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Safety Performance Indicators: a strategy to decrease undesired outcomes

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a Nadia e Piergiulio,

per le code degli aerei nelle sale d'attesa e gli angeli che spostano i mobili

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Sommario

L'esperienza di stage in qualità di Junior Safety Engineer in VistaJet Ltd. ha avuto l'obiettivo di avvicinarmi al concetto di Safety nel mondo dell'aviazione. Con il sostegno e supporto del Safety Manager e del Safety Engineer è stata sviluppata una profonda analisi relativa ai Safety Performance Indicators. Nel corso dei sei mesi trascorsi nel Dipartimento della Safety, criticità proprie di diversi aspetti degli SPIs sono emerse con una conseguente introduzione di nuove tecniche e metodologie. Incertezze relative a specifici andamenti di alcuni SPIs, la necessità di una continuità nella classificazione dei Safety Reports e il bisogno di semplificare la raccolta di informazioni sensibili relative alla Fatigue sono stati i punti focali che ci hanno spinto ad intervenire con proposte innovative. L'utilizzo di manuali e documentazioni esterne ha spesso accompagnato lo sviluppo del lavoro, portando frequentemente ad un confronto con standard internazionali ed europei. Quanto emerso, come sarà affrontato in diversi punti della tesi, è come un allineamento forzato a SPIs e procedure imposte da autorità esterne possa portare ad una riduzione dell'approccio intrinseco del Safety Management System. Una valutazione realistica e ragionata dei propri mezzi e fini è quanto può garantire una scelta di SPIs concretamente utili. Solo con una simile base solida avrà poi senso procedere con un loro monitoraggio e la introduzione di mitigazioni, se successivamente necessarie.

Parole chiave: Safety; SPIs; criticità; proposte innovative; standard esterni; valutazione realistica; scelta ragionata

Abstract

The internship as a Junior Safety Engineer at VistaJet Ltd. aimed to introduce me to the concept of Safety in the world of aviation. With the support and help of the Safety Manager and the Safety Engineer a deep analysis concerning the Safety Performance Indicators has been developed. During the six months spent in the Safety Department, critical aspects about different sides of the SPIs emerged with a consequent introduction of new techniques and methodologies. Uncertainties concerning specific envelopes of some SPIs, the need of a constant mentality to classify Safety Reports and the necessity to simplify the sensitive Fatigue data collection have been the main reasons that led the Safety Department to intervene with innovative solutions. The use of manuals and external regulations has often supported the tasks development, frequently bringing to comparisons with international and European standards. What emerged, as it will be discussed in several points of the thesis, is that a forced alignment with SPIs and procedures imposed by external authorities can lead to a reduction in applying the intrinsic Safety Management System methods. A realistic and reasonable evaluation of resources and aims is what can grant a choice of SPIs concretely useful. Only with a similar solid basis it will make sense to proceed with a SPIs monitoring and the introduction of mitigations, if further required.

Key words: Safety; SPIs; critical aspects; innovative solutions, external standards; realistic evaluation; reasonable choice

Introduction

The thesis has been developed during an internship at VistaJet Ltd. as a Junior Safety Engineer. VistaJet Ltd. is a business aviation company that operates worldwide with an expanding Bombardier fleet that counts more than 70 Global and Challenger aircraft. The work developed during the six months spent in the Safety Department has been mainly focused on the Safety Performance Indicators, including updates and trend analysis. Tools as Total AOC Centrik and Aerobytes helped the development of each tasks, providing data that have been subsequently modified in this thesis with the purpose of protecting VistaJet's information.

In a world facing an increasing globalisation with organisations aiming to grow, the concept of Safety barges its way. The birth and concrete introduction of the Safety Performance Indicators led the organisations to evaluate their own internal structure: only a reasonable choice of the indicators consist in the basis for a safe company. If this step is granted, further observations and decisions will be concretely useful. An initial wide description of the concept of Safety and its Performance Indicators will successively leave space for the practical experience in VistaJet. Situations faced and the consequent actions taken will be explained, hence highlighting the solutions provided in front of critical aspects.

In particular, the structure of this work has been developed in the following way:

- Chapter 1: it provides a general overview regarding the concept of Safety and its management, with a reference to Safety I and Safety II.

- Chapter 2: the birth of the Safety Performance Indicators, not only in the field of aviation, is explained by introducing the concepts of Leading and Lagging Indicators. The last paragraph concerning Safety Culture and Safety Climate provides a hint for Chapter 3.

- Chapter 3: the Reporting System is presented as a powerful tool at the basis of the SPIs. The analysis of the critical reports related to the Peer Support Program and to Fatigue follows, as also an explanation of the ERC methodology and ADREP taxonomy. VistaJet's solutions are therefore described.

- Chapter 4: it is focused on the practical experience in VistaJet, highlighting the complexity linked to some SPIs' aspects and the intervention provided.

- Chapter 5: it contains the conclusion of the work.

Chapter 1

The concept of Safety and of Safety Management in an overview

1.1 The concept of Safety: Safety I and Safety II

"The feeling of safety derives from not having accidents. Although the absence of accidents may give a sense of security, it is no guarantee to safety when there are hazards present."

This is what has been stated by The National Institute for Public Health and the Environment, a Dutch research institute, in *A literature review on safety performance indicators supporting the control of major hazards,* 2012. The content of the previous line will be the core of this thesis, revolving around the relevant role that safety performs in aviation and, furthermore, in other business areas. Before starting a complex analysis concerning the deep meaning of the review's title, I would like to highlight an important aspect, showing that safety has different shades and that it can be examined by several points of view. Nowadays it is possible to draw attention to, mainly, two different definitions of safety, respectively named as Safety I and Safety II, as proposed by Erik Hollnagel in *Safety-I and Safety-II, the past and future of safety management*, 2014.

It is useful to understand both, in order to comprehend the different shades related to the concept of Safety itself. Dealing with Safety I means focusing the attention on the bad outcomes related to an event that has already happened, trying to prevent negative things from occurring, instead Safety II emphasises what has gone right. In that way Safety II is able to dislodge the interest from the negative outcomes and to add a further concern in becoming more proactive. Further to this point, it might be interesting to mention an innovative system introduced by Kite Solutions S.r.l, an Italian enterprise based in Laveno. The SDS Plus (Safety Data System Plus) software that they own and developed aims to support operators and companies in the implementation of their Safety Management System (SMS). It adopts the ADREP (Accident/Incident Data Reporting) taxonomy, an instrument of management and classification of the data proposed by ICAO and recognised at an international level. In particular, the proposed innovative introduction of specific ADREP modifiers, permits to highlight the positive aspects of an event. An additional explanation could be provided by thinking about the Gaussian distribution: everyday a lot of tasks are managed and actions are accomplished, creating, in this way, a huge number of situations that can be analysed and gathered together under the Gaussian curve. Due to the probability theory, as it is a common thought, serious incidents are rarer if compared to no accident outcomes, so, in the Gaussian distribution, they will be placed in the side areas under the curve far away from the average central value related, instead, to no accident outcomes. By keeping in mind this image, it is feasible to associate Safety I with the serious incidents or major accidents localized at the borders of the Gaussian distribution, while Safety II, characterized by proactiveness, will be of course linked to all more probable remaining cases. A possible question could be why it is so important to consider both but it is quite easy to give the answer: the cooperation between them has a huge relevance because if one of them prevails over the other there will not be a complete study regarding safety. If alone, both Safety I and Safety II are incomplete and will not be able to provide an exhaustive support to a company. Keeping the attention focused only on the bad outcomes obtained in a certain time frame will prevent the safety experts from analysing the whole situation and will tie them down to retro activeness, forgetting to being proactive and, so, to make several considerations useful for the future prevention. This is why Safety II is also needed for sure. Nonetheless, it is relevant to notice how Safety II should not be too strictly linked to the concept of pro-activeness: this kind of Safety, in fact, can be associated to and introduced even after the occurrence of an event, encouraging, afterwards, to find a way to mitigate. The example provided during the VistaJet' Safety I and Safety II training concerned the decision to link with a single rope different covers on the aircraft to effectively facilitate pilots to not forget none of them in place while performing the departure walk-around check. To provide, subsequently an event, a tangible solution to decrease future occurrences will lead, in fact, to long term positive effects that a simple reminder will not cause. When dealing with different companies, mentioning the process safety is a key step to undertake. In fact, as one more time reported by the Dutch research institute, "*Improving process safety means reducing the probability of harmful consequences from [...] hazards. The probability factor cannot, unfortunately, be measured directly. Target zero will never be reached unless the hazard is removed altogether, so absence of an accident* *is not informative.*" What can be extrapolated from these lines is a kind of confirmation of what has been written in the last part of the paragraph above: not having accidents as outcomes of events will be a positive thing concerning Safety I but, thanks to the second type of safety, we are able to comprehend that this does not mean that a company is not in trouble or that it will not face in the future a difficult situation impacting, maybe, also on its finances. Facing an accident and being aware of several present hazards would be more useful for prevention in the future, giving a lot of material on which experts could work. In fact, as the review continues to report, *"..., when a major accident actually occurs all kinds of causal factors are identified which could have been better monitored and controlled*". This simply confirms even more what has been said until now regarding the needing of cooperation between both Safety I and Safety II.

1.2 The appearance of the Safety Management in an ever increasingly globalised world

In twentieth century, the world has taken part in an incredible progress of civilization towards globalization and one of the consequences is an ever-increasing air traffic. Of course, as stated by Kim S., Oh S., Suh J., Yu K., Yeo H. in *The Proceedings of the Eastern Asia Society for Transportation Studies,* Vol.9, 2013, due to the physically limited airspace and the high complexity of aviation system, the increase of air traffic during the recent decades has brought to light an increase of congestion rate and of number of accidents. Talking about numbers, despite the improvements in both technical factors (e.g. jet engines, radar, etc.) and human factors (e.g. crew resource management, line-oriented flight training, and etc.), the accident rate in air transportation during the recent years has been characterized by a quite stable and not decreasing, as expected, trend; in fact, both in 2007 and 2011, the global aviation accident rate was 4.2%, whereas it was 4.8% in 2008. Due to this data, the International Civil Aviation Organization (ICAO) tried to figure out what could have been the reason, finding out and finally stating that the absence of a proactive management system in terms of organizational safety was one of the main reasons for the non-declining air traffic accident rate. Moreover, since the value of accident rate is strictly linked, acting as a quantitative evidence, to the safety level, the non-declining envelope of the accident rate has shown the necessity of an effort for effectively promoting the level of safety. The answer provided by ICAO through the first edition of the *Safety Management Manual - Doc 9859*, 2006 is an implementation of a State Safety Program (SSP). In this way, according to the document mentioned above, each State is encouraged to consider its own aviation system characterized by different safety performances. Three years later, the first document was enriched by a second edition (*Safety Management Manual - Doc 2869*, 2009) with more detailed concepts related to safety management. In particular, this new edition provides a definition of SSP as "*an integrated set of regulations and activities aimed at improving safety related to the air transportation system of a State"*, so it is characterized by the purpose of striving safety promotion in air transportation system. To achieve this goal, the program needs to be made of three main components: State safety policy and objectives, State safety risk management, State safety assurance. The connection between these areas can be explained by thinking about the following situation: in order to achieve the State safety promotion, that can be considered as the fourth component of the SSP, the program needs to provide a platform with State safety policy and objectives, ensuring in this way domestic aviation service providers with State's safety risk management and safety assurance. Once that this structure works, the main aim becomes the achievement of an "Acceptable Level of Safety (ALoS)" by the aviation service providers (e.g. airline companies, air traffic controllers, airport operators); for "ALoS" we mean, as suggested again by the Proceedings of the Eastern Asia Society for Transportation Studies, Vol.9, 2013, "*a kind of tool for addressing safety risks in specific operation contexts in a complex system like air transportation, and it is expressed with the combination of safety measurement and safety performance measurement."*

