees explained as follows:

"The prosecutor is a barrier that affects the internal culture. The people from this organization are afraid of the external factor. If they were ready we could have achieved the implementation of the SMS sooner". (air traffic service provider employee)

"There is an unofficial anecdotal agreements for data that says that if any external organization gets data the reporting system [of the organization], the reporting process and route will get a downward route will start from the moment the external organization gets the data". (air traffic service provider employee)

5.9.5 National culture

National culture may be responsible for some differences in attitude as well as interpersonal interactions. As mentioned previously in "Media" and "Legal authorities" employees perceived that some countries had a more mature national culture, ready to accept professional errors and treat the reporters ethically. Interviewees perceived that the matter becomes even worse when media inflated the events in which individuals were involved, blamed them and overemphasized their errors.

Human Factors has expanded beyond the human-machine interface to include psychological areas such as communication, leadership, performance under stress, interpersonal relations and decision-making. Evidence suggests that these areas are all influenced by national culture (see Chapter 2). Evidence suggests that the national culture influences the implementation of SMSs in these Mediterranean service providers. This suggest that different national culture characteristic of each country might influence the way SMS is implemented by service providers in other countries. The following comment implied that one of the characteristics of the national culture of the small Mediterranean country the interviewee came from, was that after an employee reported a safety incident, other employees discussed this behind the reporter's back. It was obvious to employees and they knew if they reported a safety incident that they were involved in, other people would talk about them and gossip behind their back. Knowing that this happened in their organization, employees avoided reporting and tried to hide their error. The

following statement implied that in certain countries, their national culture becomes an obstacle to the success of the SMS as the lack of trust between employees, the fear and punishment and the embarrassment employees felt, impeded them from reporting.

> *"The will to change exists but the national culture draws us backwards. Because we know that people talk [between them] and discuss with other people". (Air Traffic Service provider employee)*

The comment that follows implied that as a result of their national culture, people did not like to be told what to do or were not willing to accept suggestions and advice from other people. The interviewee commented that although suggestions by other organizations or authorities might have made their work easier, due to the fact that they did not like other people asking them or imposing upon them the changes needed, this made them resistant to change.

> *"People will resist to change for anything, any change even for the procedures that can reduce the workload [when these were asked to be implemented] people reacted: "we are not going to let the English do whatever they want". [we are] Very resistant to change". (Air Traffic Service provider employee)*

The following comment implied that the people from this culture were revolutionaries. Revolting against changes is an indication of resistance to change that could result in delays to the establishment of a safety culture and inhibit the effectiveness of the SMS. One participant explained as follows:

> *"We are a bit more anarchists for [safety] culture. It obliges you to do something out of the culture (national culture)". (Air Traffic Service provider employee)*

Based on the comment below it was perceived that the national culture of this small Mediterranean country impeded employees from changing their habits. Resistance to change habits could be an obstacle for organizations that were striving to improve their safety culture. The following comment may imply that

not changing work habits easily might be a characteristic of some countries and it could be a characteristic of this particular Mediterranean country. A participant commented:

> *"We don't change our habits easily it has to do with the national culture". (Air Traffic Service provider employee)*

5.9.6 Family effect

The dimension of the "family effect"' falls under the property "national culture". Based on the following comments, it was considered to be one of the characteristics of the national culture of a small Mediterranean country. Participants defined "the family effect" as a situation where one of the two people working together committed an error but because they were good friends, they mutually agreed not to report the error. In the "family effect", employees who were friends with each other, mutually covered each other's back, without reporting the error. The participants explained as follows:

> *"if it's my friend [working next to me] I will tell him "don't do this again" and I will not report him". A shift manager can say this will stay between us". (Air Traffic Service provider employee)*

> "*The reporter will not report himself and will not report his friend either. The family effect is when someone does something [wrong] and then someone next to him who is his friend or they like each other the person will tell his friend "don't do that next time". (Air Traffic Service provider employee)*

5.10. Results and discussion

One of the main purposes of this study was to identify the main problems and important underlying factors impeding the production and collection of the safety data required for the development of SPIs and the effectiveness of SMSs. The following figure describes the relationship between the themes elicited.

Figure 3 presents the proposed model showing the relationship between themes. As the model suggests, the “external factors” influence the “safety management’s safety commitment”, the “allocation of resources”, the “safety culture”, the “just culture”, “resistance to change” and the “reporting culture” of the organizations. “Top management’s safety commitment” influences the “reporting culture”, the “allocation of resources”, the “lack of safety promotion”, the “just culture” and “resistance to change”. The factors “allocation of resources influences” the “reporting culture” of the organization, the “deficiency of the reporting system”, “resistance to change”, “just culture” and the “lack of safety promotion”. The factor “lack of safety promotion” influences the “resistance to change”, the “just culture” and the “reporting culture” of the organization. The “just culture” influences the “resistance to change” and the “reporting culture”. The factor “resistance to change” influences the “reporting culture” and the “reporting culture” influences the “resistance to change”.

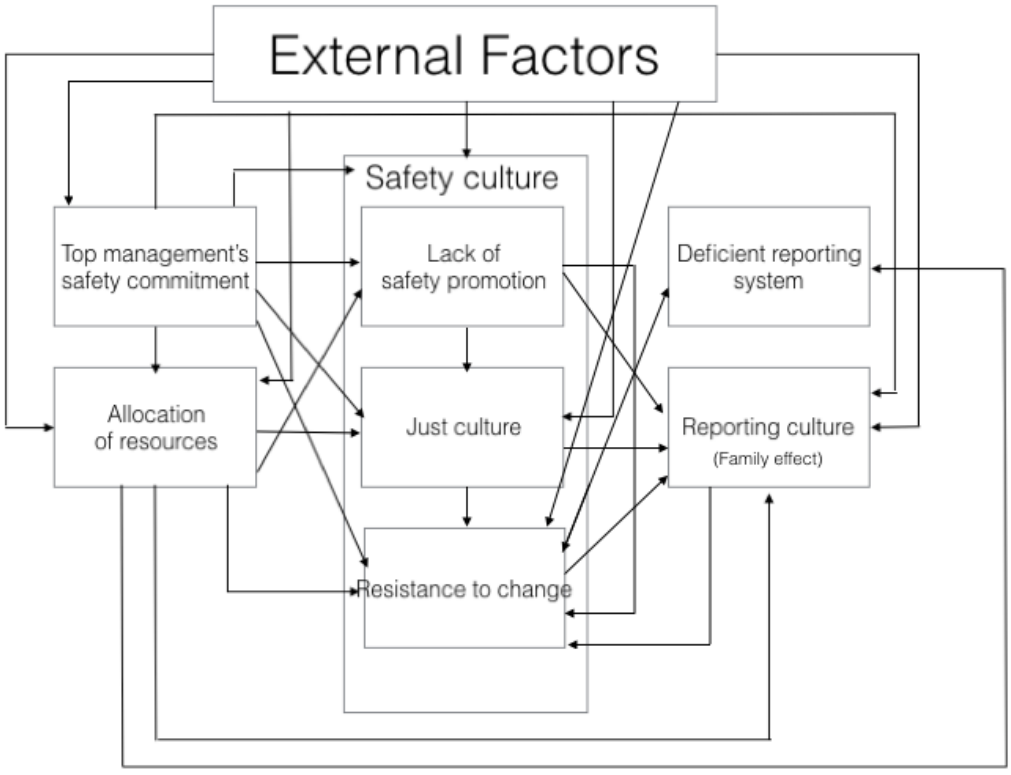

Figure 3 The final model showing the factors and the relationship between the factors impeding the production of data for the development of SPIs

Table 3 is separated in three columns. The column on the left presents the factors leading to the main problem. The column in the middle describes the main problems, namely “top management’s lack of safety commitment”, “allocation of resources”, “ lack of safety promotion”, “just culture”, “resistance to change”, ”lack of data due to the nature of the reporting system and due to ta lack of safety culture” (see Table 3). The column on the right presents the factors deriving or resulting from the main problems.

5.10.1 Top management’s behaviour towards safety

Top management can influence a significant percentage of an organization’s performance (Day and Lord, 1988) and can have a significant influence on organizational safety (Clarke, 1999). Managers’ attitudes and behaviour are related to the achievement of safe working practices (Rundmo and Hale, 2003). Attitudes affect the decisions of top and middle management and also influence the conditions under which employees will take a decision. Management attitudes affect priorities, such as policy about safety, and they also influence employee attitudes and behaviour (Rundmo and Hale, 2003). Management’s ideal safety attitude is being involved in safety promotion, committed to safety and encouraging safety behaviours, leading to lowering the frequency of accidents.

5.10.2 Top management’s commitment to safety

Since the research problem was based on the factors impeding the effectiveness of the SMS, this particular theme was of particular importance. Top management plays an important role in developing and maintaining an organizational culture (Schein, 2004:11;) and in developing a strong positive safety culture (McDonald et al., 2000; Hsu et al., 2010; Liou et al., 2008; Chen and Chen, 2012; Flin et al., 2000).

The participants believed that the top management’s safety commitment was reflected in the management’s actions which included, management not being

interested in knowing anything about safety, management not participating in the safety activities of the organization and management not appreciating the risks (see Table 1). Studies have demonstrated that top management's safety commitment may influence an organization's performance and safety culture of the organization (see Table 3).

Major accident investigations showed that senior managers have an important influence on organizational safety (Baker, 2007; National Commission on the BP Deepwater horizon oil spill, 2011). Top management may influence up to 45% of an organizations' performance (Day and Lord, 1988; Clarke, 1999). Various studies (Cohen, 1977; Cohen et al.,1975; DePasquale and Geller, 1999; Griffiths, 1985; Harper et al.,1997; Shafai-Sahrai, 1971; Shannon et al.,1996, 1997; Smith et al.,1975; Vrendenburg, 2002) revealed that organizations with lower accident rates were characterized by factors such as management showing personal involvement in safety activities, giving safety a higher priority in meetings and decisions concerning work practice, management commitment, thorough investigation of accidents and communication and feedback. Management's safety commitment was also believed to be a factor that could negatively influence the safety culture of the organization, especially in cases where the employees perceived that top management failed to promote the safety culture of the organization. Some participants believed that the top management's safety commitment influenced the safety culture of the organization as they believed that the management was not promoting safety or safety activities to the workers: these activities were promoted only by the safety manager of the organization. Poor or absent safety commitment from the management has a negative impact on the values and beliefs regarding learning, reporting, flexibility and allocation of resources all of which are required for safety improvement (Gerede, 2015b). A failure in promoting the safety culture of the organization, will also impact the reporting culture of the organization (see Figure 3). In organizations suffering from poor management safety commitment it will be difficult to engage employees and departments to support the SMS (Gerede, 2015b). Participants believed that if the management did not care and promote safety, why should they care? Resulting from the poor safety

commitment, will be a reduction in the number of reports and because of the organization's culture, hazards will remain hidden (see Table 3).

5.10.3 Allocation of resources

This qualitative study has shown that organizations found it difficult to put into practice an SMS without higher management's support. Management is responsible for determining targets, planning how to achieve the targets using leadership and motivation, coordinating departments, carrying out audits to make sure targets are met, providing feedback and allocating the resources for those activities (Daft, 2008). Safety management requires all of the above activities to be performed to achieve targets which are related to safety (Gerede, 2015b). Top management's safety commitment, values and beliefs about safety will influence the way the management will decide on how these activities will be performed.

Some participants explained that the lack of financial resources, human resources and time to perform the safety related tasks, caused difficulties in the SMS (see Figure 4).

Top management is responsible for making the decisions about the allocation of resources for the operation of the SMS (see Table 3). When top management is not committed to safety, they will regard the SMS as an extra cost or a financial burden and will attempt to optimize costs. A positive or poor safety commitment will be reflected in the decisions concerning the allocation of resources by the management. Failure to allocate the resources to accommodate the changes in the organization will additionally result into resistance to change as an indication of poor flexibility (Reason, 1997).