Chapter 2

The birth and the development of Safety Performance Indicators

2.1 Key Performance Indicators as pioneers of SPIs

Being now aware of what an airline should do to better and deeply understand the situation surrounding itself, the necessary ensuing step is to describe which measures have been introduced and provided to monitor the events and to develop even more situational awareness. As stated by the National Institute of Health and Environment, "*..., the introduction of key performance indicators (KPIs) [...] has risen in importance over the past decades.*" KPIs are a relevant business management terms that refer to measuring, and so monitoring, the performance of key areas of business activities, meaning that KPIs are, as a matter of fact, *"... a set of measures focusing on those aspects of organisational performance that are the most critical for the success (also concerning the economic aspects) of an* *organisation".* (The National Institute of Health and Environment, *A literature review on safety performance indicators supporting the control of major hazards*, 2012). A first introduction of Key Performance Indicators can be considered as done by Kaplan and Norton (1992, 1997) who created a structured approach to business management aimed to spur managers to focus on a small number of critical measures called "balanced scorecard", encouraging them to maintain an approach centered on goals instead of control. Each balanced scorecard revolves around a specific area such as customers, learning and growth, financial and internal business process, also providing some focused questions to facilitate the experts in analysing the interested area. Questions like "*To achieve our vision, how will we sustain our ability to change and improve? To satisfy our stakeholders and customer, what business process must we excel at*?" (The National Institute of Health and Environment, *A literature review on safety performance indicators supporting the control of major hazards*, 2012) are essentials to highlight the factors that perform a key role in the company. A sizable trait that must be kept in mind is that all the four branches mentioned in the previous lines must not be considered as disconnected from each other: the outcomes related to a specific area will be for sure linked to the ones of other sectors and together they will enhance the global vision the company has and the definition of an appropriate strategy to reach the goals. A clear example of the important role performed by KPIs and of the relevance of interacting different areas can be provided by reporting, as done by the National Institute for Public Health and the Environment, the financial turnaround faced by British Airways in the 1980s. In those years, the airline decided to focus on late planes as a KPI, considering that the number of late planes would have had an impact on critical success factors like costs, customer satisfaction, internal business processes and learning and growth.

The reasoning scheme introduced by Kaplan and Norton could be of course applicable for business management in companies of different industrial sectors, but the fact that the same way of thinking can be applied also in the aviation safety area is what, in this thesis, we really care about. As once again suggested by the previously mentioned Dutch research institute, *KPIs "developed for process safety performance could serve similar functions to those developed for realising financial goals: to help a company monitor and manage its level of safety performance by evaluating its progress towards safety goals, to give assurance to stakeholders that* [...]" a specific product or the work environment "*is being well-managed with respect to major hazards, to find ways to continuously improve safety. A set of performance measures will be part of a company's own general monitoring system, providing intelligence about the major hazard control system and how it is performing. This system has to be part of the company and it should be adapted and improved over time as part of the learning process.*"

2.2 Safety Performance Indicators: an overview

What has been stated in these previous lines allow us to bring to light the concept of SPIs (Safety Performance Indicators) and various definitions of them depending on the different type of operational facilities or organizations, such as chemical-related industries, nuclear power plants and etc. Before studying SPIs related to other fields, in aviation, as stated by Kim S., Oh S., Suh J., Yu K., Yeo H in *Proceedings of the Eastern Asia Society for Transportation Studies. Study on the Structure of Safety Performance Indicators for Airline Companies*, Vol.9, 2013, *an SPI is a short-term measure used for expressing the level of achievement in safety performance of a system* (*ICAO Safety Management Manual - Doc 9859, 2869,* 2006-2009). *In other words, SPIs enable aviation service providers to measure their short-term level of achievement in safety performance, so that they can set up long-term performance targets corresponding to the achievement level."* To make sense and to be useful, an SPI should be simple and realistic because only in this way it will be appropriate for the ALoS and, in general, "*SPIs are expressed with the frequency of event occurrences that are negatively effective to a system, and particularly in aviation, SPIs are to measure low-level consequence events that occurs during operation process exclusively from high-level consequence events like accidents and serious incidents."* What can be stated is that the only way for a service provider to know how well the internal organization is executing its own Safety Management System (SMS) is the safety performance measurement that performs the role of an objective evidence; this evidence needs to be provided to the State, permitting it to implement SSP through ALoS system in a successful way. Despite everything seems to be quite well defined, SPIs are still the main subject of different documents and arguments: Øien et al. stated in 2011 that, in addition to being appropriately representative, as less as variable, environmentally sensible, consistent with benefits, and clearly understandable, a good SPI should be quantifiable and Roelen and Klompstra, as reported by *the Proceedings of the Eastern Asia Society for Transportation Studies,* Vol.9, 2013, suggested in 2012 that *"quantifying the SPIs in some performance areas (e.g. safety culture) is challengeable, because such performances basically cannot be measured objectively by observation.*" Furthermore, they wandered if a simple indicator can be reliable enough to show the correct level of safety performance of an organization. But it is necessary to keep in mind that these are not the only requests about SPIs, in fact there is another essential condition that must be fulfilled: it could seem an easy and simple step, but at the base of everything there must be a deep comprehension of SPIs by those who are in charge of making decisions about their safety-related tasks using the information from SPIs. However, finally, organizations involved in the aviation field have to face various types of processes, such as airport operation, air traffic control, aircraft operation, passenger service, and maintenance, and it is not difficult to understand that, as stated by the previous source, "*in terms of both SSP and SMS, these various operation processes require a large number of SPIs, thus, there are difficulties in the way of helping the decision makers clearly understand the information from the large number of SPIs at a glance. Therefore, in order to present a list of highly reliable and well comprehensive SPIs to both service providers and regulators, building an appropriate structure of SPIs is one of the main required tasks."*

2.3 Lagging and Leading Indicators and the willingness of providing a Safety performance measure

To sum up what has been stated until now, what seems to be necessary is to provide a safety performance measure in order to have a concrete idea about the behavior of the most relevant factors in the safety environment. The following example has been reported by the Dutch research institute and fits very well for what I would like to highlight in this paragraph: *"Although it has been involved in at least 68 fatal crashes in the last 43 years, aviation experts say that the 737 has a good safety record when the sheer number of miles it has flown is taken into account".* Furthermore, as stated by the International Committee on the Safety of Nuclear Installations and Committee on Nuclear Regulatory Activities in 2006, "*safety performance indicators alone have no value unless they are to be used for a specific purpose*". From these two statements, a further aspect can be pointed out: SPIs must be introduced and must refer to a reasonable area, otherwise they will mean anything and will be useless for the company. Moreover, referring to a deeper analysis concerning the possible required features of indicators suggested from Baker's report from 2007 about the British Petroleum's US refineries, the companies should look for establishing indicators as predictors of a potential loss of control that could lead to harm or damage and indicators for benchmarking, especially unwanted consequences. These two types of indices are known as, respectively, leading and lagging indicators. Since what experienced in VistaJet will be the main core of the second part of the thesis, it is worthy to anticipate the description provided by VistaJet Safety Management Manual to better understand the role of these two. Here it is stated that lagging indicators measure events that have already occurred and what the organization is trying to avoid, so they are focused on outcomes. On the other hand, leading indicators revolve around monitoring and measuring conditions that have the potential to become or to contribute to a specific outcome. Moreover, due to the fact that lagging indicators concern about safety outcomes, they can be used to effectively measure the effectiveness of safety mitigations implemented during a Risk Assessment. A further classification can be done by dividing the latter ones in two subcategories basing on probability and severity: a first group of lagging indicators will be centered on low probability and high severity events, monitoring occurrences that bring high consequences such as accidents and serious accidents. The second group, instead, will revolve around high probability and low severity events, keeping the attention on low-consequences occurrences such as incidents; a further introduction of a Risk Matrix will show the strong relationship between probability and severity. At this point, it is possible to go back at the start of this paragraph and ask ourselves how to properly "measure safety to determine whether current activities lie within acceptable safety boundaries or whether trends in performance decline or improvement are occurring. The answer is given by the previous indicators because they offer the possibility of defining boundary limits or trends, to introduce tolerances as the remaining spaces between the boundary limits and the outcomes of the activities and associating the effective tolerances to levels of action. Finally, the huge importance and the main role that these indicators have regarding safety performance measurement can be understood by reading the review of the National Institute for Public Health and the Environment; in fact, as a first suggestion, it is stated to "*Measure the inputs of the management system to the safety processes and the outputs of these processes using leading and lagging indicators."* Another way recommended by the same institute is to

"*Measure the safety culture (beliefs and attitudes) or safety climate (perceptions about safety and risk) which is believed to underpin safety at a collective level, across the organisation."* An explanation about safety culture and safety climate will be later provided.

2.4 The link between Lagging and Leading Indicators and Heinrich's Triangle

By continuing focusing the attention on the indicators' role, as suggested by the report stated by the National Institute for Public Health and the Environment, *"Many see the new breed of performance indicator as another layer of Heinrich's triangle*". In order to find a relationship with the just mentioned tool it is necessary to get the chance and to discuss a little about it: this tool is an accident triangle that performs a huge, if not the main, role in the theory of industrial accident prevention. Initially it showed a relationship between serious accidents, minor accidents and near misses and proposed that if the number of minor accidents was reduced, then there was going to be a corresponding fall in the number of serious accidents. Thereafter, Bird decided to develop some analysis by using the same triangle, and he showed that there was a relationship between the number of reported near misses and the number of major accidents and claimed that the majority of accidents could be predicted and prevented by an appropriate intervention. It is necessary to keep in mind that a concrete prevention requires that the participants of the SRB meeting agree about actions to be put in place, involving financial evaluations. To provide further details, this Safety Review Board, as described by SKYbrary (2008), "Safety Management System – Guidance to organisations", is "*a high-level committee which considers strategic safety functions. The board should be chaired by the Accountable Manager and should normally include the Senior Management of the organisation*.". Its aim is to monitor "*safety performance against the safety policy and objectives, the effectiveness of the SMS implementation plan* [and] *of the safety oversight of sub-contracted organisations,* [to verify] *that necessary corrective or mitigating actions are being taken in a timely manner* [and to control] *the effectiveness of the auditing of the SMS.*

In light of these facts, it is clearly possible to confirm what Dutch institute suggested in the previous lines, so that the performance indicators are strictly related to the method introduced by the Heinrich and Bird's triangle: both of them, in fact, aim to push the concerned company to focus the attention on prevention, probability and severity. In a certain way, our performance indicators seem to behave as predictors of safety. But in truth, to sum up what has been said until now, they act also like as alarms and, in fact, also the National Institute for Public Health and the Environment suggests this characteristic linked to the PIs, stating that "*Many major accidents are considered to have harbingers which a company should have recognized*." This fact give us the possibility to bring to light another relevant problem that companies are used to face, as suggested and stated also by an analysis of data from the MARS database (Bellamy and Baksteen, 2009), in Dutch major hazard LOC data (Mud et al 2011, Bellamy et al, 2012) and in UK data (Lisbona et al, 2012): it often occurs that, even when dealing with technologies that establish interfaces with human detection capabilities, there is a lack of indications or signals that a deviation has occurred. In this way, this deviation not detected is capable to deteriorate and to develop into an accident. This is why management should measure these deviations, comprehend why they occur and use the SPIs interpreted as tools able to ring as alarms when detecting something that seems to not follow the procedures or to hide a trap for the future outcome. Furthermore, another source mentioned by the Dutch institute provides us the same topic: "*Körvers and Sonnemans (2008) have also argued for a focus on these kinds of precursors which they found to frequently recur in accident reports: '... it is striking to see that these disruptions are not used for constructing pro-active SIs; neither are they emphasized in accident reports as pre-warning signals*." As an additional confirmation of what has been stated until now in this paragraph, this last sentence proof that it is a must for a company to ask itself why these diverted events faced a deviation and why they are developing into accidents.