Lack of financial resources allocated to the SMS can become a challenge, especially when the organization needs to be more flexible. As changes in the organization may bring new hazards and risks, the organization will have to allocate the financial resources to address these emerging hazards. Poor safety commitment from the management may have a negative impact on the values and beliefs regarding the improvement of safety in the organization and will result in the management demonstrating resistance in allocating

resources (see Figure 3). Lack of financial resources can lead to insufficient human resources, which is experienced by workers in terms of time pressure. A lack of sufficient human resources causes an increase in the workload of employees and in particular to the workers involved in safety tasks. This can cause a delay in safety actions, in investigating incidents and finding corrective actions as workers need to divide their time between their everyday work and safety activities.

Poor safety commitment may also have a negative impact on the values related to reporting and learning. Participants mentioned that they perceived a lack of safety commitment from the top management, as the management would not allocate the resources for a recurrent training on reporting. With the lack of such resources the organization cannot use the data from the reporting system for learning and training. This has an impact on the learning and informing culture of the organization. Participants also mentioned that due to the lack of resources the organization was not able to promote the activities of the SMS and encourage reporting.

Table 3 Showing the factors leading to the main problem, the main problems and the results deriving from the main problem

Factors leading to the main problem	Main Problem	Results deriving from the main problem
Not interested to know anything about safety **Top management does not participate in the safety activities** **Failure to understand risks** **Pressure of top management derived from a concern about the loss of income to support the SMS activities**	**Top management lack of safety commitment/** **poor safety commitment**	Actions, decisions and behaviour of top management influences the safety culture of the organization Lack of commitment impacts the decisions about the allocation of resources Impact on the learning, reporting, flexible culture of the organization Difficult to engage employees to participate in the safety activities Reduction in the number of reports Impact on the just culture of the organization Employees hide their errors Impact on the effectiveness of the SMS

Reluctance of the top management to allocate sufficient human resources for the activities of the SMS		
Failure of the top management to understand the significance of the SMS		
Failure to clarify and demonstrate by actions their safety commitment		
External factors responsible for allocating resources to the aviation organizations	**Allocation of resources**	Insufficient allocation of human resources, financial resources and time
		Absence of dedicated personnel for the safety activities
Lack of top management safety commitment influencing their decisions about the allocation of		Delay in the investigation of incidents
		Difficulties in performing timely and effectively the SMS

resources		activities
Unwillingness of the top management to allocate sufficient financial resources for the SMS activities		Impractical reporting system Delay in performing the risk assessments Delay in taking corrective actions and monitoring performance over time.
Reluctance of the top management to allocate sufficient human resources for the activities of the SMS		Increased workload Time pressure leading to human errors and violations
Top management's lack of safety commitment	**Lack of safety promotion**	Employees don't know what is acceptable and unacceptable behaviour
Reluctance of the top management to allocate sufficient human resources for the activities of the SMS		Impact on the just culture of the organization Employees are not encouraged to participate in the safety activities of the organization

Failure to practice what they preach. Failure to clarify and demonstrate by actions their safety commitment		Fear to report
		Lack of safety promotion causes a lack of strengthening the safety culture of the organization
Failure to offer effective SMS training.		
External factors: international and national practices, legal system, media	**Just culture**	Lack of just culture becomes an obstacle in the safety culture of the organization
		Impact on learning culture
Top management safety commitment		Impact on reporting culture
		Fear culture
Failure to establish a just culture		Employees will attempt to hide their errors
		Fear to report
Not clear for employees what is acceptable and		Reporting weakens

unacceptable behaviour		
Failure to share accountability and responsibility		
How the sanctions are determined by the organization		
Blame culture and punishment		
Top management's safety commitment	**Resistance to change**	Organization works with outdated practices that might not be safe
Insufficient resources		Weak positive safety culture
External factors: national culture, the government not allocating sufficient resources to the aviation		Delay in performing the activities of the SMS
		SMS delays to yield the intended beneficial outcomes
		Increased workload causing increased pressure to

organizations		employees
Lack of understanding the need to change		Failure of the organization to provide training
National culture causes a failure to change current habits		Impact on learning culture
		Impact on flexible culture
		Impact on reporting culture
		Employees hiding their errors
		Misleading results
Top management's safety commitment	**Lack of data due to the nature of reporting system and due to a lack of reporting culture**	Reporting system does not produce enough data about the effectiveness of the SMS activities
Insufficient allocation of or failure to allocate resources for the promotion of the reporting system and the just culture of the		Delay in the investigation of incidents, organization awaiting to receive more data to proceed with corrective action
		Lessons learnt process impaired, learning culture impaired
		Hazards remain unknown because they were not reported

organization	Hazards remain hidden
Resistance to change the behaviour related to reporting	Hazards captured by chance
Lack of a reporting culture	Wrong impression of the safety performance
Poor safety culture	Insufficient data can hinder hazards and risk analysis, risk mitigation, measuring safety performance, monitoring safety, finding root causes, unable to predicting the future and unable to manage change
Lack of encouragement to report/ lack of safety promotion	False impression about the performance of the reporting culture of the organization
Lack of motivation and support to report	Insufficient data for the development of SPIS.
Lack of just culture	Gaps in data that is to be used for the development of SPIs
Insufficient data from reporting system	Misleading results
Impractical reporting system	

hinders the reporting process
Fear of punishment impairs reporting
Blame culture
Lack of trust among employees
The belief that reporting might not provide any benefits
External factors such as the legal system and international practices creating a fear culture in the organization
Not knowing what is

considered as acceptable and unacceptable behavior
The sanctions the organization will take for the errors/ violations of the employees
National culture creating a family effect in the organization
Embarrassment to report/ fear of losing their reputation as professionals
Peer pressure to hide the error
Employees hiding errors

Selective reporting
Psychological pressure by the legal authorities and media due to a lack of understanding human errors, that hinders the reporting process.

5.10.4 Safety culture

Studies have shown that efforts to improve safety have focused on organizational factors (von Thaden et al., 2006; Reason, 1997). Dekker (2007c) considers that errors and violations or unsafe actions should be considered as symptoms related to the performance of the organization and should not be considered as outcomes causing accidents. They are a result of organizational factors creating certain latent hazards, decreasing human performance, and influencing people's behaviour and decisions.

5.10.5 Lack of safety promotion

Many studies have demonstrated that safety culture has an important role in improving safety and it is important for the effectiveness of the SMS (Guldenmund, 2000; Williamson et al., 1997; Neal et al., 2000; Gerede, 2015 a, b). Some participants felt that the organization was not promoting safety or encouraging employees to participate in the safety activities. The findings showed that in some cases, organizations failed to promote safety activities resulting in a lack of engagement and participation from the employees (see Figure 3). Management needs to support the efforts of the organization's safety department in engaging and encouraging employees to participate in safety activities. Management's support is essential for the operation of the SMS (Gerede, 2015 a, b).

Lack of safety commitment may be one reason which results in a lack of safety promotion (see Table 3). Top management's values and beliefs with regards to safety will shape their decisions for safety activities. Management needs to be motivated to mobilize the organization and allocate the resources for these activities (Daft, 2008).

Since a SMS is something quite new for the workers, lack of SMS training or lack of information about the activities of the SMS including hazard identification, analysis, reporting and encouraging a safety culture can impede and delay its effectiveness. Lack of safety promotion can make employees unaware about the blame-free approach of the organization, creating an atmosphere of fear which will impact on the reporting system,

decrease reporting and workers will try to hide their errors. Hazards will not be reported and only be captured by chance; corrective actions will be delayed and the organization will obtain misleading safety data.

5.10.6 Just culture

The participants perceived that just culture is one of the most important factors in the effectiveness of an SMS. Just culture was considered as the most important component in a safety culture, since a reporting culture and learning culture strongly depend upon the existence of a positive just culture (Dekker, 2007c, 2009; Reason, 1998; Gerede, 2015a, b). One participant commented that the just culture of the organization is reflected by the top management's safety commitment (see Figure 3). Management demonstrating a lack of safety commitment will fail to distinguish between what is considered acceptable and unacceptable behaviour, will blame employees and punish them either directly or indirectly. When the balance between accountability, blame and punishment is disturbed, either accountability is suspended or people who make errors are crushed by the blame culture and punishment, which results in a culture of fear (Dekker, 2007c, 2009; Reason, 1998). When there is a fear culture in an organization, just culture will be compromised, violations will increase, and workers will try to hide their errors (Gerede, 2015b). One participant suggested that the lack of just culture affects the safety culture of their organization and a positive safety culture is needed for the SMS to work. It results in employees being afraid to report or choosing not to report and hide their errors. Workers who have previously experienced blame when reporting, the next time they are involved in an occurrence they will recall their previous experience and will conceal their errors. Peer pressure from workers who have already experienced blame can also influence other workers who intend to report their errors but actually convince them to conceal their errors and not to report. Fear culture and blame culture is nurtured by a poor just culture and impacts on the reporting culture of the organization (Dekker, 2007c; Gerede, 2015b). Workers might be afraid of top management, losing their job, losing their license or about people gossiping behind their back. Poor just culture or lack of a just culture, can weaken the reporting, learning and flexible culture

and workers might perceive this as a lack of safety commitment from the organization.

5.10.7 Resistance to change

Changes in an organization may bring new hazards and risks. The organization will be required to address these for both regulatory requirements and to enhance safety performance. If the organization, top management and, workers fail to manage the changes it will be difficult to manage safety (Gerede, 2015b). Because the SMS is something relatively new to employees, top management, the regulatory authorities and the aviation industry are required to participate not only in the changes required for the SMS but also in a cultural transformation to achieve a positive safety culture (Gerede, 2015b). For SMS implementation and to ensure its effectiveness the most important component is this cultural transformation since shared beliefs and attitudes shape people's and the organization's policies and attitudes, and as a consequence their decisions and behaviour (Gerede, 2015b). A cultural transformation will change the beliefs and attitudes of the organization, hence will influence decisions and behaviour of the organization. Cultural transformation can contribute to a change in the behaviour towards safety, in the way the organization makes decisions regarding safety and will reduce the reluctance to change.

Cultural transformation is a requirement in organizations where workers resist participation in safety management activities and in the efforts an organization makes to develop a positive safety culture. As one of the external factors, elements of national culture of the participants coming from the small Mediterranean countries influence the performance of the SMS. Studies involving pilots from different national cultures have shown that because of their national culture there were differences in the ways these pilots conducted their work and there were differing implications for safety (Helmreich & Merritt, 1998; Johnston, 1993; Merritt & Helmreich, 1996a; Merritt & Helmreich, 1996b; Sherman, Helmreich, & Merritt, 1997). This is an important challenge to resistance to change within organizations. Employees coming from the small Mediterranean countries in this study perceived that

their national culture had an impact on the culture of their organization and affected their SMS. This finding may suggest that certain characteristics of national cultures may become an obstacle to improving their SMS. As previously seen, cultural transformation within an organization is required to eliminate elements from the national culture having a negative impact on the culture of the organization. Governmental organizations allocating financial resources to aviation organizations may have limited available funds. Organizations that depend financially on the government, might perceive that the government is demonstrating a resistance to change when it comes to allocating the financial resources required for their cultural transformation (see Table 2).

5.10.8 Reporting systems/ Data collection

Incident data is an important element of an SMS as from incident data, safety metrics can be derived and quantitative risk assessments can be conducted (Wilke et al., 2014). Yet, the quality of the incident data resident in an organizational database, influences the results. The quantity and quality of the reports are influenced by a number of factors. The effectiveness of the SMS may be hindered by a poor reporting culture (Gerede, 2015b). People perceive reporting as risky. The fear of the unknown about their report and the fear of the consequences of reporting is a prevailing factor for most potential reporters (see Table 3). Challenges related to reporting can also hinder organizational learning: safety related data are needed to learn lessons from the past and to assure safety in the future.