2.5 Safety Performance Indicators: not exclusively aviation related

As mentioned before, Safety Performance Indicators perform a relevant role in some fields other than aviation so it would not be a surprise to bump into lagging and leading indicators while dealing with, perhaps, nuclear and chemical industries. In fact, as reported by the *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.9 (2013), the Health and Safety Executive (HSE) has issued in a guidance material in 2006, the Developing process safety indicators, that provides the well-known concept of Dual Assurance to assist the organizations that are most affected by major hazard and that wish to introduce PIs to obtain an "*improved assurance in terms of controlling major hazard risks".* The "well-known" adjective associated to "Dual Assurance" is related to the fact that, as confirmed by HSE (2006), Ale (2009) and Hopkins (2009), this concept refers to the use of both lagging and leading indicators for each risk control system. To resume and emphasize their previous definitions and proactiveness, lagging indicators only measure the outcome of processes granting a judgment of the safety performance, while leading indicators, unlike the former, provide the measures that enable an organization to examine the processes which may lead to failures. Their role is even clearer once the Swiss Cheese Model, introduced in 1997 by Reason for risk control systems, is depicted: from the picture below provided by HSE (2006) it is understandable that, in a generic organizational process, a possible accident follows an hypothetical trajectory starting from an hazard and becoming an actual occurrence, understood as an harm or a damage. Proceeding along the path, leading indicators come into play as the barriers preventing the incident or accident to progress towards the next level of damage risk while, on the other hand, lagging ones are represented as the holes in the same barriers, pointing out that the walls were not able to prevent the accident or incident to reach the following level.

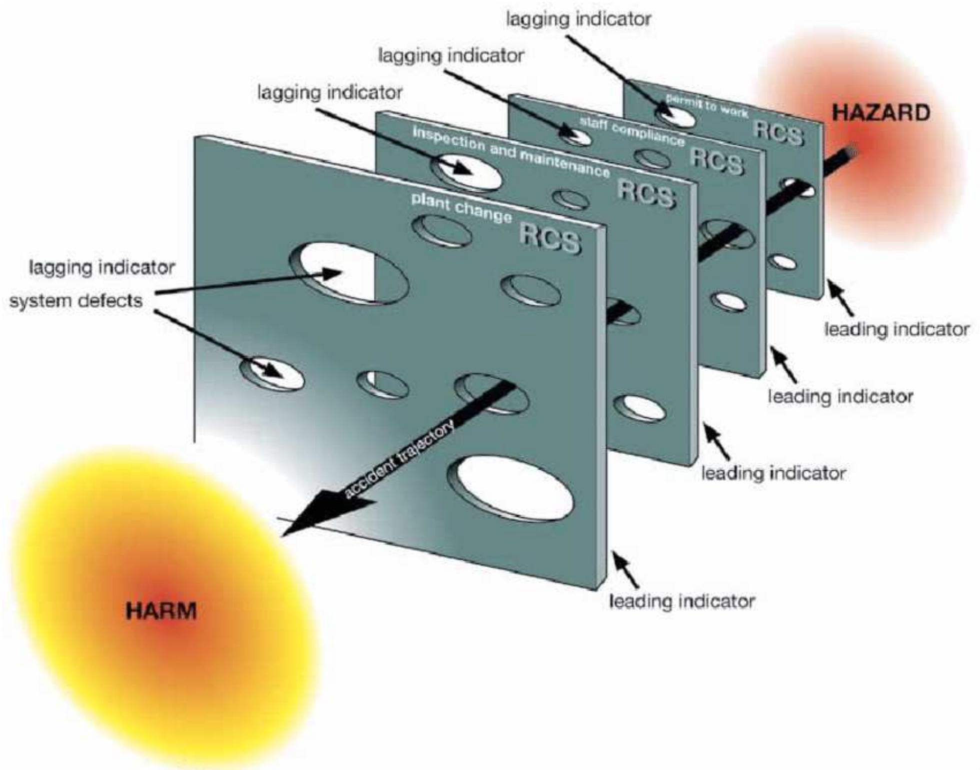

Figure 1 - The Swiss Cheese Model, HSE (2006)

In particular, it has been fine-tuned a "step-by-step" guide for dealing with monitoring and controlling risks in the organizational processes which is also available in HSE (2006). On the whole, there are six steps to follow to measure performance and, as it is by now a metabolized and main concept, step number 2 revolves around the hard decision about the aim of performance indicators, showing three possible levels to belong to: organization, site, or facility level.

Step 1 – Establish the organisational arrangements to implement indicators

Step 2 – Decide on the scope of the indicators

Step 3 – Identify the risk control systems and decide the outcomes

Step 4 – Identify critical elements on each risk control system

Step 5 – Establish data collection and reporting system

Step 6 – Review

As stated in the last two lines of the previous paragraph, performance indicators can be further divided in three categories subjected to a hierarchical structure. Firstly, "*organization level indicators provide information of overall level of safety performance reflecting the safety performance of all facilities of an organization. Site level indicators provide lower-level information reflecting the safety performance of all facilities of a site, while facility level indicators provide individual information reflecting the performance of a single facility*" (*Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.9, 2013). Generally, due to the gathering of the concerned indicators, chemical industries that rely on this method are able to monitor safety performance in a more systemic way. Here it follows the hierarchical structure referring to the indicators as depicted by *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.9, 2013.

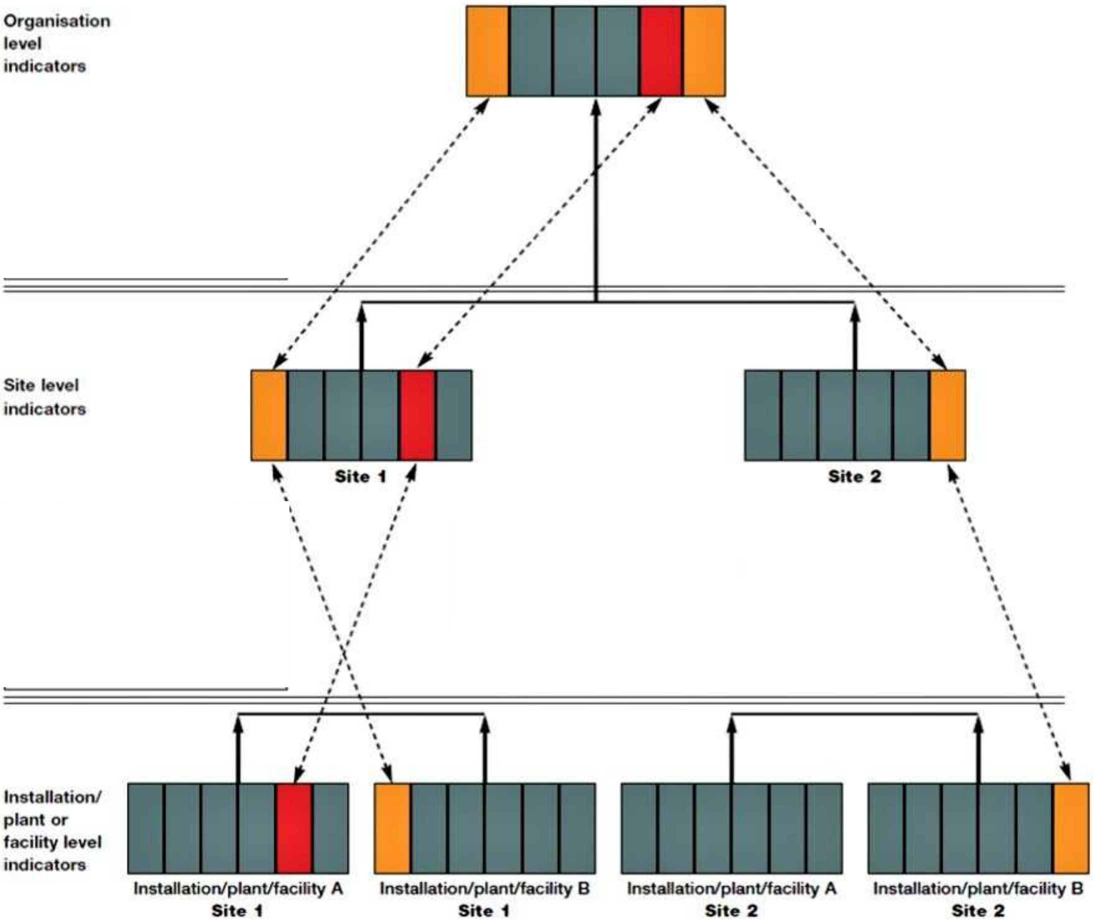

Figure 2 – The Indicators' hierarchic structure, Proceeding of the Eastern Asia Society for Transportation Studies, Vol 9 (2013)

Firstly, site level indicators are in charge of reflecting the major hazard scenarios relevant to each site of the level below and, showing the risk condition in place at the concerned site, they are supposed to prevent major accident hazards. Then, the upper level's indicators are quite generic and they have to mirror process safety system elements in place in all the facilities related to the involved company. The use of red and orange, also known as "Traffic light system", is related to the link between the levels: if the two sites number 1 of the Installation/plant or facility level are characterized by an element in orange and/or red, this will affect the interested site in the levels above. The same happens for sites number 2 and, from the cooperation of these two types of site, the organizational level's site is obtained. By keeping the attention focused on the chemical-related area, particularly on refineries and petrochemicals, more efforts to improve safety performance have been made in the 1990's by issuing documents and guidelines. For example, as stated again by the *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.9, 2013, The Organization for Economic Cooperation and Development (OECD) edited, as a reaction three years later a fire explosion at BP Texas City Refinery in 2005, the second edition of Guidance on Developing Safety Performance Indicators. In fact, "*the Report [f*rom 2007] *of the BP US Refineries Independent Safety Review Panel recommended that an integrated set of lagging and leading performance indicators should be developed, implemented, maintained, and periodically updated for more effectively monitoring the process safety performance*." Furthermore, other recommendations about safety indicators have been stated also by the Center for Chemical Process Safety (CCPS) through a guidance from 2011 called *Process Safety Leading and Lagging Metrics*. In this document it is possible to simply find again other definitions about leading, lagging and near misses and other internal lagging metrics, finding in this way an umpteenth demonstration of how what has been seen and stated for safety in aviation is also valid and used in more and more areas. Furthermore, in the same text a safety pyramid is provided thus referring to Heinrich's triangle characterized, as stated in the first pages, to serious incidents, minor incidents and near misses.

For what concerns nuclear energy, as stated again by *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.9, 2013, it has been made the effort to develop indicators to control the safety performance of nuclear power plants (NPP); The International Atomic Energy Agency (IAEA) is the pioneer society that has tried to achieve this goal since the late 1980. The first result, following a meeting, has been obtained in 1991 and a preliminary indicator framework has been developed, showing and highlighting three key operational safety attributes about NPP: "Plants operate smoothly", "Plants operate with low risk", and "Plants operate with a positive safety attitude". As showed previously for what concerned chemical industries, also for the nuclear sector we have had a hierarchical indicator structure available from 2000 and IAEA strongly believes and expects it to monitor safety performance more systematically. If the operational safety attributes keep first level in the scheme, overall, strategic and specific indicators perform a main role as well. Overall ones, supported by the remaining two, concern operating performance while strategic indicators are linked to lower level of information such as forced power reductions and outages and they take "*a role as a bridge between overall and specific indicators*". The number of forced power reductions and outages due to internal causes constitutes the last type of indicators and provide detailed information since they represent quantifiable performance. Here below a schematic representation taken from IAEA about the framework described in the previous lines.