5.10.9 Deficient reporting systems

The preliminary study and the current study suggest that problematic reporting systems or process may have an impact on the SMS (see Figure 2).

Unsuccessful reporting can hinder hazard and risk analysis, risk mitigation, measurement of safety performance, monitoring of safety over time, finding root causes of factors that compromise safety, predicting future performance, and as a consequence, taking measures for and managing

change (Gerede, 2015b). Reporting and the production of safety data ensure the flow of information and knowledge related to the above activities (see Table 3). Values and beliefs related to reporting and obtaining information from the reports, are all required for the reporting system to work, and hence for the SMS to survive. In a discussion with the employees, they mentioned that when the management acknowledges their contribution, explains to them the benefits of their reports and shows how their reports contribute to safety, they feel encouraged to report. In a discussion with the middle management, they mentioned that the reward system they implemented encouraged employees to report.

The majority of participants believed that the importance of reporting and the relationship with top management's commitment to safety and just culture were important for the effectiveness of the SMS. Participants explained that the reporting process was impaired when they felt that the top management was not committed to safety and this resulted in a number of challenges related to reporting. They believed that lack of top management's safety commitment contributed to a lack of allocation of resources to promote reporting and in developing a more user-friendly reporting system for the employees to use. Top management's safety commitment influences the decisions related to the allocation of resources for the operation of the reporting system (see Figure 3). Poor top management safety commitment has a negative impact on the beliefs and values regarding reporting and thus workers felt a lack of encouragement to report. Lack of encouragement to report, lack of support in reporting, resistance to change their attitudes, beliefs and facilitating the safety management activities, all demonstrate a resistance to change. Resistance to change derives from the fact that the organization is not taking the actions required for a cultural and safety management transformation to motivate workers to report (see Table 3).

An effective safety culture is essential to improve safety and for the effectiveness of a SMS. Poor safety culture can create an atmosphere of blame, fear and punishment. Such a culture of fear and blame in the organization will foster a culture where employees hide their errors at the

price of a threat to safety and create peer pressure, negatively influencing other workers who were intending to report. When employees are blamed this atmosphere will reduce their confidence in reporting and increase the belief in the lack of just culture in the organization.

Inadequacies in the reporting system mean that the reporting systems does not give a complete picture of the hazards and risks in the organization. The effectiveness of the SMS and organizational performance is hindered as organizations lack the complete picture of hazards. An inadequate reporting system can hinder hazard and risk analysis, development of mitigation measures, measurement of safety performance and monitoring of safety over time.

5.10.10 Selective reporting

A number of participants thought the concept, that they named as “selective reporting” was a challenge to the effectiveness of the SMS and in measuring their safety performance (see Table 2). The fear employees held about losing their license, job, salary or reputation drove them into selecting the events to report while hiding other events. Participants explained that their national culture, (coming from a small Mediterranean country) influenced the safety culture of the organization. However, they would report their error when they perceived that the other party involved would report it.

In an atmosphere of fear, blame and punishment employees will choose not to report and hide their error rather than be blamed. If employees perceive that there is a lack of just culture, they will report, but they choose what to report. Just culture is an important component of safety culture and the promotion of a reporting and learning culture depends on the existence of a just culture. If an organization has a disciplinary system which does not balance accountability, blame and punishment, then the organization will foster a culture of fear; just culture will be compromised, errors or violations will increase, and workers will try to hide their errors (Dekker 2007c, 2009; Reason, 1998; Gerede, 2015b). Selective reporting can be a challenge for organizations because the organizations receive reports (and falsely believe

that the reporting system is working well) while employees report only minor events. They hide major hazardous events that actually endanger safety and require action.

The number of reports might give the false impression that the organization has a strong reporting culture, while in fact, there are other hazards, usually major ones, remaining unknown because they were not reported (see Table 3). Selective reporting can result in employees hiding their errors, errors not being reported and only captured by chance hence the learning culture is impaired and corrective actions delayed. Most importantly, selective reporting gives a false impression of safety performance.

5.10.11 External factors

The findings from the study suggest that external factors influence the performance of an organization's SMS. The external factors identified in the current study include the government, outsourcing, the media, the legal authorities and national culture. Aviation organizations that are managed by the government may face restrictions concerning the allocation of resources forcing them to prioritize the safety activities of the organization and causing a delay for organizations attempting a cultural change. Organizations that are subcontracting some services to other organizations have experienced a number of hazards due to the unsafe habits of the personnel from the subcontracted organization. Employees explained that the way the media treated employees involved in accidents has influenced their day to day work, causing a fear of punishment, blame and humiliation causing them to conceal their mistakes. Miyazawa's study (2008) suggests that there is a link between cultural and political populism with the punitiveness of a country's criminal justice system and the media coverage creating social reactions.

Additionally, interviewees expressed the opinion that fear of the legal authorities has an impact on the safety culture of their organization. Aviation has been reporting an increase in the criminalization of human error (Michaelides-Mateou and Mateou, 2010; Michaels, 2008; Pandit, 2009; Ter Kulle, 2004; Thomas, 2007). Automatic criminal prosecution after an

accident has become a common practice in most countries (FSF, 2006; ICAO, 2007) and in the aftermath of several accidents and incidents (Wilkinson, 1994; Ballantyne, 2002; Ruitenberg, 2002) the aviation professionals involved were charged with criminal offences such as professional negligence or manslaughter (Dekker, 2003). Interviewees commented that their National culture, being from a small Mediterranean country, also had an effect on the culture of the organization and impeded the effective implementation and effectiveness of their SMS. Applying Hofstede's work (1980, 1991) with national culture in the commercial aviation environment, it is emphasized that national culture underlies and interacts with many other influences to shape performance (Helmreich & Merritt, 1998).

Figure 4 presents the detailed model including the broad categories, the properties and the dimensions of each property (see Table 2). This model shows the relationships between factors and how each factor influences other factors resulting in misleading data and hidden hazards. Figure 4 suggests that external factors such as the "government" and "national culture," influence the "safety commitment" of the "top management"; top management appears not to participate in safety activities, does not understand risk and is not interested in knowing anything about safety. The government (external factor) also influences the allocation of resources in the aviation organizations when these are part of the government. The government may also influence safety promotion, as some organizations might require resources from the government to provide training and promote safety.

External factors such as the media, the legal system and the national culture can influence the just culture of the organization, creating a culture of fear and blame for the employees and impeding their reporting. External factors such as the government may not allocate enough resources to enable organizations to implement cultural change, thus resulting into resistance to change.

The media, legal system and national culture may influence employees as they might feel that they will be blamed for their errors, thus they resist change and choose to hide their errors. Family effect, a characteristic of the national culture of small countries in the Mediterranean, results in employees selecting what to report and who to report.

Top management's safety commitment will reflect on safety promotion, their encouragement of employees to report and the provision training. Failure to do so, demonstrates a lack of top management safety commitment. Top management's safety commitment influences the allocation of resources. A management which is committed to safety will allocate the financial and human resources for the performance of safety activities. Top management's commitment to safety will also influence just culture. A committed top management will not foster a culture of fear and blame and will ensure a just culture in which employees are encouraged to report.

The allocation of resources, such as financial or human resources may influence safety promotion of the organization and training. Lack of resources will have an impact on promoting safety culture and providing safety training to employees. As a result, this will impact the just culture of the organization; not informing employees about the just culture of the organization may create a culture of fear (see Figure 4). The allocation of resources also influences the resistance to change. Cultural change and changing employee habits requires resources. A failure to allocate the necessary resources will mean that the organization will be unable to improve their safety culture and their safety performance.

The model suggests that the lack of safety promotion and the lack of training influences the reporting process. Employees should be encouraged to report and trained in the benefits of reporting for the improvement of safety. Lack of safety promotion fosters a culture of fear as employees are afraid to report if they are not informed about the just culture of the organization. Just culture influences the reporting culture. Lack of a just culture will impact the reporting system as employees will be afraid to report. Just culture also influences resistance to change. Blame culture and fear culture will influence

the employees' attitudes as they will prefer to avoid reporting if that might get them into trouble. The impracticality of the reporting system suggests that because of the nature of some reporting systems, this may allow other employees to identify the reporter also creating a fear culture. Selective reporting influences the resistance to change. Because of the characteristic of this national culture, employees refuse to abandon their habits and they select what, and who to report. Due to this national cultural characteristic, they resist changing their work habits.

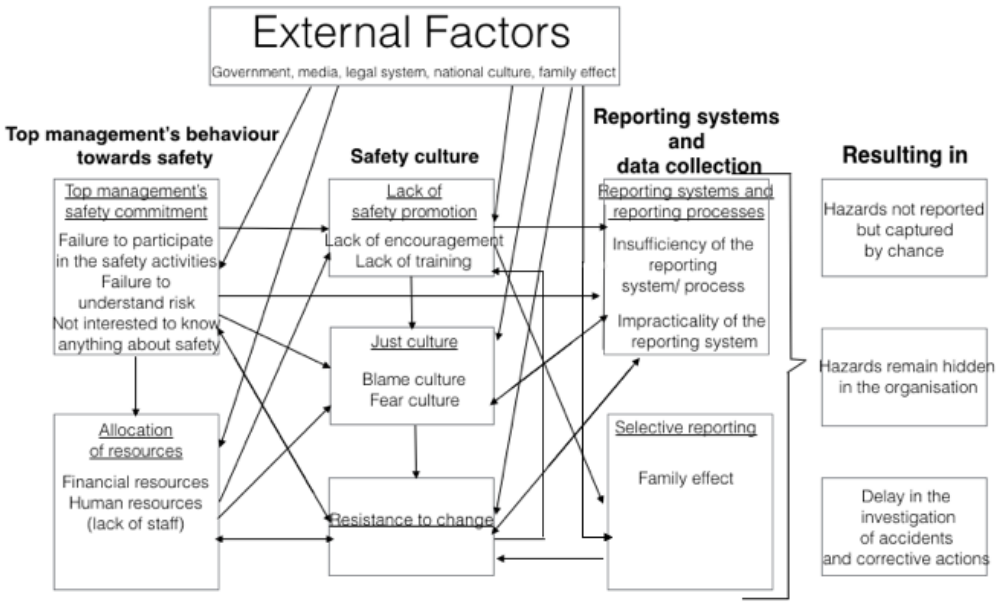

Figure 4 Final detailed model showing the influence of each factor on other factors

5.11 Conclusions

This qualitative interview-based study set out to explore the factors that hindered the effectiveness of an SMS in aviation service providers and whether there were factors influencing the quality and quantity of the safety data required for the development of their SPIs. It built upon the structure initially proposed in the earlier exploratory study. The results suggested the individual factors and combinations of factors which may have an impact on the hazard and incident reporting system. Poor reporting or insufficient

reporting, results in the production of low-quality data. Since organizations depend on the data to develop their SPIs, the organization might be developing their SPIs using inappropriate data. The results indicate that there are challenges affecting the effectiveness of the SMS and hence the performance of the SMS as measured by the SPIs. The analysis explored the most significant challenges hindering the performance of the SMS from top management's attitude towards safety, safety culture and challenges related to the reporting systems and reporting processes, and proposed a model of 'cause and effect'. The most significant challenge derived from a poor positive safety culture as there was a link between this and the other factors and safety culture. This is validated in the following study.

Chapter 6

6. Survey study

6.1 Introduction

The previous studies (see Chapter 4 and Chapter 5) provided a theoretical framework for the factors that can directly influence the performance of an SMS in aviation service providers, as well as describing the effects of the relationship between these factors on an SMS. The preliminary study used a grounded theory approach to discover the factors impeding the performance of an SMS. Building on the preliminary study, the larger qualitative study (see Chapter 4) used a thematic analysis derived from interview data, in which safety managers and safety officers from aviation organizations participated. Quantitative data obtained from a survey is used for this study, which describes the perceptions of aviation organization employees and aims to confirm the findings from the previous studies.

6.2 Procedure

6.2.1 Questionnaire

The first phase of the qualitative interview data collection was between June 2015 and January 2016. During that period, all operational personnel and their line managers were invited to participate in this questionnaire study during the visit to their organizations. Additionally, they were also invited to participate by an email written to them by their line manager. It was agreed with top management, staff union representatives and employees that their participation was entirely voluntary, and confidentiality and anonymity would be ensured. The questionnaire was distributed to the participants through an email invitation containing a link that directed the participants to online software (BOS-Bristol online surveys).

The questionnaire was also distributed to further participants during a second phase between October 2016 and May 2017, this time as a paper

and pencil version. Data from competed surveys were then manually transferred into the online data collection software for storage and analysis.

The main focus of the set of items in the questionnaire was to capture respondent's perceptions regarding the role that top management played in safety management activities, their demonstration of commitment to ensure safety, and their perceptions about the safety culture and the reporting systems in their organization.

The full survey questionnaire included 55 items derived from the preliminary study results. These were divided into four themes of which three were further subdivided into two parts.

The first section concerned the respondent's perceptions of the organization's top management's safety commitment. This included nine items. The second section concerned respondent's views of top management and just culture, and included 14 items. The third section looked at the respondent's perceptions of their safety culture and included 24 items. The fourth section comprised respondent's perceptions of their reporting system included eight items. A Likert scale rating was used, using a five-point scale ranging from "Strongly Disagree" at one end to "Strongly Agree" at the other with "Neither Agree nor Disagree" in the middle. Each level on the scale was assigned a numeric value or coding, usually starting at 1 for "Strongly Disagree" and incremented by one for each level, reaching to 5 for "Strongly Agree".

The questions included in the questionnaire were derived from the main themes of the model (see Figure 2) which was initially developed in the preliminary study and further refined in the larger follow-on interview study. A full copy of the questionnaire items is contained in Appendix D.

Participants were informed that the questionnaire would require 15-20 minutes to be completed.

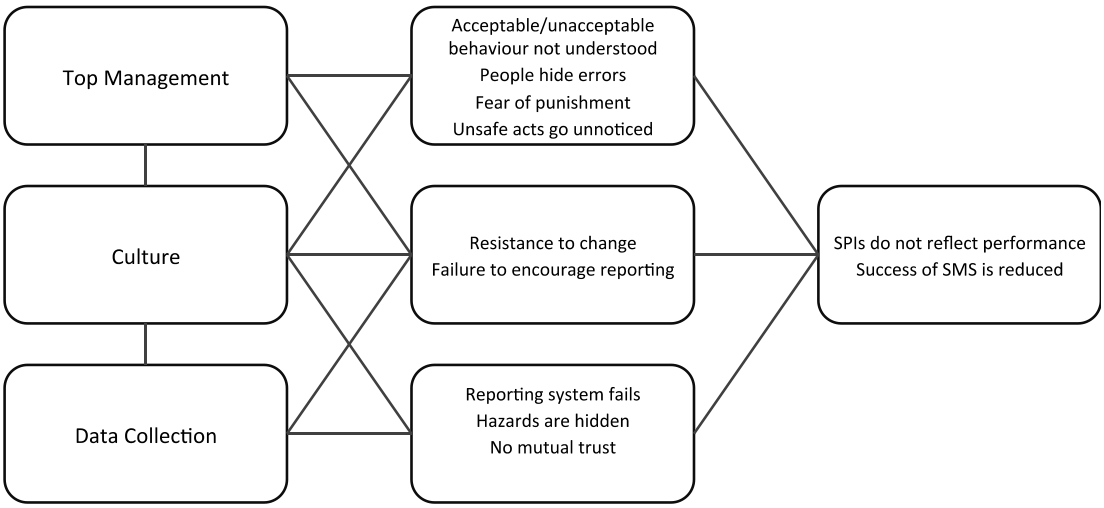

Figure 5 Hypothesized model showing the factors impeding the production of quantity and quality safety data required for the development of SPIs, showing the gaps between SMS and actual performance.

6.3 Results

A total of 90 employees including (pilots, air traffic controllers, aircraft engineers and cabin crew) completed the questionnaire regarding the safety data collection practices in their organization. Out of the 90 surveys, 34 were completed online and 56 were filled in using pen and paper. Through the screening process it was found that three of the participants returned the questionnaires with some items unanswered. These questionnaires were dropped and not considered in the analysis. Among the participants, 83 were male and 7 female.

6.4 Overview of analysis

Data were analyzed with IBM SPSS software (version 22) and IBM AMOS (version 24). A reliability analysis was conducted to examine the internal consistency between the scales.

Structural equation modeling (SEM) techniques were used to construct a path analysis and test the hypothesis and goodness of fit of the various

models.

An initial confirmatory factor analysis (CFA) was then conducted, derived directly from the hypothesized structure. The initial CFA model showed a poor fit with the hypothesized underlying structure and a process of model modification was followed by removing the weak indicators and combining indicators together. After this process, the scales were modified and combined, subsequently resulting in eight scales. A final factor model was produced after removing weak indicators and further combing some variables together which resulted into six latent variables. Based on the six latent variables derived from the final factor analysis a path analysis was conducted.

The means and standard deviations for the questionnaire items are presented in appendix E. The path model tested was based upon the model described in Figure 2 and is presented in Figure 6.

6.5 Initial Cronbach's analysis of scale internal consistency

Reliability is defined as the proportion of observed score variance that is attributable to true score variance. Reliability, like validity, is one way of assessing the quality of the measurement procedure used to collect data. For results to be considered valid, the measurement procedure must be reliable. There are several ways of establishing the reliability of a measuring instrument, and internal consistency is one of the most commonly used methods. Internal consistency is estimated using Cronbach's alpha (α) (Cronbach, 1951). An α value of 0.70 and above is considered to be the criterion from demonstrating strong internal consistency of established values (Nunnally, 1978). The hypothesized model in Figure 6, shows six factors that influence the safety data collection of organizations which are required for the development of SPIs. The scales which were based on the factors derived from that model. Table 4 presents a description of these factors. The factor top management has one scale namely "top management" (TM), the culture factor has one scale namely, "culture" (CULT) and one namely "safety culture" (SC). The factor "data collection"

comprised two scales namely “data collection” (DC) and “data collection/data collection” (DCDC). The factor just culture has three scales namely, “just culture” (JC), “just culture/management” (JCM), and “just culture/employees” (JCE). The factor resistance to change, has one factor namely “resistance to change” (RTC). The factor reporting system, has one scale namely “data collection/reporting system” (DCRC).

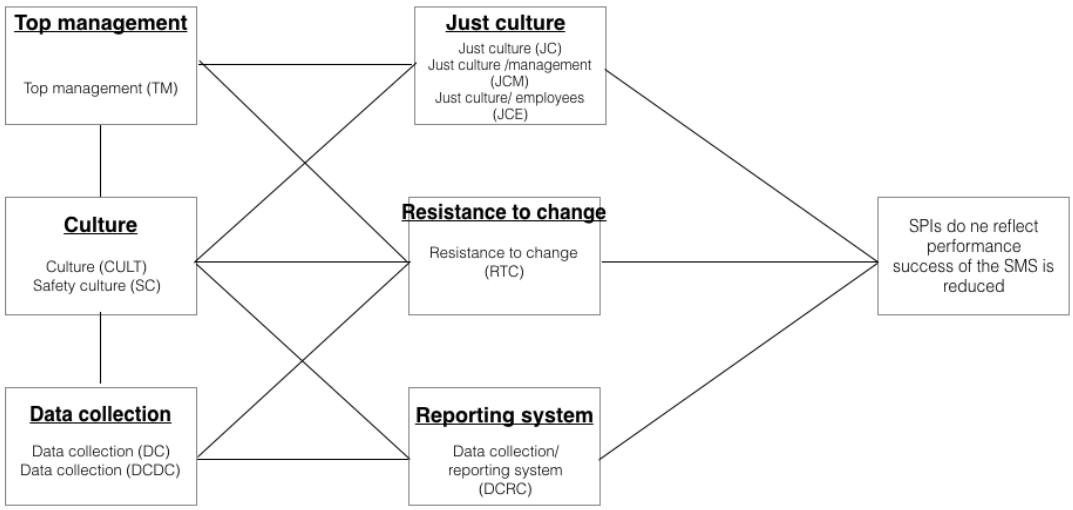

Figure 6 The preliminary model showing the factors and the scales under each factor.

Table 4 Summary of the factors hindering the production of safety data required for the development of SPIs.

Factors	Factor description
	TOP MANAGEMENT
TM	Top management: Indicates the actions the top management follows to demonstrate their commitment to safety.
	JUST CULTURE
JC	Just culture: identifies employee's perception about management's contribution to the safety culture of the organization.
JCM	Just culture (management): Indicates if the top management promote, supports and takes actions for a just culture in their organization. Indicates if employees undstand what is acceptable and unacceptable behaviour, or if they hide errors. Indicates if there is a fear of punishment in their organization and unsafe acts go unnoticed.
JCE	Just culture (employees): Demonstrates the employees' perceptions about the just culture of their organization.
	CULTURE
CULT	Culture: Indicates the actions taken for a positive safety culture in the organization.
SC	Safety Culture: Indicates if the organization has he components (1997) of a safety culture according to Reason (1997).

RESISTANCE TO CHANGE

RTC Resistance to change: Identifies the factors that may cause Resistance to Change such as failure to change their behaviour which reduces the flexibility of the culture.

DATA COLLECTION

DC Data collection: Indicates the existence of data collection systems in the organizations, if there is an open-door policy to report errors and hazards. Indicated whether the organization is using a non-punitive approach and whether there is mutual trust among employees.

DCDC Data collection: Identifies the data collection systems and the practicality of the reporting processes of the organization. Identifies whether the reporting system may fail, hazards remain hidden.

DCRC Data collection, reporting culture: Indicates if there is a punitive, fearful reporting culture where there is a lack of mutual trust and people believe that can be identified if they report.

6.6 Reliability

Results from the reliability analysis of the 10 sub-scales making up the questionnaire are reported in Table 5. All scales showed strong internal consistency, except *just culture*, *just culture (employees)*, *data collection* and *data collection (reporting culture).* The Cronbach alpha values were not satisfactory for these scales: .646 for JC, .535 for JCE, .667 for DCDC and

. -059 for DCRC. All the values that were below 0.70 were removed or combined, initially reducing the variables to eight. A further improvement was obtained, removing or combining the weak indicators resulting in six scales.

Table 5 Reliability of safety management practices

	Safety management practices	No. of items	Cronbach's α	Cronbach's α based on standardized items
1.	Top management's commitment to safety	9	.905	.905
2.	Just culture	14	.646	.687
3.	Just culture (management)	9	.858	.855
4.	Just culture (employees)	5	.536	.532
5.	Culture	14	.801	.802
6.	Safety culture	5	.862	.861
7.	Resistance to change	5	.904	.907
8.	Data collection.	8	.667	.722
9.	Data collection (data collection)	4	.797	.802
10.	Data collection (reporting culture)	4	-.059	.139

6.7 Confirmatory Factor Analysis

The evidence for “convergent validity” is obtained when a measure correlates well with other measures that are believed to measure the same construct (Kaplan and Scauzzo, 1993). In other words, convergent validity is the degree to which the various approaches to construct measurements are similar to other approaches that they theoretically should be similar to (Sureshchander et al.,2001). Using a confirmatory factor analysis technique, the convergent validity of the questionnaire scales was established. A confirmatory factor analysis (CFA) was initially performed using the pre-determined factor structure derived from the qualitative study (see Figure 5) to test to see if the underlying dimensions in the data set reflected those in the hypothesized model. The confirmatory factor analysis was conducted using AMOS-22 software. The present study used a set of different types of fit measures such as Chi-Square values (χ^2). Comparative Fit Index (CFI), the Bentler-Bonnett fit Index (NFI) and root mean square error of approximation (RMSEA) to determine the goodness of fit of the model. The recommended values for CFI, NFI are higher than 0.9 and RMSEA value less than or equal to 0.006 for good model fit (Hu and Bentler, 1999).