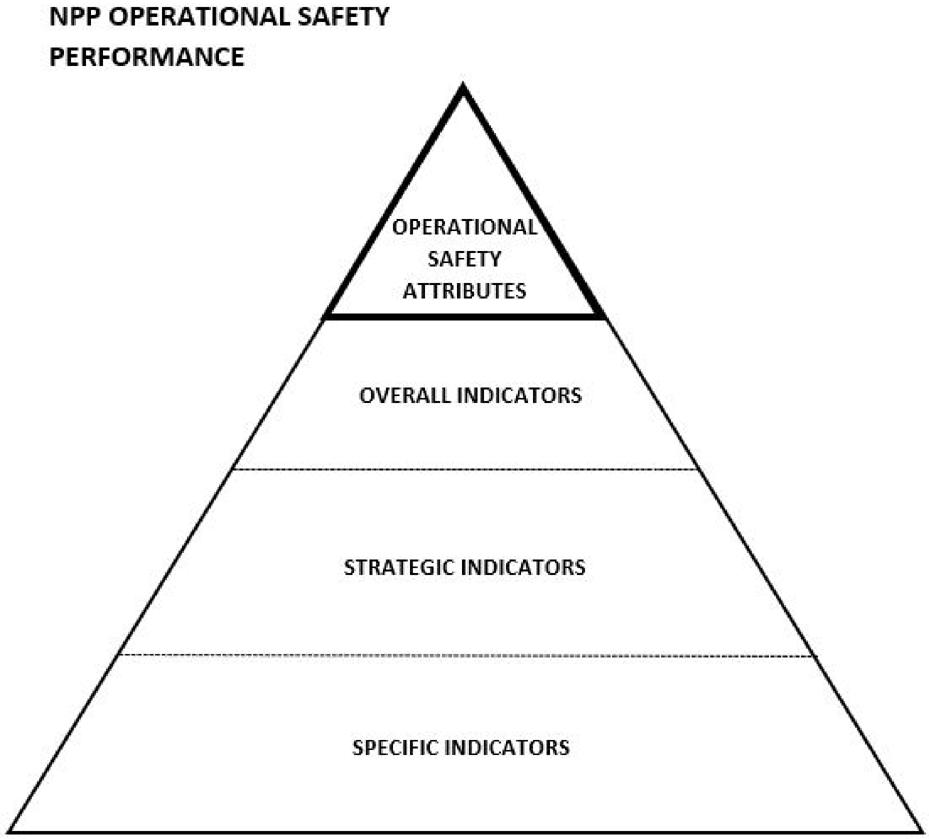

Figure 3 – A second hierarchical indicators structure, IAEA, 2000

In which:

- Overall Indicators are linked to parameters that represent the overall level of operational Safety
- Strategic Indicators are related to convenient parameters
- Specific Indicators are connected to parameters that can be directly monitored and measured.

2.6 Safety Climate and Safety Culture: another concept applicable to more fields

The link between different sectors is remarkable not only dealing with safety indicators but also discussing about general safety concept. An interesting article provided in 2019 by Safety4sea.com concerning the Maritime Knowledge highlights two main aspects valid in aviation as well. The author, in fact, wants to deeply explain the difference between safety culture and safety climate, factors that I have been mentioning in the previous pages: generally, safety culture and safety climate are similar terms that revolve around how an organization is approaching to safety, concerning visible efforts such as attitudes its members chose to adopt but also hidden ones, i.e. the thoughts and mental function that define every member's behavior. In particular, safety culture refers to values, perceptions and competencies shared by a group of people or by a single person, instead safety climate usually describes tools and techniques used by the concerned organization to be compliant to safety. All in all, the climate is perceived by others while culture lies hidden under the surface establishing a basis for climate itself. In this way, the separation between these two can seem useless due to the fact that the first one, as stated before, is the visible result coming from the hidden basis, but to distinguish could be a fundamental tool to evaluate failures and understand the reasons that are pushing employees to an unsafe behavior. The Safety Culture consists in the unrevealed part of a company's character and requires discussions and specific questions respectively developed and submitted by and to office employees and onboard crew members. In fact, Safety Culture can be considered as a mental process that needs targeted questions to let the answers come on the surface, unveiling what safety is and which are the responsibilities towards safety itself in employees and crew members' opinion. Generally, dealing with their own business, organizations try to adopt an attitude and to follow a defined path with the aim of not letting their actions deviate from the approved plan: in that way the results may be acceptable and very close to the scopes of the company itself. To keep continuing mentioning other areas interest by safety concept, several theories have made their appearance to define different culture approaches as reported by safety4sea's website: Non-blame Culture consists in "an approach that tries to see any problem from a view that is totally disconnected by any term of fear." Therefore, all employees are always encouraged to report committed errors and, in general, every problem arisen at workplace without any punishments. On the other hand, Just Culture theory prefers to stick to an approach that has zero tolerance regarding any unsafe behaviour to such an extent that some organizations decide to "draw a strict line that separates the acceptable incidents that may be opportunity for learning from unacceptable and totally unsafe behaviour that could lead to sever and catastrophic consequences." It is worthy to notice that a combination of these two theories could bring to a truly strong and reliable organization in which employees are not afraid of reporting and admitting their own mistakes but they are aware of how important is to not underestimate consequences of unsafe behaviours. It is also essential to notice that to arise questions regarding a personal point of view concerning safety and to lead employee submit reports about mistakes and highlight problems will permit the organization itself to obtain lessons to be learned, in order not to repeat the same errors in future. Generally, as it will be further discussed in the following chapter, the higher is the number of reports submitted by employees, the greater is one of the data-sources on which SPIs rely. Hence, as stated in the lines before, the company could face a decrease of future undesired outcomes since the trend analysis and the measures taken will be built on Safety Performance Indicators that have a strong, concrete and reliable basis. A direct reflection of what has been depicted in this paragraph could be found in more sensitive SPIs that rely both on submitted reports and FDM analysis. A gap between events triggered automatically by the FDM system and events reported by crew members can be a signal of a lack of self- confidence. Once again, the need of improving this aspect emerges, claiming measured to be put in place.

Chapter 3

The relevance of the Reporting System and its different sides

3.1 The Reporting System as a needed strong basis to improve Safety: the experience in VistaJet

As suggested by the last lines of Chapter 2, the Reporting System consists in a powerful tool that will grant the Safety Department to obtain more and more data useful to update and modify the list of SPIs currently monitored. To provide a further proof about safety performing a relevant role in several sectors, the CAMO Personnel SMS Training experienced in VistaJet will be a great example to link what has been said in the previous lines to aviation's area. The core of this meeting has been the role of Safety and the importance of arranging a concerned Department able to highlight problems, to classify faced risks complying the standards and procedures, to learn from mistakes and provide corrective actions. As depicted in the table below, a Safety Department can be described by different structures, ranging from a pathological, a bureaucratic to a generative one. The characteristics related to each of these vary, respectively, from having all employees that keep silence and no department taking into account problems and errors, to office workers that simply "tick a box" regarding a faced issue without any further useful analysis to an internal structure in which submitted reports are rewarded and failures are scrutinized. It is clear, basing on what has been stated before regarding the Reporting System and its influence on the SPIs, that both the Pathological and the Bureaucratic cultures will never lead to an appropriate data-source for the Safety Indicators, which can be estimated will be around the value of 0. If a slightly better situation could be maybe imagined for the second culture type, the only one who will grant a satisfactory basis for the development of the SPIs is the third one. To have people not afraid of noticing and highlighting issues is the main aim in VistaJet' Safety Department and this is why the available Safety Reporting System has three level of confidentiality. A reporter, in fact, could choose among submitting a Non-confidential, a Safety Manager only and an Anonymous report, but it is necessary to keep in mind that the latter choice would not bring any feedback to the reporter him/herself. In particular, as stated during the SMS Training meeting, with a non-confidential "*the action owner can see the full report content of the report including the name of who submitted the report*", which means that the "*reporter authorizes to share his/her details with external departments*". If the reporter chooses the Safety Manager Only option, it will lead to have the details of the reporter known by the members of the Safety Department only and they will not be shared outside unless prior authorization from the reporter him/herself. Finally, as already mentioned in a few lines above, with an Anonymous report "*the Safety Department will not be able to see the name of the* *reporter and the action owner cannot see full content of the report and name of who submitted the report. Since the name of who submitted the report is not recorded in Centrik, the reporter will not receive any feedback*".

	Pathological	Bureaucratic	Generative
Information	Hidden	Ignored	Sought
Messengers	Shouted	Tolerated	Trained
Responsibilities	Shirked	Boxed	Shared
Reports	Discouraged	Allowed	Rewarded
Failures	Covered up	Merciful	Scrutinized
New ideas	Crushed	Problematic	Welcomed
Resulting organization	Conflicted organization	"Red tape" organization	Reliable organization

Figure 4 - Three possible organisational cultures, Ron Westrum

3.2 VistaJet's Just Culture

To summarise what has been stated until now, whether the report is about a technical issue onboard or it concerns an argument between a cabin hostess and a passenger, to receive a feedback is always useful to keep developing an in-depth analysis that could arise other and hidden problems, providing possible advantageous suggestions to avoid the same issue in the future. This is basically the reason why crew members and office employees should be confident enough about submitting a non-anonymous report, helping the growth of the whole internal system. As stated in the SMS Training, in fact, "*Safety Management System covers all company areas, employees and processes including CAMO*". Moreover, as introduced before dealing with sailing sector, also Vista Jet is following the same school of thought, taking care of ensuring the presence of the Just Culture Theory. VistaJet's Just Culture policy "*ensures that no action will be taken against any employee who discloses a safety concern through the reporting system, unless such disclosure indicates, beyond any reasonable doubt, an illegal act, gross negligence or a deliberate disregard of regulations or procedures. Every report received will be treated with care applying the confidentiality level selected by reporter*". So, this policy can be described as a sum of three main aspects: it consists in a Learning versus Punitive culture which encourages honesty and accountability taking human error into consideration. Furthermore, to add even more details, Just Culture Theory can be besides described, as reported by SKYbrary – Just Culture Manifesto, by five commitments as it follows:

- Ensure freedom at work, encourage everyone to speak up and to report without fear.
- Support people involved in incidents or accidents.
- Do not accept unacceptable behaviour.
- Take a systems perspective.
- Design systems that make it easy to do the right thing.

3.2.1 Germanwings Flight 9525: the importance of feeling free and confident about a personal issue

A great example able to highlight the importance of the first commitment stated in Just Culture Theory, once again linked to the concept of the Reporting System as a strong basis for the SPIs, is the one provided by Dave Fielding during the EBAA Virtual Safety Summit 2020. On March 24, 2015 Germanwings' flight 9525 departing from Barcelona El-Prat headed to Düsseldorf collided into a mountain after falling during en-route phase over Provence's Alpes due to suicidal intentions of the First Officer. By analysing cabin records, technicians from Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile found out that First Officer Andrea Lubitz took advantage of the temporarily absence of Captain Patrick Sondenheimer and decided to lock himself in the cockpit. Then, Lubitz flew the Airbus A320 towards terrain ignoring the several attempts of the captain, who was repeatedly hitting the door, to enter again in the cockpit.

In 2009, Lubitz had suspended for about eleven months his pilot-training due to severe depression and suicidal impulses but he had greatly recovered and passed medical and psychological tests. Despite an initial unsuccessful investigation, a medical certificate was found in a trash bin near Lubitz's home stating that the First Officer would have not been able to fly on the accident's day. Germanwings declared that no information about his clinical condition has been received because, under German law, an employer cannot have access to employees' medical records and the medical certificated produced to justify the absence of a worker cannot five information on the diagnosis, but only the prognosis. After this event, more airlines such as Air Canada, Air Transat, Alitalia, Easy Jet, Finnair, Icelandair and Norwegian Air Shuttle have restored the rule about having at least two crew members continuously in the cockpit as it was already valid in the United States and for Spanish airlines such as Iberia and Vueling. As furthermore reported by Wikipedia's page about Germanwings Flight 9525, on March 27, 2015, "*the European Aviation Authority (EASA) urged all aircraft operators to adopt procedures ensuring the presence of at least two persons in the flight crew compartment throughout the flight*". The consequence of flight 9525 has been the introduction demanded from UE of a European Pilot Peer Support Initiative (EPPSI) as mentioned during EBAA Virtual Safety Summit and as stated by the EASA's article "EASA welcomes new rules on mental fitness of air crew" from July 25, 2018. As a first step, this program requires different kind of inputs ranging from crew members submitting autonomous reports about personal issues to family, friends and colleagues raising concerns. Then, the core support process consists in gathering information, in clarifying and defining the interested problem and, finally, in helping the pilot to come to a solution. At the end, the aim is to satisfactorily solve pilot's issues through conversations with a Peer, "*that in the context of a* support *programme is a trained person who shares a common professional qualifications and experience. This may or may not be a person working in the same organisation as the person seeking assistance*" EPPSI, *Pilot Peer Support Programmes. The EPPSI Guide*, Vol. 1, Ed. 2, 2020. A second example of a circular being an important aspect could be the following concept introduced during the EBAA Summit: to obtain a self-referral from crew members is probably the hardest stumbling block and it can prevent a company to provide the necessary and adequate support to pilots. By introducing a figure of speech, crew members can be imagined as horses that can be easily scared and that needs a fenced area in which they can feel safe. What this actually means, again, is that pilots are not inclined to submit reports about personal concerns due to an intrinsic fear of being judged, of losing their reputation and, in the worst imaginary, their license. To grant the required support and the safe and calm work environment, a fictious circular fence, intended as a mutual collaboration between seven areas can be introduced as it follows:

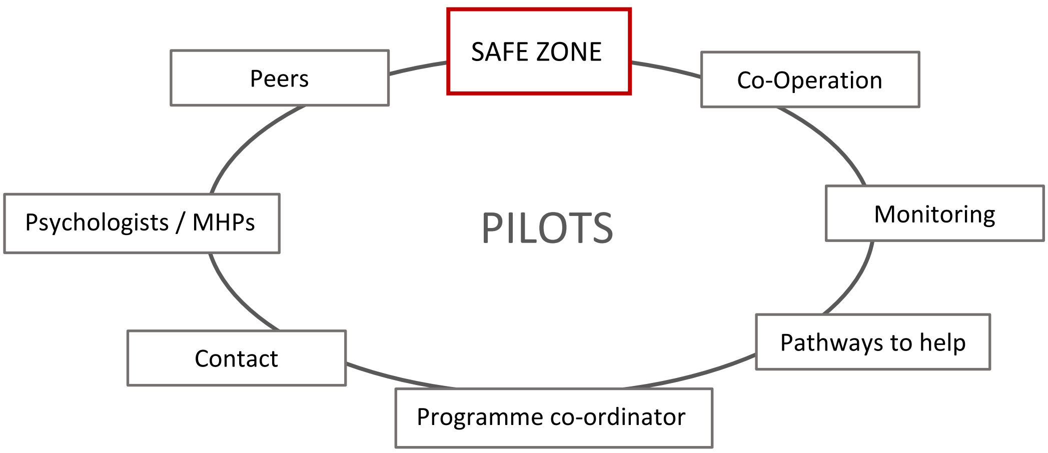

Figure 5 – Pilots' Safe Zone, EBAA Virtual Safety Summit 2020

3.2.2 VistaJet Peer Support Program

Basing on EPPSI, a Peer Support Program has been developed on Centrik in order to grant the adequate support to whoever needs it. As reported by EPPSI, *Pilot Peer Support Programmes. The EPPSI Guide*, Vol. 1, Ed. 2, 2020, the scope was to have a solution that is not an emergency service, but a tool on which crew members can always rely on. Different grades of help might be required and many factors can be the source of the stress, leading to possible several KPIs. The classification of PSP Reports will take place in the same way of the Safety ones, so each classified aspects will be then linked to the corresponding Key Performance Indicator. Before the effective start, Peers have to be carefully selected keeping in mind that, as reported by EPPSI, existing programs have shown that an appropriate number of Peers is between 0.5% and 1% of the pilots served by the program. Moreover, "*The exact numbers will always be a balance between [...] the workload, which is likely to be light in the early stages of the programme's existence until trust in it grows [...] and having a minimum number of Peers available to ensure efficient training numbers and coverage*". VistaJet has currently involved six Peers, as in EPPSI's point of view a lower number for the initial training is unlikely to be beneficial. It is superfluous to reiterate how confidentiality and data protection will be the cornerstone of the entire service: "*personal data of flight crew who are enrolled in a support programme should be handled in a confidential, non-stigmatising, and safe environment.*" (EPPSI, *Pilot Peer Support Programmes. The EPPSI Guide*, Vol. 1, Ed. 2, 2020,)

3.3 VistaJet Crews reporting Fatigue

Disregarding these previous private and delicate issues, crew members are also increasingly encouraged to submit reports about Fatigue. Once again, the previously mentioned circular bond among different sectors is brought to light, showing how it is important to trace Fatigue experiences: in particular, the reference is to a constant interaction between crew members, crew planners and the Operations Department. Different situations have been identified and associated to Fatigue, leading the Safety Department to develop a Fatigue Analysis and to implement a new Fatigue Form, aiming to encourage crew members to submit reports regarding the scenarios they face.

3.3.1 The development of a Fatigue Analysis

What emerged while developing a fatigue analysis is that providing statistics about these kinds of reports can be a too subjective task, depending on the interpretation of each person. Due to this fact, as a Safety Department, the need to improve the previous analysis and then to overcome this obstacle emerged. As a result, a new set of rules to sort out this situation has been established. Initially, VistaJet's Safety Department decided to identify all the fatigue concerned reasons associated to each report from 2019 and 2020 and to divide them into causes and leading factors. In particular, the following list of causes has been created:

Causes:

- Accumulated/Chronic Fatigue
- Circadian Disrupted Fatigue
- Sleep Loss Fatigue
- Extended Wakefulness
- Workload Fatigue

Especially, as "Accumulated/Chronic Fatigue" we are referring to situations in which crew members started feeling tired in the previous legs and, in between, they have not been able to properly rest, gaining an ever-increasingly weariness that eventually becomes chronic fatigue. With regard to the Circadian Disruption, this fatigue cause probably deserves a deeper analysis as it follows: firstly, as reported by the US National Library of Medicine – National Institute of Health, the circadian clock is a sophisticated mechanism that functions to synchronize endogenous systems with the 24-

hour day in a wide variety of organisms, ranging from simple organisms to complex systems. The circadian rhythms control a variety of biological processes, including the regulation of the sleep-wake cycle besides body temperature, hormone secretion, intestinal and immune function and metabolic glucose homeostasis, so basically it concerns any biological process that displays an oscillation of this 24 hours' time frame. Basically, the circadian system regulates physiology and the personal behavior so, dealing with challenges to the system such as those experienced by crew members when traveling across time zones, will eventually result in resynchronisation to local time but this will be often accompanied by adverse short-term consequences. In general, in fact, "*functional consequences of modern-day society, such as late-night activity, work schedules that include long-term night shifts and those in which employees change or rotate shifts (i.e., shift work), and jet lag are substantial environmental disruptors of normal circadian rhythms".* Furthermore, if this kind of challenges are experienced chronically, this adaptation may not be achieved, as for example in the case of rotating night shift workers. Eventually, a transient and chronic disturbance of the circadian system, known as circadian disruption, will appear. From what has been written in these lines, "*it is now beyond doubt that the circadian system contributes to health and disease, emphasizing the need for clear terminology when describing challenges to the circadian system and their consequences".* As stated by the Bureau of Labor Statistics in 2005, fifteen percent of American workers perform shift work, highlighting how "*the pervasiveness of circadian disruption [became] a normal part of modern-day society. This change from the diurnal lifestyle of our ancestors to one that is more prominently nocturnal results in misalignment between natural rhythms based on the 24-hour day and behavioral activity patterns (circadian misalignment)".*

3.3.2 A new Fatigue Form to encourage crew members to share their experience

Seeing as Fatigue is part of the Safety Performance Indicators, the Safety Department aimed to improve the Fatigue Form currently available, encouraging pilots and cabin hostesses to state whenever they felt fatigued providing more details as possible. Instead of sending emails to the crew involved in Fatigue Safety Reports requiring to fill-out an attached form, a mandatory fatigue form has been developed and implemented on VistaJet's Centrik. To provide a deeper overview, until 2020, the procedure to obtain details about fatigue has been the following one: whenever a reporter decided to submit a report, he or she had the possibility to select if the concerned case was related to Human Fatigue by selecting a marker in the General Information of the report itself. As a consequence, while dealing with the report classification, the ADREP event related to fatigue would have been assigned to this case. On a few occasions, the reporter did not mark the report as related to fatigue by using the designated marker, but the ADREP event has still being assigned since details about crew's weariness were stated in the narrative of the case. Then, a fatigue form was sent to the involved crew to receive details about the concerned event. The possibility to receive no or not enough information lead the Safety Department to try to overcome this inconvenience. As already mentioned, a mandatory fatigue form has been implemented on Vista Jet's Centrik and will be mandatorily filled out by the reporter if he or she positively marks the "Is Fatigue-Human Related?" tab. To avoid missing data, the form required all the spaces to be filled outs, otherwise the report will not be submitted.

3.4 ERC Classification and ADREP Taxonomy: two powerful tools to evaluate Safety Reports

Since the submission of reports has been mentioned several times in the previous paragraphs, it would be useful to spend some words on describing how the ERC classification and ADREP taxonomy have a strong role in the Safety Department. To provide an overview about ERC methodology it is necessary to introduce a definition of ARMS (Aviation Risk Management Solutions), described by the Methodology for Operational Risk Assessment ARMS Working Group, 2007-2010 as *"a non-political, non-profit working group, with a mission to produce a good Risk Assessment methodology for the industry."* This industry working group was set up in 2007 with airlines being the primary target and with the aim of decreasing as much as possible the subjectivity during an event classification. Before focusing the attention on how the new ASRM methodology provides this reduction in subjectivity, its structure should be described as it follows:

- The Event Risk Classification (ERC) consists in the first step in the ARMS process and it is based on a needed review of all new incoming Safety Event Data within an acceptable timeframe so that there can be an immediate reaction to any urgent issues. In this way a quick initial estimation on the risk inherent the concerned event is available and, as a result, a double classification is obtained: a coloured risk class indicates what further needs to be done with the interested event and a numerical value of risk named ERC Score can be used in quantitative risk analysis. However, it should be kept in mind that the ERC consists in the first step of the process but it might be revised after developing, for example, further investigations.

- A following step takes place revolving around the question "what was the risk, at the time when the event occurred?". This means that the person who is analysing the event will extrapolate the actual event into what accident outcome could credibly have occurred and will also consider the barriers that participated to avoid this event being that accident outcome.

- Then, it is possible to proceed with a Data Analysis, referring to the Safety Data contained in the database aiming to identify any Safety Issues that affect the current operation.

Since the framework has been provided, ARMS, as previously stated, aims to reduce the subjectivity and for what concerns the "*ERC attempts to identify the likelihood of this event having resulted in an accident outcome*", the ASRM methodology relies on assessing the barriers that avoided this event being that outcome. Despite the definition and consideration of these barriers still remains a subjective task, a good knowledge and understanding of them in some typical scenarios will help in reducing even more the subjectivity. To better analyse what has been stated in the previous lines regarding the subjectivity, it is relevant to highlight the attitude hidden behind the ERC Score which revolves around two questions:

- If this event had escalated into an accident, what would have been the most credible accident outcome?
- What was the effectiveness of the remaining barriers between this event and the most credible accident outcome?