The initial CFA derived from the questionnaire items suggested a poor fit to the hypothesized underlying structure and the model was modified by removing the weak indicator variables and by combining two of the latent variables which resulted into reducing the initial 10 scales in the questionnaire (see Figure 7) to eight scales in the CFA.

Two CFA models were subsequently tested. In the first model all the items of the questionnaire were now loaded on eight latent variables. This eight-latent variable model also did not show adequate fit to data. Figure 7 shows the hypothesized model showing the relationship between the eight latent variables.

Table 6 Initial descriptive statistics, inter-factor correlation among latent constructs (*n*=90)

	TM	JCM	CULT	SC	RTC	DCDC	JCE	DCR(
JCM	.947**							
CULT	.751**	.913**						
SC	.756**	.839**	.846**					
RTC	.764**	.888**	.868**	.868**				
DCDC	.511**	.129**	.750**	.612**	.698**			
JCE	-.555**	-.662**	-.549**	-.575**	-.640**	-.513**		
DCRC	.622**	.790**	.665**	.632**	.711**	.693**	-.916	

Table 6 shows the initial inter-factor correlations amongst the latent constructs. Correlation measures the association between two latent variables. Figure 7 suggested a poor fit to the hypothesized underlying structure and the model was modified by removing the weak indicator variables and by combining two of the latent variables which resulted into reducing the eight scales in the questionnaire to six scales The weak indicators were removed and the items were loaded on two other latent variables resulting into 6 latent variables (see Figure 8). Table 7 shows the descriptive statistics showing the inter-factor correlation among the six latent variables after removing the weak variables. The statistics is Table 7 were used to develop Figure 8. Figure 8 shows the final improved model after the removal of the weak indicators, resulting into six latent variables.

Table 7 Descriptive statistics showing the inter-factor correlation among latent constructs after removing the weak indicator variables (*n*=90)

	TM	JC	CULT	RTC	DC
JC	.879**				
CULT	.715**	.893**			
SC	.734**	.803**	.849**		
RTC	.758**	.897**	.882**	.867**	
DC	.626**	.841**	.831**	.642**	.794**

TP, Top Management; JC, Just Culture; CULT, Culture; RTC, Resistance to Change; DC, Data Collection.

** Denotes p<0.01. All correlations are significant.

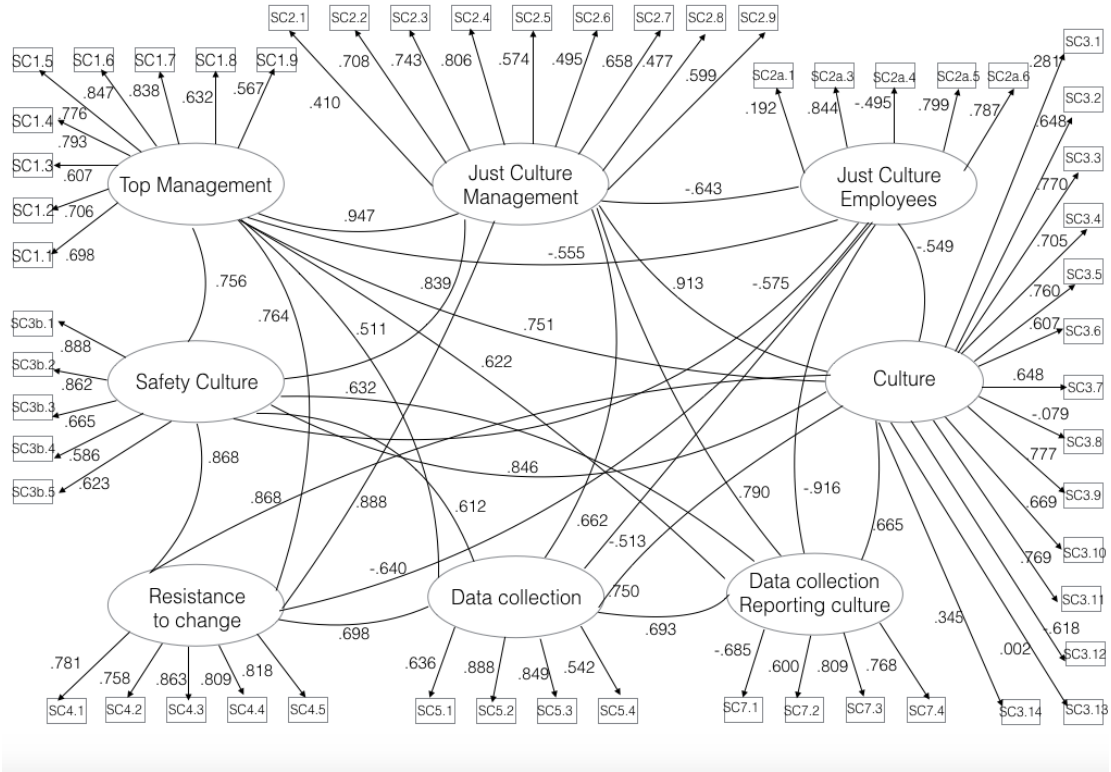

Figure 7 Hypothesized initial model showing the relationship between the latent variables.

CFA model development

CFA was performed to test that the structure of the underlying dimensions in the data set as suggested in Figure 2 (see Chapter 4) could be confirmed. The first ten latent variable model suggested poor fit and the weak indicators were combined reducing the ten scales to eight. Figure 7 shows the eight latent variable model developed in the second CFA which was developed using the initial descriptive statistics, inter-factor correlation among latent constructs (*n*=90) from Table 6 and modification indices from the CFA output. This second CFA model also suggested poor fit and the model was improved further by removing the weak indicators and combining two latent variables resulting into reducing the model to six latent variables. Figure 8 shows the final CFA model with six latent variables and the relationship between those latent variables.

6.8 Final CFA model

Table 8 shows the internal consistency (Cronbach's α) of the scales of the final model. Figure 8 shows the final CFA model and shows the correlation between the six latent variables.

Table 8 Reliability analysis of the latent variables in the final CFA

Safety management practices	Cronbach's α	Cronbach's α based on standardized items
Top management	.896	.896
Just culture	.834	.836
Culture	.892	.893
Safety culture	.819	.816
Resistance to change	.904	.907
Data collection	.845	.849

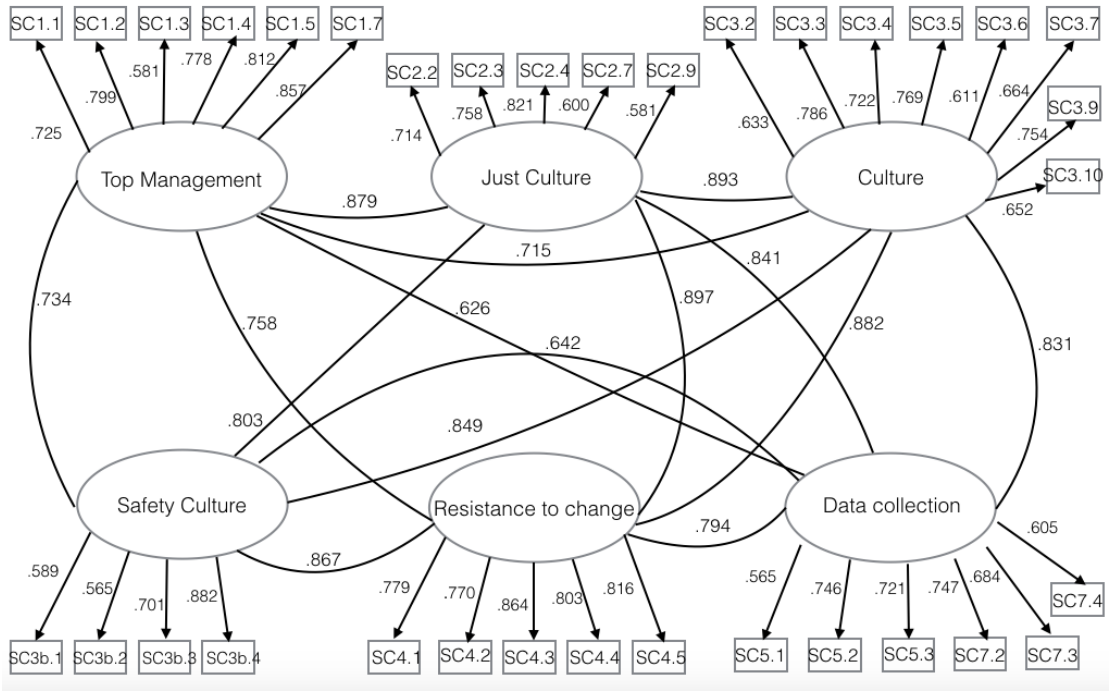

Figure 8 Final CFA solution showing the correlation between the new latent variables.

6.9 Path analysis

The results from the final CFA solution were used to develop a path model. The path model tested was based upon the model described in Figure 2 and is depicted in Figure 9.

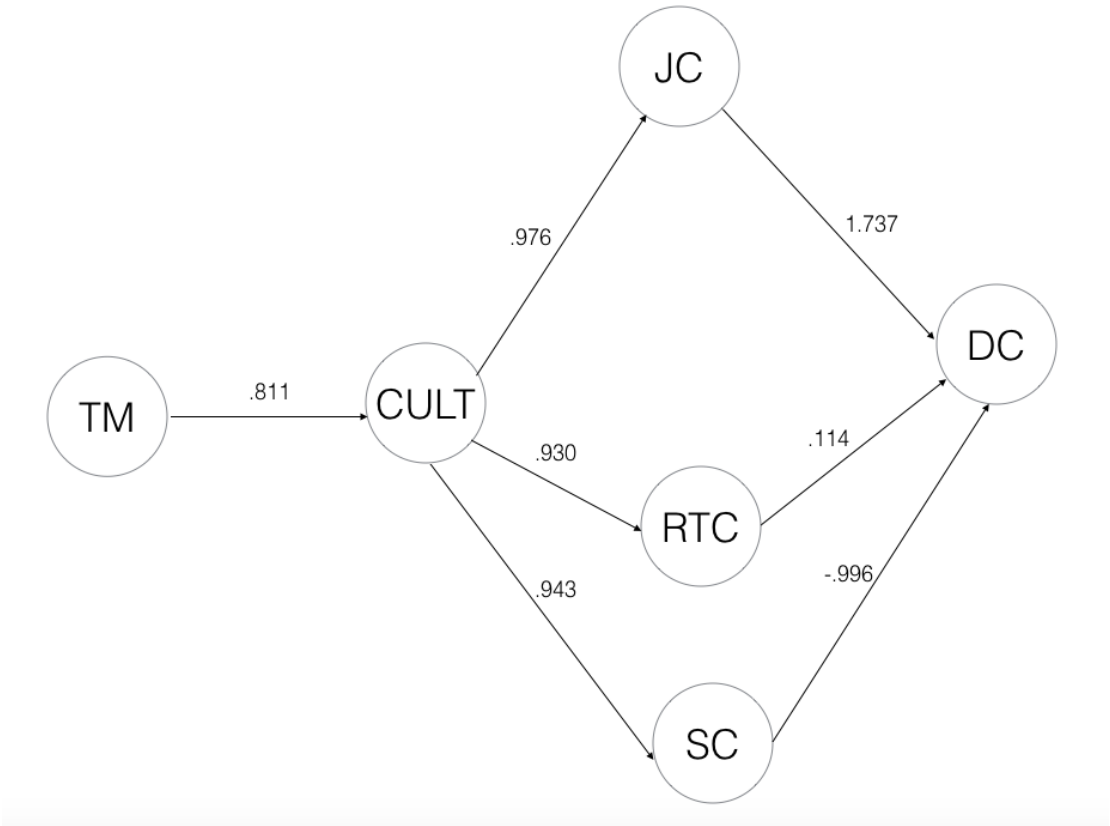

Figure 9 Path analysis model describing the impact of the safety management practices on the data collection, based on the meta-variables derived from the CFA. Path weights are standardized regression weights. TM=Top Management, CULT= Culture, JC=Just Culture, RTC= Resistance To Change, SC=Safety Culture, DC=Data Collection

The fit indices of the path analysis are summarized as follows: chi-square =980.818, chi-square value/degrees of freedom, df=1.657, $p<0.01$; the root mean square error of approximation (RMSEA)=0.86; goodness of fit index, GFI=.653; adjust goodness of fit, AGFI=.587; the parsimony goodness of fit, PGFI=.550; normed fit index,; the normed fit index, NFI=.677; comparative fit index, CFI=.836.