It is worth noting that the first question is seeking to identify "*the accident outcome that is of most concern when this type of incident occurs*", so literally it is trying to highlight which is the accident that an airline is aiming to avoid by having these incidents reported. It is extremely relevant to notice that this step does not revolve around the most probable outcome but not even around the worst possible outcome since this scenario would usually not be the most obvious accident to expect. To reduce the subjectivity left due to different users providing an answer to the first question and due to their events perception, a question nr. 2 is introduced. Hence, the previous answers' diversity will be balanced through the consideration of the remaining barriers and therefore the probability of that accident outcome. Unfortunately, some subjectivity could still be in place as it has been experienced in VistaJet. While dealing with how to answer the two questions, the Safety Department mutually agreed to use specific options for some events granting the required continuity in the application of this methodology. The same concept is also explained in the Methodology for Operational Risk Assessment ARMS Working Group, 2007-2010, in which it is affirmed that in the longer terms it is likely that an organisation will identify the outcomes associated with certain types of events and hence remove the subjectivity associated with the first question for most incidents.

For what concerns the second question, the person developing the analysis will only consider the remaining barriers to estimate the probability of further escalation into the most credible accident outcome depicted in the first answer. As a rule, the barrier that stopped the escalation will be counted in since it was still in place and will be considered together with any other barrier that is believed to still remain. On the other hand, the already failed barriers will be ignored. By analysing the here below proposed

ERC 4x4 matrix, it will be possible to deeply understand the mechanism described until now.

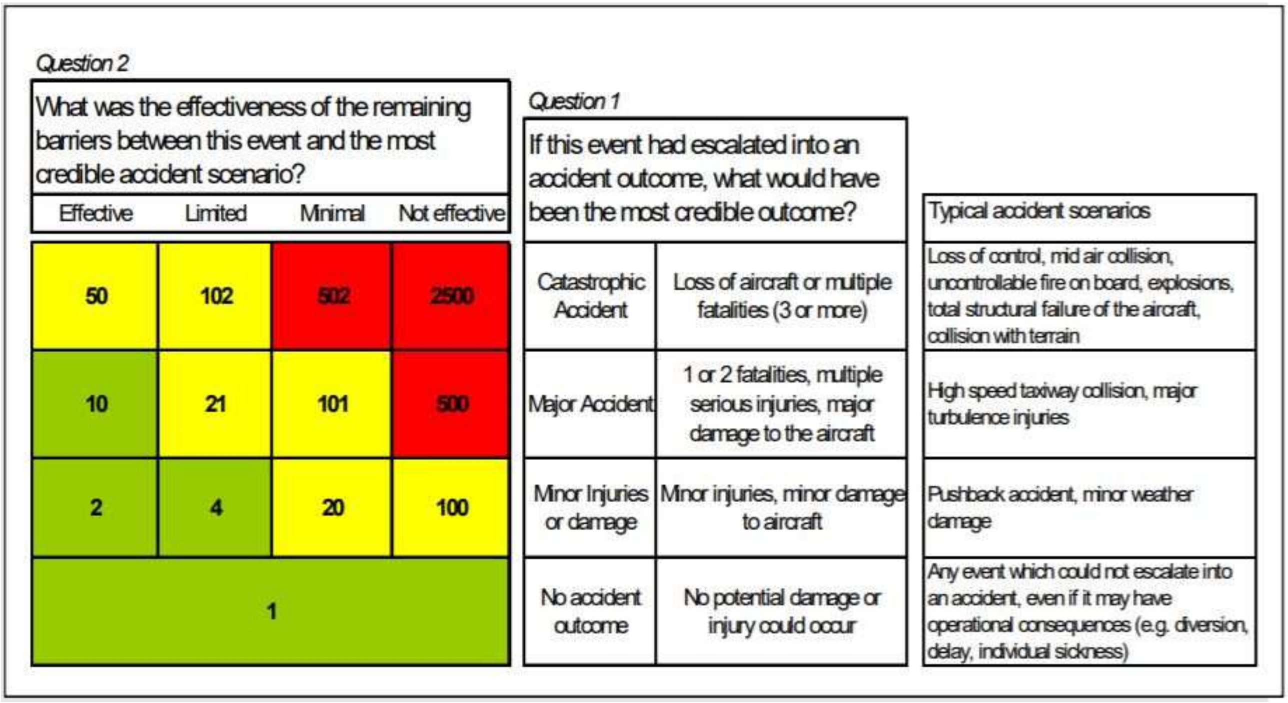

Figure 6 – ERC Matrix, SKYbrary

As stated before, The ERC has two outputs: the first one is a recommendation on what should be done about the event so an organisation will understand which are, if any, the preliminary actions to be done by looking at the colour obtained after the classification. In particular, both red and yellow events will require to be investigated but with a difference for what concerns the urgency to provide an action, since, respectively, an immediate and a necessary but not compelling intervention will be needed. In this way, these two categories of events will lead to direct action basing only on one individual event. On the other hand, the remaining green one will push the organisation to file the event itself in the database and to use it for statistics and a continuous improvement. To summarise, the first result should be interpreted as it follows

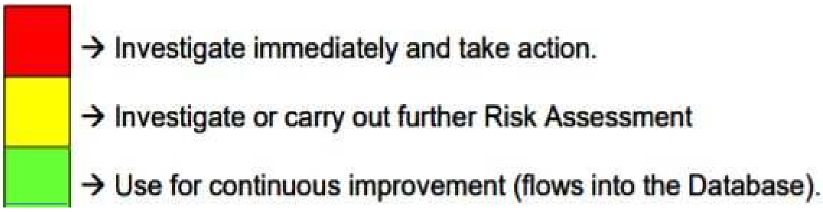

Figure 7 – ERC Matrix first output, SKYbrary

The second output of the ERC is a number, the ERC risk index, which, as it has already been stated, gives a quantitative relative risk value and is very useful in compiling statistics: It is important to realise that neither "number of events" nor "rate of events" consider the severity of the events so statistics based on these two values could be misleading. To focus the attention on the risk and to hence have a better basis for further decisions making, the ERC values are what may be used for any type of statistical analysis.

The fictitious example provided below by the Methodology for Operational Risk Assessment ARMS Working Group, 2007-2010 shows a chart on ground events sorted by airport illustrating the importance of looking at risk instead of only event numbers and rates. Providing an event count, an event rate and the total risk per airport expressed as a cumulative ERC of all ground events in that airport, it is possible to notice how, for airport DDD, the risk is high despite a low event number and rate. This actually means that "*the severity of the (potential) outcomes has been high* *in the events taking place in this airport. Therefore, the classic analysis based only on number/rate or events would lead to underestimating the importance of ground events at DDD."*

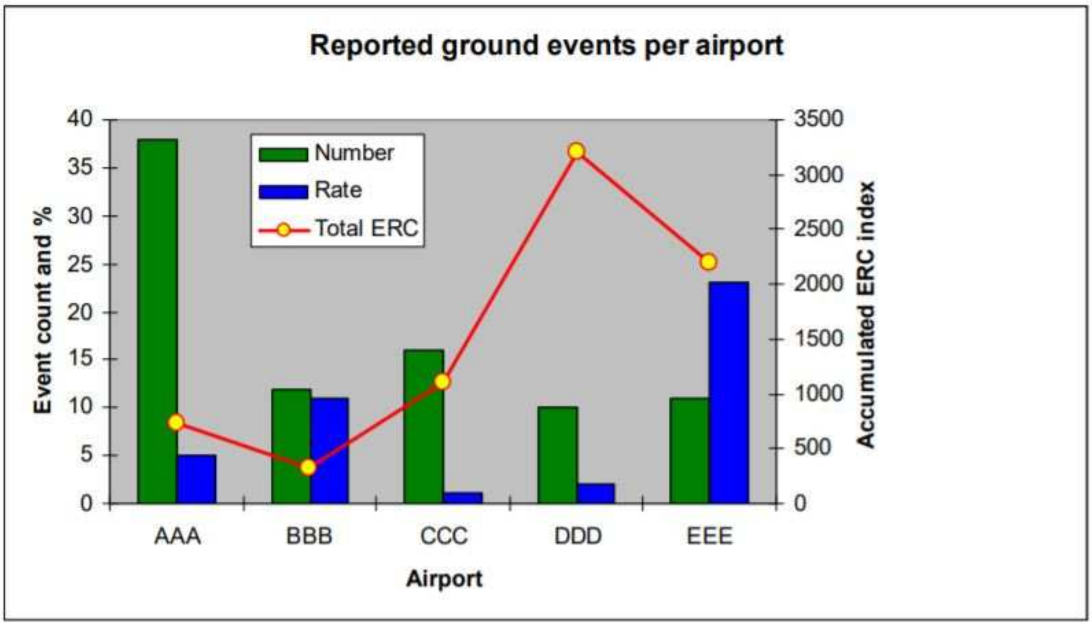

Figure 8 – ERC Methodology in statistics, the Methodology for Operational Risk Assessment ARMS Working Group, 2007-2010

Another way to use the ERC Score, as shown in the Figure 15 below, consists in grouping every event from the database by the ERC colour outcome per 1000 flights obtaining the so-called event rates per ERC outcome that could be monitored over time (perhaps per month or per year – usually, in fact, while dealing with years, the rate is evaluated considering 10.000 flights).

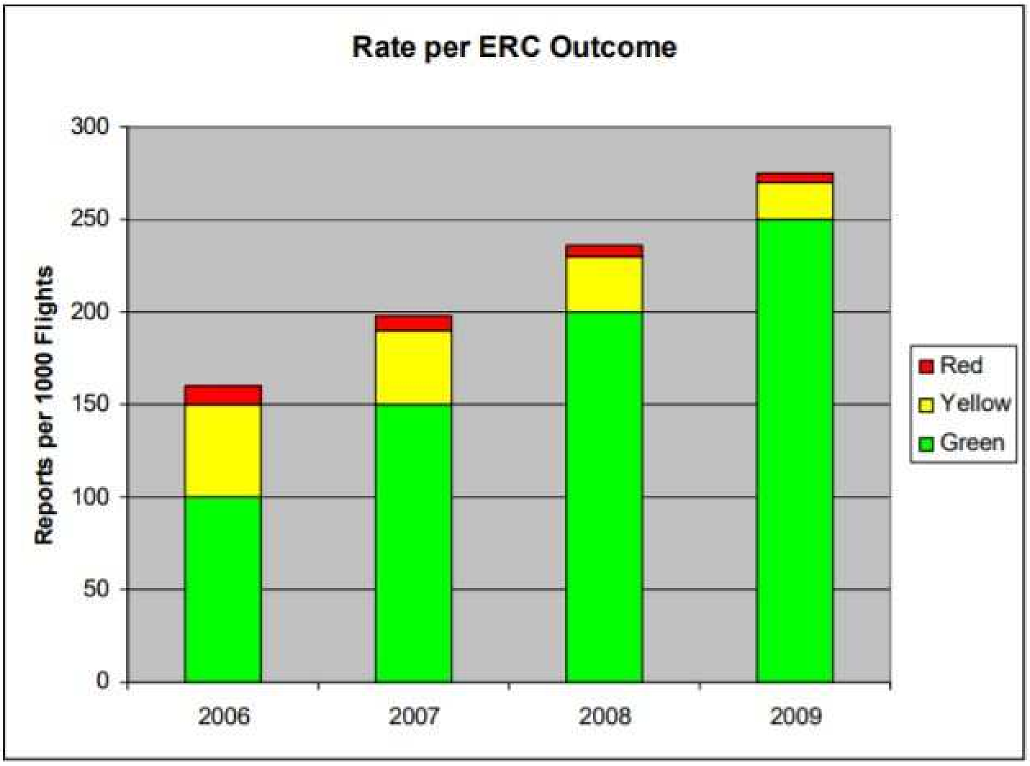

Figure 9 – A second example of ERC Methodology applied in statistics, the Methodology for Operational Risk Assessment ARMS Working Group, 2007-2010

A further interesting aspect that should be analysed is the assignation of the numerical values in the ERC matrix, in which in fact the risk indices run from 1 to 2500 and each square in the matrix shows a unique value. The reason behind the choice of these values is presented in the following lines among other structural details:

- An exponential scale is used both vertically and horizontally to better reflect the difference of weight between the classes since a linear scale would have not satisfied this requirement.

- It was agreed that the difference in the order of magnitude between the lowest and highest index needs to be in the range of 1 to 1000 to highlight that the difference between the least and most risky event is indeed very significant.

- Real accident data was studied and the accidents were classified based on Question 1 of the ERC. It was observed that the relationship between the quantified losses in each class was 1:5:25. This was used on the vertical scale and, for symmetry purposes, the same relationship was used for the horizontal scale.

- The bottom row is one single block instead of four squares. This is because the bottom row corresponds to the case "No potential damage or injury could occur" and therefore it does not make sense to estimate the "effectiveness of remaining barriers".

- It was decided that each square should have a unique number, so that the index value would immediately indicate its place in the matrix. Therefore, indices 20, 100 and 500, which appeared in several squares in the first version, were adjusted by adding a small increment to make them different, causing a negligible impact on the ERC values. In particular, the top row values were increased by 2 and the second one's values by 1.

Moreover, if there are several possible "accident outcome" scenarios that can be imagined, the ERC process should be run on each and the one that gives the highest risk index should be picked.

Finally, for what concerns the ADREP taxonomy, it is a compilation of standard attributes that ICAO Annex 13 - Aircraft Accident Investigation contains and that all Contracting States are required to use to report to the International Civil Aviation Organisation (ICAO) itself information on all aircraft accidents which involve aircraft of a maximum certificated take-off mass of over 2 250 kg. An Accident/Incident Data Reporting (ADREP) system, established in 1976, is operated and maintained again by ICAO and it is based on the use of a common reporting taxonomy, which is periodically updated in cooperation with Contracting States. The key role of the combined use of filters available on Centrik and of the ADREP taxonomy will be described in the following chapter.

Chapter 4

A closer analysis about VistaJet' SPIs

4.1 The identification and monitoring of SPIs in VistaJet

As defined by VistaJet Safety Management Manual, "*The identification of SPIs should be realistic, relevant, and linked to safety objectives, regardless of their simplicity or complexity.*" What it means is that SPIs should be chosen and kept only if the availability of the necessary data is granted, since to have an SPI which is always at 0 will not provide any relevant information. As deeply described in Chapter 3, Safety Reporting System consists in one of the main data sources for SPIs as also the Flight Data Monitoring (FDM), as it will be clearer in the following lines of this last chapter. Moreover, Ground Operations handling information and reports and Internal audit results shared, respectively, during Ground

Operations and Quality and Safety meetings, contribute to create a huge database for SPIs.

Once all the SPIs are defined, it is the turn of the Monitoring phase which can be defined as *"a periodic data extraction to generate a trend chart or graph updated on a monthly basis"*. In particular, data can be taken by using a specific KPIs section available on Centrik which contains a filtering system or by manually filtering among all the reports. In both cases, to filter by Event Phase or Event Type will rely on the ADREP Taxonomy, so, again, it emerges how it is relevant to receive reports since a huge numbers of them signifies more data for an SPIs analysis. In both cases, data are extrapolated and included into a dedicated Excel file (or into a few specific external ones) with the aim of obtaining graphs and trend analysis. Basically, as shown in the Figure 13 below, all SPIs sheets are characterised by a column collecting the number of reports received on a monthly basis that will be then used to evaluate the following values:

- Number of Occurrences (per 1.000 flights)
- Average number of reports of the previous year
- Standard deviation of the previous year
- Alert 1, Alert 2 and Alert 3
- Target
- Average number of reports in the actual year (per 1.000 flights)

All of these will be then plotted into a graph like the following one:

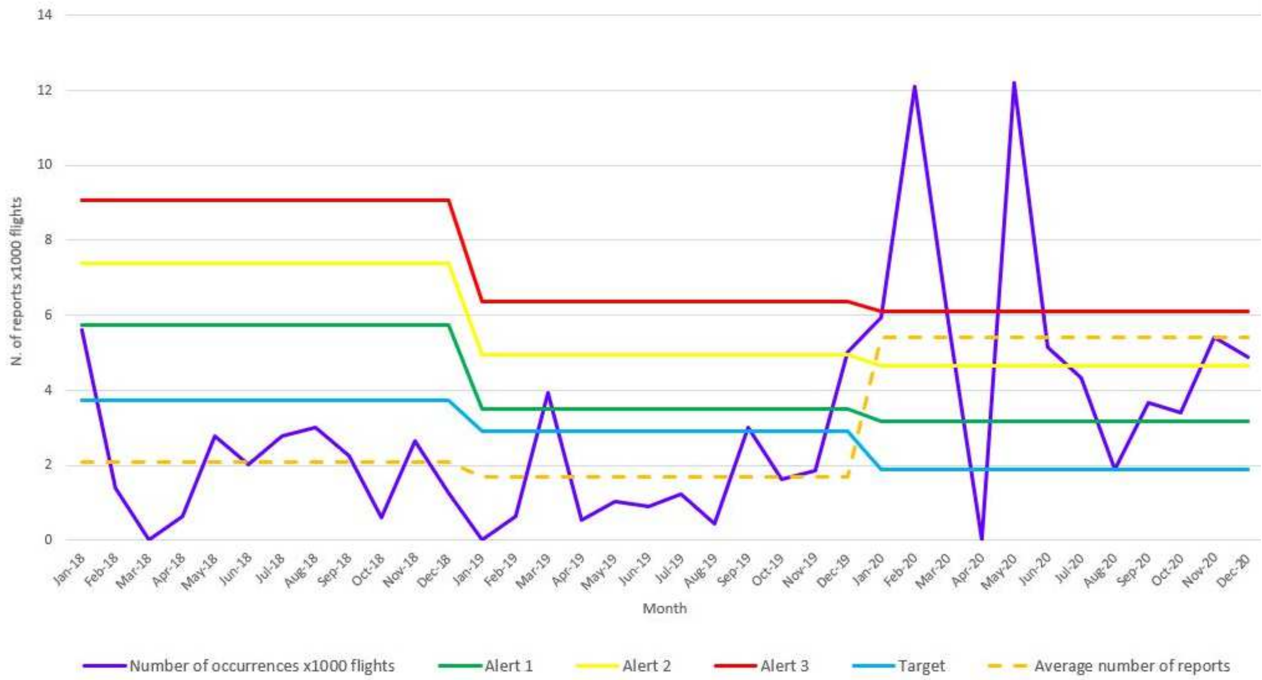

Figure 10 – Example of SPI's envelope, VistaJet' SPIs Excel file

In particular, to fit the monthly flights flown by VistaJet, it has been reasonably agreed to consider 1.000 flights to evaluate the rate, since data are provided on a monthly basis. Average number of reports and Standard Deviation concepts are necessary to calculate the subsequent Alert Levels: being in a risk-monitoring perspective requires to establish an alert level, basing on an objective method that revolves around standard deviation. In particular, the Alert Levels are influenced by the previous year's performance, especially the data points average and the standard deviation and this is to ensure that the alert setting of an indicator takes into account its own recent historical behaviour. The mathematic formula hidden behind each Alert Level consist in summing the Average number of reports of the previous year and the standard deviation multiplied by a coefficient:

$$Alert\ Level\ 1: \quad Average\ + 1\ \cdot Standard\ Deviation$$

$$Alert\ Level\ 2: \quad Average\ +\ 2 \cdot Standard\ Deviation$$

$$Alert\ Level\ 3: \quad Average\ + 3\ \cdot Standard\ Deviation$$

Basically, this is referring to the Gaussian Distribution in which it is possible to identify three different ranges which correspond to a percentage of events taken into account:

Mean $\pm 1\ \sigma$ contains 68.2% of all values

Mean $\pm 2\ \sigma$ contains 95.5% of all values

Mean $\pm 3\ \sigma$ contains 99.7% of all values

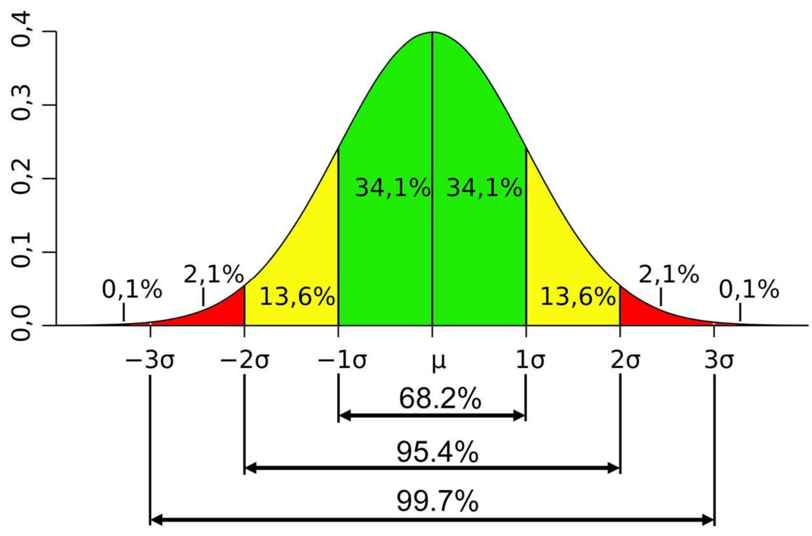

Figure 11 – Gaussian Distribution, SPH Boston University

In particular, $Standard\ Deviation = \sigma = \sqrt{\frac{\sum|x-\bar{x}|^2}{n}}$ and it is defined as "*a measure of the amount of variation or dispersion of a set of values*". In statistics, "*a low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range*".

The reason behind the introduction of Alert Levels consists in the willingness to monitor the envelop of the number of occurrences (per 1.000 flights) and to identify a potential abnormal/unacceptable trend. In fact, as stated by ICAO and reported on VistaJet' SMS Manual, an alert is triggered when one of the conditions below are met for the current monitoring period (current year), requiring a subsequent analysis of the event/s it/themselves:

- Any single point is above the Alert Level 3 line.

- Two consecutive points are above the Alert Level 2 line.

- Three consecutive points are above the Alert Level 1 line.

Furthermore, a target line is required to monitor a possible improvement of the concerned SPI and it is defined as *"a desired percentage improvement over the previous monitoring period's data point average."* The rule behind the definition of the target line consists in considering the average rate at the end of the current monitoring period and, if it is at least equal or less than the desired value, i.e. the average rate of the previous two years, then the desired improvement is deemed to have been achieved. In particular, if this condition has been reached, it has been established to apply a fixed rate of improvement in the target of the current year. Here it follows a concrete example taken from one of the SPIs analysed in VistaJet.