The path analysis model describes the perceptions of aviation organization employees. The model suggests that the top management's commitment to

safety, influences the culture of the organization. The culture of the organization, influences the just culture, the resistance to change and the safety culture of the organization. Then the presence of a just culture, of resistance to change and the presence of a safety culture influence the data collection upon which organizations rely for the development of SPIs. Poor quality and quantity of data will yield misleading results, influencing the decisions related to the development of SPIs.

6.10 Discussion

The purpose of the study was to verify the structure of the underlying factors and the relationship between them which may impede the safety management practices and the success of the SMS and to validate the model derived in the qualitative interviews. In the first step, a CFA was conducted using the main factors to validate the underlying structures in the data, however the data did not fit the hypothesized underlying model very well. The initial CFA derived from the initial questionnaire items and the model was modified by removing the weak indicator variables and by combining two of the latent variables. As a result, a large decrease in the Chi-square/df value was obtained and much increased values of the various goodness of fit indices. The latent variables from the CFA were used in the path analysis to develop a model of the factors influencing the collection of data to be used for the development of SPIs.

The model (Figure 6) containing the factors influencing the safety data required for the development of SPIs consists of Top Management (TM), Culture (CULT), Just Culture (JC), Resistance to Change, (RTC), Safety Culture (SC) and Data Collection (DC). The ultimate objective of the study was to predict the success of safety data collection, which is required for the development of the SPIs. All SMSs are dependent upon the amount and quality of the safety data collected. The model was developed based on the underlying assumption that top management's safety commitment will influence the culture of the organization. The analysis suggests that the top management's safety commitment does influence the culture of the organization. The culture of the organization determines the existence of a

just culture and just culture influences data collection. The findings suggest that in an organizational culture, data collection would not be successful without the presence of a just culture. Culture predicts resistance to change and resistance to change subsequently predicts data collection which suggests that resistance to change in organization influences the data collection process. Overall, the findings of the model suggest that top management influences the culture of the organization and in an organizational culture, the presence of just culture, resistance to change and safety culture influence the data collection of an organization. These factors may work in isolation or in a combination with each other to influence the culture of an organization.

Top management had an impact on the culture of the organization. Zohar (1980), McDonald et al., (2000), Hsu et al., (2010), Liou et al., (2008), Chen and Chen, (2012), Flin et al., (2000), also found that management's commitment to safety was a major factor that affected the success of the safety management system. This study also suggests that top management has an impact on the culture of the organization, which itself then influences just culture. Just culture is seen as the most important component of a positive safety culture since the promotion of a reporting and learning culture depends upon a positive just culture.

In a culture where people are blamed and punished for errors, the organization will foster a fear culture, just culture will be compromised and errors will be concealed (Dekker, 2007c). Employees might be afraid to make changes as these create uncertainty concerning what may happen if they change: errors that may occur during change may lead to the employees getting blamed and punished. It was suggested in this study that just culture helps to predict data collection. Lack of just culture may create a fear culture compromising safety data collection. When employees perceived that they are going to be blamed and punished after a report, they will try to conceal their error. Lack of just culture in the organization can also mislead the organization into believing that it is receiving adequate safety reports and thus perceiving that the reporting system is successful. In such a case,

people report minor events that may not practically contribute to enhancing safety, while the severe events are concealed because of the fear of punishment.

Reason (1997) defined failing to keep pace with changes and resisting changes as a poor flexible culture. This study also suggests that culture is related to resistance to change. Resistance to change is the result of a poor flexible culture (Reason, 1997). Organizational cultures that demonstrate a resistance to change will have difficulties developing a safety culture, as the organization will need to make some changes to improve safety. If the organization fails to manage the changes it will be difficult to manage safety. To enhance safety in an organization, there is a need for a flexible culture and employees should be encouraged to adapt to organizational changes and not to resist them. An SMS requires systematic management of change and it will not be possible to have a successful SMS in cultures that act only through habit and resist changes (Gerede, 2015a). Resistance to change can also impact the data collection process of the organization. Resistance to change suggests that employees demonstrate an unwillingness to change their current habits and are being reluctant to report even if there was an improvement in the reporting process (Figure 5). Organizations might mention in their policies or in initial or recurrent training that they have a just culture, but uncertainty about what is going to happen to reporters after they report may still impede people from reporting. Since shared beliefs and values shape people's and organization's policies, attitudes and hence decisions and behavior, cultural change will be needed for an effective and successful SMS.

When analyzing the relationship between culture and safety culture, it can be seen that the culture of the organization influences the safety culture. Reason (1997) introduced the concept of "organizational accident" and he argues that without a positive safety culture, it will be difficult to prevent organizational accidents if this culture is not present. Obadia (2011, p. 16) argues that ''safety culture shall not be seen as a part of the organizational culture, but rather that an organizational culture has safety as a perceived,

effectively shared and prevailing value." This suggests that the organization's safety culture is formed by peoples' perceptions of the value of safety in the work environment (Heese, 2012). Hence, safety culture is influenced by the overall organizational culture reflecting national, vocational, and other subcultures, and vice versa. In line with these results, studies (Heese, 2012; Vinodkumar and Bhasi, 2011; Gerede, 2015a,b; Ioannou et al., 2017) have found that the effectiveness of the organization's SMS depends upon the strength and maturity of the organization's safety culture. This study suggests that the safety culture of the organization influences the data collection of the organization (see Figure 5). Poor and unsuccessful reporting will result into a lower quality of data which influences the results of the organization's performance measurement. The output of any data analysis is limited to the quality of its data sets (Wilke et al., 2014). Unsuccessful reporting is likely to hamper hazard and risk analysis, risk mitigation controls, safety performance measurement, monitoring over time, finding the root causes of factors compromising safety, predicting the future and thus managing change.

Overall, the study findings suggest that top management's behavior and attitudes influence culture. Organizational culture, predicts just culture, resistance to change, and safety culture. The presence of a just culture, resistance to change and safety culture within an organizational culture, ultimately influences the data collection process of the organization. Reporting means providing the data that is required for the SMS to function. Lack of reporting may result directly or indirectly from a poor just culture and may also hinder the development of a mature safety culture as it influences the organizational learning and flexible culture. Unsuccessful reporting is likely to impede hazard and risk analysis, risk mitigation measures, understanding the effects of risk mitigation, measurement of safety performance, monitoring safety over time, finding the root causes of factors compromising safety, predicting the future and taking measures for the management of change (Gerede, 2015b).

6.11 Conclusions

This study attempts to identify the factors that impede the collection of data to be used for the development of SPIs by the aviation service providers. The results suggest that data collection, which is required for the development of the SPIs are dependent upon the amount and the quality of the safety data collected and can be influenced by a number of factors. The findings highlight different areas that organizations should change to achieve more successful and accurate safety performance measurement and hence enhance the effectiveness of their SMS.

There are obvious benefits having an SMS is place but the problems impeding the performance of the SMS need to be diagnosed accurately so the best can be brought out of the SMS. The results of this study provide support for the theoretical model that was developed in the previous work. The influence of the top management, just culture, culture, safety culture, resistance to change and data collection were demonstrated. The framework developed in this research is recommended to be used for the assessment of organizations' SMSs as these components may be the underlying factors hindering performance. The results of this study highlight the mechanisms by which changes in an organization wishing to improve the performance of their SMS will take effect.

Chapter 7

7. General discussion and conclusions

7.1 General discussion

Accidents such as that at Dryden (see Chapter 2) indicate that the human causes of major accidents are distributed widely within an organization as a whole and may be present for several years prior to the event. The Swiss Cheese model (Reason, 1990) traces the development of an accident sequence from organizational and managerial decisions, to various conditions in the workplace and on to personal and situational factors leading to errors and violations.

Researchers and practitioners for some years have been concerned with specifying the organizational preconditions that will enhance safe performance and risk handling in complex and hazardous situations (Pidgeon, 1997). In order to reduce the accident rate, new approaches on the part of all participants in the aviation industry, including ICAO, nation states, aircraft manufacturers and operators will be required. In particular, emphasis on pro-active, risk analysis-based approaches recognizing that the human element in the aviation system is of paramount importance to accident prevention initiatives and aviation safety are required (ICAO, 2003:67). Safety management systems (SMS) are expected to significantly improve aviation safety (Gerede, 2015b). The objective of this PhD was to identify the factors that impede organizations from obtaining the data to be used for the development of their SPIs which are required for measuring and monitoring the safety performance of their SMSs in aviation service providers. The findings from this research are based upon Mediterranean aviation service providers. Nevertheless, the factors impeding the effectiveness of the SMS, either individually or in combination, may be present in aviation organizations in other parts of the world. What may be different in the other parts of the world might be the magnitude of these factors either taken individually or in combination.

7.2 Dryden accident and Safety Management today

The literature review presented in Chapter 2, suggested that in accidents such as that at Dryden, had the required effective and adequate resources, regulations, procedures, training and policies been in place on March 10, 1989 it is possible, and indeed likely, that the event sequence of events resulting in the accident would have been interrupted. Moshansky states in the findings of the accident report that the Air Ontario accident was preventable and should not have occurred.

Had the required effective and adequate resources, regulations, procedures, training and policies identified throughout this Inquiry, been in place on March 10,1989, it is possible and indeed likely that the event sequence that resulted in the accident would have been interrupted.

Moshansky, p1138

Some of the findings in the report relevant to safety management included:

- A lack of understanding existed within the aviation industry in general, and within Air Ontario in particular, with respect to both safety and accident prevention management with a resultant lack of Air Ontario management's attention and commitment to these important areas prior to the Dryden accident.
- Air Ontario's efforts in the area of safety management in the critical months of the company's restructuring prior to the accident received little or no priority and can be best described as cosmetic.

Moshansky in the final report of Air Ontario (p1135) explains that he was convinced that whatever flight safety organization might have existed, it had little if any management support and was largely ineffective. The chief pilot also resigned a month later, citing lack of support by Air Ontario Management. The findings from this research suggested that management support is extremely important for the effectiveness of an SMS. The Air Ontario's informal culture, similar to the "family effect" identified in this research, combined with the operational management of Air Ontario,

demonstrated a tendency to follow non-standard operational practices. Organizational background and experiences working together, combined with the lack of standard operating procedures reduced the effectiveness of the employees working together.

7.3 Recommendations for safety management based on the findings:

Some of the recommendations after the accident changed the way safety management was viewed and contributed to today's improved safety management.

Although IATA issued a policy since 1989, requiring member airlines to appoint a safety manager and perform the safety management functions Moshansky went further and observed that these safety related activities were not only relevant to air carrier management, but also to the management of the regulatory bodies responsible for aviation safety. In line with the IATA requirement, regulatory authorities need to implement an SSP, for the regulation, guidance and oversight of service providers and responsible for the overall state safety.

Aviation service providers as well as regulators should know which factors influence the effectiveness of their SMS. As Moshansky suggested, regulatory bodies responsible for aviation safety need to recognize that certain regulations that are developed from a North American and Western European country might be challenging for implementation by small countries and smaller aviation service providers. This study to address the challenges small Mediterranean countries are facing with the effectiveness of their SMS. The following discussion summarizes the findings of the research.

In the preliminary study (see Chapter 4), safety managers from aviation organizations participated in an interview. Using grounded theory, their interview comments were analyzed to identify the factors hindering the performance of their SMS. The hindering factors were categorized and integrated into a model. Several features of the model were consistent with the findings of Gerede (2015a), who also showed how the success of the

safety management systems could be impeded. Gerede (2015a) identified the failure of the reporting system, acceptable and unacceptable behavior not being distinguished, fear of punishment, and hazards that remain hidden as the main factors contributing to the success or failure of an SMS. The model developed in this initial study suggested that top management, culture, and data collection processes were significant factors that could either individually or in combination influence the success of the SMS by impeding the development of appropriate practices.

Based on the findings of the preliminary study and using these factors as themes for interview questions, safety managers and safety officers from aviation service providers were asked to participate in a further interview study to uncover what they perceived as hindering factors in their SMSs. Using a thematic analysis, the second study further described the factors that hindered the production of the safety data required for the development of SPIs in aviation service providers. This study identified the main factors that hindered the safety data production to be used for the development of the SPIs and also described the underlying factors or subcategories deriving from these main factors (see Chapter 5). The results indicated that there were several challenges affecting the effectiveness of the SMS and hence the performance of the SMS as measured by the SPIs. The qualitative analysis explored the most significant performance challenges, comprising top management's attitude towards safety, safety culture and challenges relating to the reporting systems and reporting processes. The most significant challenge derived was from a poor positive safety culture as there was a link between this and all the other important factors.

The third study used the theoretical framework (see Chapters 4 and 5) developed in the previous studies to develop a questionnaire that employees from aviation service providers were asked to complete. The quantitative data obtained from a survey described the perceptions of aviation organization employees and supported the earlier findings of the previous studies. This study used a CFA and a path analysis model (see Chapter 6) that described how top management, culture, just culture, resistance to

change, and safety culture impacted on the safety data collection upon which organizations relied to develop their SPIs. Overall, the findings of the model suggested that top management influenced the culture of the organization and the presence of just culture, resistance to change and safety culture influenced the data collection of an organization.

The ultimate objective of the study was to identify the factors providing for safety data collection, which are required for the development of SPIs. The study suggested that poor and unsuccessful reporting will result into a lower quality of data which influences the results. All the SMSs depend upon the amount and the quality of the safety data collected. The findings of this study support the findings of Wilke et al. (2014) who suggested that the output of any data analysis is limited to the quality of its data sets. Important prior research (Gerede 2015b) suggested that unsuccessful reporting is likely to hamper hazard and risk analysis, risk mitigation controls, safety performance measurement, monitoring over time, finding the root causes of factors compromising safety, predicting the future and thus managing change.

Chapter 8

8.1 Conclusions

The research identifies that safety data required for the development of the SPIs and the performance of SMSs in aviation service providers is hindered by a number of factors. The research also further supports other work in aviation organizations (Gerede, 2015a, b) who also showed how the effectives of the SMS could be impeded. Gerede's study (2015a) was performed during a two-day workshop using nominal groups and brainstorming to identify the problems with the implementation of the SMS. This current study extends the work of Gerede and also attempts to acquire deeper knowledge by performing, a three-hour interview with each participant for a better understanding of the factors impeding the effectiveness of their SMS.

While the results of this research suggest that there are challenges with the effectiveness of the SMS and these challenges might influence the quality and quantity of data used for the SPIs, there are a number of limitations in its method acknowledged by the researchers. Primarily, this research applies principally to small Mediterranean countries. Nevertheless, this does not suggest that the findings of this research might not be applicable in other parts of the world. Furthermore, as a result of the nature of the research question, which addressed attempting to identify the challenges and problems people were facing with the implementation of their SMS, in some cases, the interview questions may have induced some potential bias in the way that they were phrased.

It is suggested that future studies can explore the factors that also contribute to the effectiveness of the SMS. The survey study could also have included a larger number of participants to enhance the generalizability of the results. It is also suggested that in the future the models of the study can be presented to the participants for validation.

8.2 Research contribution

Although different manuals are published by aviation organizations to comply with Annex 19 and assist regulatory authorities in the monitoring of aviation safety in their country, these manuals are considered to be guidance material. Nevertheless, the ICAO SMS approach assumes a Western (North American/ Western European) perspective and assumes that the organizations implementing the SMS requirements are also relatively large with the necessary resources. As a result, the subsequent strategies for preventing the underlying causes of accidents, such as an SMS, might seem reasonable and easily implemented to deliver the intended results. However, these strategies might in fact present problems for smaller countries in the rest of the world. This study suggested that the Mediterranean countries with a different national culture, have difficulties implementing the SMS requirements as developed using a more Western approach. As observed by Moshansky and included in his findings, it is increasingly important that regulators understand the effects of national culture on attitudes and behaviour when designing programs in one country which are required to be implemented in other countries. This research fills the gap between regulatory requirements and reality, identifying the problems such organizations are facing while attempting to meet international regulatory requirements. What is more, Westerners developing SMS requirements may not be aware of such a problem that certain nations are facing with the implementation of their SMS.

This study suggests that safety culture is a very important component for the effectiveness of the SMS and that the lack of a safety culture may influence other contributory factors, thus affecting the performance of the SMS. The benefits of a positive safety culture in aviation organizations are considerable, drawing emphasis on observations that the lack or poor safety culture increases the difficulty of aviation organizations in establishing an effective SMS.

The study also fills in the gap between the assumed and the actual performance of the SMS. It suggests that data collection, which is required

for the development of the SPIs and determines their quality, can be influenced by a number of factors. When a number of factors or a combination of these factors are present in aviation organizations, these influence the quality and quantity of the data used to develop their SPIs. Poor quality data may result into the organization relying on safety data that are misleading.

The thesis has identified factors that can impede the successful performance of an SMS. Furthermore, it has identified the relationship between reality and the performance of the SMS. Although the SMS is a regulatory requirement and aviation organizations are required to undertake safety activities based upon the data derived from their SMS, this study has found that because of a number of factors the underlying SMSs can be less-than-optimal. There are obvious benefits of having an SMS is place but the problems impeding performance of the SMS need to be diagnosed accurately to bring out the best from it.

8.3 Suggested further research

Given the observation that there are different areas organizations should change to achieve more successful and accurate safety performance measurement and enhance their SMS, it might therefore be prudent to expand the work by attempting to identify other possible factors impeding the performance of the SMS. The current study's contribution suggested that certain national cultural characteristics affect the implementation of SMS in aviation service providers. For future research, it is recommended to build on the current research and investigate the effects of National culture on the implementation of SMSs.

It is also equally recommended researching the factors that can enhance the effectiveness of SMS in aviation service providers.

The framework developed in this research is recommended to be used for the assessment of an organization's SMS as these components may be the underlying factors hindering performance. The results of this study highlight the mechanisms by which changes in an organization wishing to improve the

performance of their SMS will take effect. A further development may be to investigate whether organizations that have implemented changes in the factors and underlying factors actually improve their safety performance. The factors and underlying factors suggested in this study may be used by organizations to implement changes and improve around these areas of potential concern. It would be beneficial to research how these factors can be used to suggest new safety management practices to be adopted by aviation organizations and assess whether these changes improve their performance. Since the use of SMSs and safety performance measurement is used in other industries, research can be undertaken to investigate and compare the safety management practices used in other industrial socio-technical systems such as nuclear, oil and gas. The research may investigate the ways these industries are measuring their performance and how can these practices be applied in aviation organizations, so the aviation industry can also learn and benefit.

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Appendix A

Interview Questions of the preliminary study

Biographical

1. How many people are in the safety department?
2. Can you tell me what is your job description?
3. Is the person responsible for the SMS, responsible for other things? If yes, how much time do you spend for other responsibilities and how much time do you spend for the safety responsibilities?

Safety

1. In what ways does the Safety Policy influence your daily work?
2. Is the Safety Policy understood by all employees? How do you know?
3. Do you understand the contents of the SMS? Can you provide any examples?
4. How do you think management's commitment to safety can affect the safety of an organization?
5. How does management promote the Safety Policy and the SMS?

SMS

1. Who is the responsible person for the SMS?
2. What processes and procedures do you have in place for data collection?
3. How do you communicate safety issues?
4. How does the SMS affect you daily work?
5. How does the SMS affect your operations?
6. Has there been a change in safety? Eg the rate of incidents and events or any other measure, since the implementation of the SMS?
7. Who performs risks assessments?
8. How effectively are these risks assessments performed?
9. What sort of training in safety and SMS do you provide to new employees?

10. How often do you provide recurrent training for the existing employees?
11. How are the employees trained in identifying hazards?
12. How are employees communicating safety issues to supervisors? How often is this performed?

SPIs

1. How are hazards identified and prioritized?
2. what do you do with the collected data? How is it analysed, shared and used to take action?
3. Does the reporting system give a clear picture of the most important risks in your work and does it help you manage them effectively?
4. Do you know to whom to report?
5. Do you take remedial actions for all hazards?
6. How do you prioritize remedial actions?
7. Do you have a “lessons learnt” process?

Outcomes

1. How do you monitor remedial and follow up on actions taken?
2. Can you provide an example of an action taken and the outcome of the remedial action taken?
3. What is your data collection approach?
4. How often do you collect data?
5. Do you consider the SPIs in isolation or in combination with other indicators?
6. Do you think SPIs give you an opportunity for learning? Can you give me an example?
7. Do you think SPIs give you an opportunity to adjust your SMS? Can you give me an example?

Appendix B

Interview questionnaire/qualitative study

Safety management systems

1. What do you think about SMS?
2. Is it working?
3. Do you see any problems with SMS? What problems are you facing as an organization working with the SMS?
4. Could it have been implemented in a better way?

Top management safety commitment and involvement and safety knowledge

1. How does management adopt a positive safety culture? How do they do this? Can you give an example?
2. How is management involved in the safety process?
3. Do you think management understands the risks?

Top management and just culture

1. Do you think the management encourages reporting? How do they encourage reporting, can you give an example?
2. What are the actions the management takes to change the culture of the organization?

Culture

1. How would you describe the culture of the organization? Safety culture? (Components of safety culture-Reason)

Culture/resistance to change

1. Is the organization willing to change towards the adoption of a positive safety culture?
2. Do you try different ways to change current habits?
3. How do you change different habits? Can you give an example?

Data collection

1. How do you use the collected data?
2. Do you think the reporting system gives you a clear picture of all the hazards?
3. Were there cases where hazards were not captured through the reporting system but you discovered them by chance?

Culture/ data collection

1. Do you encourage your employees to report? How?
2. Do you think employees report their errors, hazards or any safety concerns or they are a bit reluctant?
3. Do you think because of the organizations culture, there are hazards that remain hidden?

(Primary data can be provided by contacting Crystal Ioannou)

Appendix C

Interview questions	**Number of positive quotes for each question**	**Number of neutral quotes, neither positive or negative**	**Number of negative quotes for each question**
Safety management systems			
What do you think about SMS?	5	18	
Is it working?	6	17	
Do you see any problems with SMS? What problems are you facing as an organization working with the SMS?		12	(seeing problems) 11
Could it have been implemented in a better way?	10	13	
Top management safety commitment and involvement and safety knowledge			

How does management adopt a positive safety culture? How do they do this? Can you give an example?	12	4	7
How is management involved in the safety process?	11	6	6
Do you think management understands the risks?	9	9	5
Top management and just culture			
Do you think the management encourages reporting? How do they encourage reporting, can you give an example?	12	3	8
What are the actions the management takes to change the culture of the organization?	10	6	7
Culture			
How would you describe the culture of the organization? Safety culture? (Components of safety culture-Reason)	5	11	7

Culture/resistance to change			
Is the organization willing to change towards the adoption of a positive safety culture?	6	11	6
Do you try different ways to change current habits?	11	5	7
How do you change different habits? Can you give an example?	14	4	5
Data collection			
How do you use the collected data?	12	10	1
Do you think the reporting system gives you a clear picture of all the hazards?	2	11	10
Were there cases where hazards were not captured through the reporting system but you discovered them by		10	Not reported captured by chance

chance?			13
Culture/ data collection			
Do you encourage your employees to report? How?	15	8	
Do you think employees report their errors, hazards or any safety concerns or they are a bit reluctant?	3	9	11
Do you think because of the organizations culture, there are hazards that remain hidden?	No hazards remaining hidden	6	Hazards remain hidden
	2		15

Appendix D

Questionnaire items

Management contributes a lot in preventing accidents.

Management is committed to safety.

Management always encourages employees to inform them about any worries regarding safety issues.

Management encourages safety improvement proposals.

Management is concerned about safety.

Management goes around the facility to see if any safety issues arise.

Safety is given high priority by the management.

Management always takes corrective actions when they find out about unsafe practices.

Management attends safety meetings.

Management encourages reporting.

Management takes actions to change the culture of the organization.

Management creates a just culture. (A just culture is a an atmosphere of trust, in which people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn between acceptable behaviour

---

Management pays attention to what employees say.

When near misses/accidents are reported, management acts quickly to solve the problems.

Supervisors and managers try to enforce working according to the procedures.

Management encourages employees to attend safety training programs.

Safety training given to me is adequate to enable me to assess hazards.

Safety issues are given priority in training.

I don't understand what is acceptable and unacceptable behaviour.

There is the fear that we will get punished.

Employees are rewarded for reporting safety hazards (thanked, recognition in letters).

People are blamed when they make an error.

I don't trust other people in the organization.

Management encourages reporting.

Management takes actions to change the culture of the organization.

Management creates a just culture. (A just culture is a an atmosphere of trust, in which people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn between acceptable behaviour.

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Safety training given to me is adequate to enable me to assess hazards.

Safety issues are given priority in training.

I don't understand what is acceptable and unacceptable behaviour.

There is the fear that we will get punished.

Employees are rewarded for reporting safety hazards (thanked, recognition in letters).

People are blamed when they make an error.

I don't trust other people in the organization.

In the organization we follow rules and procedures to avoid accidents.

There is an open door policy for safety issues.

There are sufficient opportunities to discuss and deal with safety issues in safety meetings.

We have safety meetings where employees participate.

Employees are encouraged to share safety concerns.

Safety inspections are carried out regularly.

The safety procedures in the organization are useful and effective.

Employees do not sincerely participate in identifying hazards.

Lessons learnt are shared with the whole organization so they will be avoided next time.

The organization uses information derived from the reporting system for organizational learning.

We have an open communication and distribution of safety information.

We wait for accidents to happen before we take action.

I know how to identify hazards.

Safety culture makes a significant contribution to the high levels of safety performance.

Those who manage and operate the system have a knowledge about the human, technical, organizational factors that determine the safety of the system as a whole.(Informed culture, Reason,1997)

There is a culture in which people are prepared to report their errors and near-misses (Reporting culture, Reason,1997)

The organization has a culture in which is able to reconfigure in case of high tempo operations or certain kinds of danger-often shifting from the conventional hierarchical mode to a flatter mode (Flexible culture, Reason)

The organization demonstrates the willingness to draw the right

conclusions from the safety information system and is willing to implement major reforms (Learning Culture, Reason 1997)

The organization has an atmosphere of trust, in which people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn between acceptable and unacceptable behaviour (Jus

The organization has a flexible adaptation to change.

Efforts to persuade staff regarding changes are sufficient.

The organization is willing to change towards the adoption of a positive safety culture.

The organization changes easily bad habits .

The organization motivates people for improvement.

My organization has a hazard reporting system where employees can report hazards before these become into accidents

We have an open reporting of all observed hazards and mistakes.

The organization provides me with feedback concerning the report I submitted in the reporting system.

The reporting system of the organization is practicable/easy to use.

I am afraid that someone can identify me through the reporting system.

The management encourages us to report hazards/safety concerns in the reporting system.

There is a non punitive culture in the organization.

There is a no blame culture in the organization.

My organization has a hazard reporting system where employees can report hazards before these become into accidents

We have an open reporting of all observed hazards and mistakes.

The organization provides me with feedback concerning the report I submitted in the reporting system.

The reporting system of the organization is practicable/easy to use.

I am afraid that someone can identify me through the reporting system.

The management encourages us to report hazards/safety concerns in the reporting system.

There is a non punitive culture in the organization.

There is a no blame culture in the organization.

Appendix E

Table showing the Means and Standard deviations of the questionnaire items

	Mean	Std. Deviation	N
Management contributes a lot in preventing accidents.	1.97	.893	90
Management is committed to safety.	1.89	.867	90
Management always encourages employees to inform them about any worries regarding safety issues.	1.97	.841	90
Management encourages safety improvement proposals.	2.20	.914	90
Management is concerned about	1.80	.796	90

safety.			
Management goes around the facility to see if any safety issues arise.	2.66	1.029	90
Safety is given high priority by the management.	2.03	.953	90
Management always takes corrective actions when they find out about unsafe practices.	2.08	.890	90
Management attends safety meetings.	2.10	.937	90
Management encourages reporting.	1.63	.800	90
Management takes actions to change the culture of the organization.	2.77	1.017	90

Management creates a just culture. (A just culture is a an atmosphere of trust, in which people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn between acceptable behaviour	2.69	1.158	90
Management pays attention to what employees say.	2.87	1.019	90
When near misses/accidents are reported, management acts quickly to solve the problems.	1.99	.954	90

Supervisors and managers try to enforce working according to the procedures.	1.97	.741	90
Management encourages employees to attend safety training programs.	2.47	1.124	90
Safety training given to me is adequate to enable me to assess hazards.	2.16	.935	90
Safety issues are given priority in training.	1.98	.912	90
I don't understand what is acceptable and unacceptable behaviour.	3.93	1.159	90
There is the fear that we will get punished.	2.84	1.323	90

Employees are rewarded for reporting safety hazards (thanked, recognition in letters).	3.56	1.191	90
People are blamed when they make an error.	2.78	1.234	90
I don’t trust other people in the organization.	3.21	1.086	90
Management encourages reporting.	1.63	.800	90
Management takes actions to change the culture of the organization.	2.77	1.017	90
Management creates a just culture. (A just culture is a an atmosphere of trust, in which	2.69	1.158	90

people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn between acceptable and unacceptable behaviour			
Management pays attention to what employees say.	2.87	1.019	90
When near misses/accidents are reported, management acts quickly to solve the problems.	1.99	.954	90
Supervisors and managers try to enforce working according to the	1.97	.741	90

procedures.			
Management encourages employees to attend safety training programs.	2.47	1.124	90
Safety training given to me is adequate to enable me to assess hazards.	2.16	.935	90
Safety issues are given priority in training.	1.98	.912	90
I don't understand what is acceptable and unacceptable behaviour.	3.93	1.159	90
There is the fear that we will get punished.	2.84	1.323	90
Employees are rewarded for reporting safety hazards	3.56	1.191	90

(thanked, recognition in letters).			
People are blamed when they make an error.	2.78	1.234	90
I don't trust other people in the organization.	3.21	1.086	90
In the organization we follow rules and procedures to avoid accidents.	1.53	.565	90
There is an open door policy for safety issues.	2.23	.912	90
There are sufficient opportunities to discuss and deal with safety issues in safety meetings.	2.87	1.153	90
We have safety meetings where employees	3.13	1.291	90

participate.			
Employees are encouraged to share safety concerns.	2.33	1.151	90
Safety inspections are carried out regularly.	2.68	1.179	90
The safety procedures in the organization are useful and effective.	2.11	.813	90
Employees do not sincerely participate in identifying hazards.	3.13	.939	90
Lessons learnt are shared with the whole organization so they will be avoided next time.	2.79	1.166	90
The organization uses information	2.44	1.103	90

derived from the reporting system for organizational learning.			
We have an open communication and distribution of safety information.	2.62	1.128	90
We wait for accidents to happen before we take action.	3.39	1.260	90
I know how to identify hazards.	1.87	.810	90
Safety culture makes a significant contribution to the high levels of safety performance.	1.74	.894	90
Those who manage and operate the system have a knowledge about the human,	2.22	.871	90

technical, organizational factors that determine the safety of the system as a whole.(Informed culture, Reason,1997)			
There is a culture in which people are prepared to report their errors and near-misses (Reporting culture, Reason,1997)	2.41	1.048	90
The organization has a culture in which is able to reconfigure in case of high tempo operations or certain kinds of danger-often shifting from the conventional hierarchical mode to a flatter	2.81	1.080	90

mode (Flexible culture, Reason)			
The organization demonstrates the willingness to draw the right conclusions from the safety information system and is willing to implement major reforms (Learning Culture, Reason 1997)	2.60	1.079	90
The organization has an atmosphere of trust, in which people are encouraged (even rewarded) for providing essential safety related information, but in which is also clear about where the line must be drawn	2.88	1.140	90

between acceptable and unacceptable behaviour (Jus			
The organization has a flexible adaptation to change.	3.01	1.195	90
Efforts to persuade staff regarding changes are sufficient.	2.86	1.045	90
The organization is willing to change towards the adoption of a positive safety culture.	2.53	1.083	90
The organization changes easily bad habits .	2.98	.948	90
The organization motivates people for improvement.	2.91	1.278	90
My organization has a hazard reporting system	1.86	.943	90

where employees can report hazards before these become into accidents			
We have an open reporting of all observed hazards and mistakes.	2.14	1.087	90
The organization provides me with feedback concerning the report I submitted in the reporting system.	2.62	1.205	90
The reporting system of the organization is practicable/easy to use.	2.21	1.000	90
I am afraid that someone can identify me through the reporting	2.86	1.354	90

system.			
The management encourages us to report hazards/safety concerns in the reporting system.	2.11	.905	90
There is a non punitive culture in the organization.	2.86	1.167	90
There is a no blame culture in the organization.	3.10	1.237	90
My organization has a hazard reporting system where employees can report hazards before these become into accidents	1.86	.943	90
We have an open reporting of all observed hazards and	2.14	1.087	90

mistakes.			
The organization provides me with feedback concerning the report I submitted in the reporting system.	2.62	1.205	90
The reporting system of the organization is practicable/easy to use.	2.21	1.000	90
I am afraid that someone can identify me through the reporting system.	2.86	1.354	90
The management encourages us to report hazards/safety concerns in the reporting system.	2.11	.905	90
There is a non punitive culture	2.86	1.167	90

in the organization.			
There is a no blame culture in the organization.	3.10	1.237	90

Table showing the scale statistics means and standard deviations

Scale	Mean	Variance	Std. Deviation	N
Management safety commitment	18.69	37.610	6.133	9
Just culture	36.83	39.242	6.264	14
Just culture (management)	20.51	35.713	5.976	9
Just culture (employees)	16.32	12.625	3.553	5
Culture	34.88	59.771	7.731	14
Safety culture	12.92	17.691	4.206	5
Resistance to change	14.29	22.477	4.741	5

Data collection	19.76	21.164	4.916	8
Data collection (data collection)	8.83	11.242	3.353	4
Data collection (reporting culture)	10.92	5.308	2.304	4

Appendix F

Certificate of Ethical Approval

Applicant:

Crystal Ioannou

Project Title:

Critical assessment of the implementation of a performance based Safety Management Systems in aviation service providers

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

28 April 2015

Project Reference Number:

P32970