Jan-18	2	1.41		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Feb-18	3	2.11		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Mar-18	1	0.66		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Apr-18	2	1.30		1.25	1.05	2.30	3.34	4.39	1.46	1.10
May-18	4	2.22		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Jun-18	2	1.01		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Jul-18	3	1.39		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Aug-18	0	0.00		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Sep-18	2	1.12		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Oct-18	0	0.00		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Nov-18	2	1.32		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Dec-18	1	0.63		1.25	1.05	2.30	3.34	4.39	1.46	1.10
Jan-19	1	0.74		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Feb-19	0	0.00		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Mar-19	4	2.25		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Apr-19	2	1.10		1.10	0.67	1.77	2.44	3.11	1.17	0.96
May-19	1	0.52		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Jun-19	3	1.34		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Jul-19	3	1.23		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Aug-19	0	0.00		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Sep-19	3	1.51		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Oct-19	2	1.09		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Nov-19	0	0.00		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Dec-19	3	1.68		1.10	0.67	1.77	2.44	3.11	1.17	0.96
Jan-20	1	0.54		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Feb-20	4	2.20		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Mar-20	1	0.73		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Apr-20	1	3.15		0.96	0.69	1.65	2.34	3.03	0.98	0.82
May-20	0	0.00		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Jun-20	0	0.00		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Jul-20	2	1.08		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Aug-20	2	0.94		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Sep-20	1	0.61		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Oct-20	0	0.00		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Nov-20	0	0.00		0.96	0.69	1.65	2.34	3.03	0.98	0.82
Dec-20	1	0.61		0.96	0.69	1.65	2.34	3.03	0.98	0.82

Figure 12 – Evaluation of a SPI's target, example taken from VistaJet SPIs Excel file

In the example above taken from VistaJet SPIs, the Average Rate of year 2020 marked in green corresponds to 0.82, while the one of the previous two years highlighted in blue is equal to 1.03. This means that a decrease in the number of occurrences has been faced and that the target for the year 2020 should be reduced as per procedures.

What has emerged during the experience in the Safety Department is that the specific decrease in target could be not completely appropriate for all the SPIs analysed by VistaJet. Some critical indicators would require a higher decrease since, perhaps, VistaJet should be more worried about this kind of events and should not accept to have a target that allows to have this number of occurrences. Hence, a variable decrease percentage would be more suitable, since it will consider the intrinsic characteristics of all the SPIs and it will better adapt to each situation.

To perform a further and deeper analysis, the core of *Target Culture: Lessons in Unintended Consequences* reported on HindSight 17 by EUROCONTROL in 2013 suits this aim. Numerical targets, "*which are judged as either met or not met*", strongly affect the behaviour and system performance, whether they are in cost-efficiency, safety or environment. Even if their introduction appears to be in the interest of the organisation, it is still worthy to ask ourselves if numerical targets are actually influencing companies well. Despite the research in psychology affirms the opposite, it is a common thought that "*people need an external motivator to do good work,* [ignoring] *the fact that the majority of outcomes are governed by the design of the system* [...]". Targets are exactly performing this role. Directing people to do anything to achieve the set numerical value while disregarding the "*purpose from the end-user's perspective*" and the concrete possibility to reach the numerical target. Employees are hence guided towards their tasks, with an idea of how much and how quickly they are supposed to act. It is then clear that a direction to be followed is set but it is focused mainly on the achievement of the numerical target and not of the desired system state. It will be further analysed in Paragraph 2.1 in Chapter 4 and in the Conclusion in Chapter 5 that the attention should be kept also on the uncertain positive aspects coming from a comparison: targets will undoubtedly allow to compare information but it is often a process based on false, manipulated and meaningless data. The unintended consequences of targets are not new, since economists and social scientists have studied and analysed how "*interventions in complex systems can have unwanted effects, different to the outcome that was intended.*" As an example, in the late 90s the British government introduced targets as a main feature in its policy and way of thinking. The Healthcare was particularly affected by this reform, with targets based on the needs of patients and budgeting, while disregarding the quality of care. The consequences of this target culture in healthcare were illustrated in the Mid-Staffordshire Hospital Trust scandal, in which it has been estimated that "*hundreds of patients may have died as a result of poor care between 2005 and 2008 at Stafford hospital*", basing on a 2009 Healthcare Commission Investigation.

The aim of this line of reasoning is, finally, to highlight how pointless it is to struggle to achieve values that are meaningless for the organisation, especially if the quality of the surrounding work environment will be affected by it. Since VistaJet is aware of these possible undesired effects, the quality of the SPIs and related targets is in the main interest of the Safety Department, which tried to meticulously scrutinise each specific aspect of all SPIs, as done with the TCAS RAs. The related dashboard is characterised by an analysis regarding the compliant use and chase of autopilot, auto-throttle and vertical path. Since each of these aspects could or could not have been managed in conformity with the procedures, it has been considered worthy to deal with all of them individually. Specific trend analysis and consideration have been done for each of them, leading to a definition of future individual expectations. Hence, in this way, a single target concerning the whole TCAS RA SPI has been roughly turned into three targets, increasing the quality of this single indicator.

4.2 Practical experience with VistaJet' SPIs

To contribute and complement the Reporting System, in some cases, it is necessary to resort to an FDM Analysis highlighting which, if any, parameters during the flight were uncompliant with the procedures imposed by VistaJet. If some are detected and no report is available concerning this event, the Safety Department will require the involved crew to submit a Retrospective Report. An attachment of the developed FDM Data Analysis will be then provided in the Action report' section on Centrik. The huge help that Aerobytes provides will be analysed in the following paragraphs, in particular regarding the Unstable Approach SPI. Furthermore, it can also happen to be contacted by external air navigation authorities or airports regarding a Safety occurrence that has been noted by them. In situations like these, an External report will be open by the Safety Department and the involved crew will be contacted to obtain further information and details if a report is not already available.

As disclosed in the previous lines, Aerobytes performs a key role. Before highlighting how it contributes to and simplifies the Safety Department's analysis, to provide an overview of some SPIs deeply analysed in these months may help to better understand the whole faced procedure. During my personal experience within VistaJet Safety Department I had to deal, supported and helped by the previous and current Safety Engineers, with the development of two interactive dashboards on Excel regarding TCAS RAs and Unstable Approaches. Firstly, the TCAS (Traffic Collision Avoidance System) consists in an aircraft collision avoidance system designed to reduce the incidence of mid-air collisions between aircraft by monitoring the airspace around and detecting the presence of other corresponding transponder-equipped aircraft which may present a threat of a mid-air collision (MAC). In case of traffic detected around the aircraft, an initial Traffic Advisory is provided to pilots to assist them in the visual acquisition of the conflicting aircraft and prepare the crew for a potential RA. The Resolution Advisory, as reported by SKYbrary, consists in "*a manoeuvre intended to provide separation from all threats*" or "*a manoeuvre restriction intended to maintain existing separation.*" Furthermore, ICAO breaks down this concept in two more ones, describing a corrective RA as an aural message that "*advises the pilot to deviate from the current flight path*" and a preventive RA as one that "*advises the pilot to avoid certain deviations from the current flight path but does not require any change in the current flight path.*"

On the other side, for what concerns the Unstable Approaches, for each fleet VistaJet provides an Operation Manual (Part B) in which all the Stable Approach Criteria are reported, basing on the approach type. As shown in the Figure 16 below, for a Challenger 350 with an ILS (Instrument Landing System) Approach it is required to be stable at 1000 ft with an Airspeed within a defined window and in landing configuration (Gear down, flaps deployed at 30). Basically, the FDM Analysis on Aerobytes mentioned in the first paragraph of this Chapter will revolve around checking if all the criteria were satisfied at the indicated Stabilisation Altitude (1000ft) and, even if all of them where met, the flight data will be checked until the Touch Down (TD): it is possible, in fact, that an aircraft was stable at the gate but became unstable at lower altitudes; the effective stabilisation altitude will be then identified.

While dealing with both this events a spontaneous question arose in our minds: are, perhaps, VistaJet procedures too tight? For example, in case of gusts, VistaJet OM Part B provides for each fleet a change in the maximum accepted Vref, *("Vref shall be corrected in gusty conditions by adding half of the gust component up to a maximum of 10kts"*, VistaJet CL350 OM Part B, 4.5.3.1 Wind Correction), granting to perform an approach with a higher airspeed than usual. But in some cases, an uncompliant situation requires a personal evaluation performed by the Safety Engineer, as when some parameters are not in accordance with the procedures for a few seconds or when the value is slightly higher or lower than what is required. The obvious question that comes to the mind is if it is worthy and useful to highlight as uncompliant, for example, a vertical speed slightly above the maximum accepted one (1000 fpm), especially if this situation lasted for a few seconds. A comparable reasoning can be introduced regarding TCAS RAs : it happens to deal with Resolution Advisories that took place in crowded air-zones in the United States with a great numbers of helicopters being in use or, for example, in a parallel approach performed in San Francisco. In cases like these, it can happen that the crew is completely aware of the situation and has in sight the surrounding traffic, fact that leads the pilots to disregard the TCAS aural messages. Not only in such border line cases it has been necessary to intervene with, as already mentioned, hidden rules mutually agreed, Due to the proven complexity associated to both these two SPIs, it has been in the interest of the Safety Department to develop a deeper analysis highlighting which parameters brought a case to be uncompliant with the procedures or to point out the reasons who lead the crew to perform a continued landing following an unstable approach. The two interactive dashboards previously mentioned are now in place providing more details to be shared with other departments and the related risk owners. Moreover, for what concerns such border line cases illustrated in the previous lines, their manual evaluation is supported by automatic thresholds implemented on Aerobytes. In particular, for what concerns Unstable Approaches, single peaks in the envelope of certain FDM parameters will now be disregarded since Aerobytes will highlight only the critical values that lasted for longer than a certain time lapse (in terms of seconds). The same time frame could be considered for the manual analysis, in order to keep continuity in the two analysis methods. Hence, a combined use of both allows to overcome the majority of problems associated to these border line situations. Nevertheless, generally, to highlight the reasons behind a non-compliance with the procedures remains a main aim. This is why, for example, the classification of Unstable Approach reports has been enriched with the use of three new possible ADREP events. In particular,

- Knowledge of procedures: for cases in which crew was not aware of the criteria related to the stabilised approach.

- Monitoring of Equipment/Instruments: this concerns cases in which the crew got distracted and reached the stabilisation later than required.

- Situation Induced Individual/Team non-conformance: it revolves around "Violation" cases, i.e. situations in which crew was completely aware about the procedures to be followed but decided to perform a landing even if the stable criteria were not achieved. In this cases, in fact, a go around has to be performed immediately after the stabilisation gate.

4.2.1 External data providers

To further monitor VistaJet SPIs and their behaviours, it can be useful to rely on external authorities such as IATA (International Air Transport Association) or EUROCONTROL, respectively in charge of setting technical standards for airlines and of achieving safe and seamless air traffic management across Europe. What has been done among VistaJet Safety Department is to provide a comparison between internal SPIs' behaviour and the standard envelopes proposed by such authorities. In particular, the following sources have been used:

- IATA FDX data regarding the monthly event rate (per 1.000 flights) of Unstable Approaches.

- EUROCONTROL – Hindsight 31 that, basing on a research over 9 mln. flight hours, stated that an airline should face 1 Resolution Advisory over 6567 flight hours flown.

- FOQA (Flight Operations Quality Assurance) data provided by Professional Pilot Magazine stating that an airline should have 1 Stall Warning every 100.000 flight hours flown.

What can be pointed out is the difficulty to source such information: for example, a subscription is required to have access to IATA FDX Data and the same information provided by a third part are usually partial. Despite this aspect, VistaJet keeps being interested in obtaining a comparison based on this information to keep an eye on what is happening beyond the company. Furthermore, the focus is not on the distance from these proposed standard values, but rather on the trend of its own parameters in relation to such external data. In fact, the Safety Department is aware of how these statistics are based on airlines that could be noticeably different from VistaJet, both in terms of procedures and number of operations.

4.2.2 Safety Leaflets as a mitigation

The last main role of Safety Department consists in try its best to decrease the increase of undesired events after having monitored the whole list of SPIs. To monitor their envelopes, in fact, is not sufficient to avoid future unwanted events, so mitigations are required. The issue of Safety Leaflets and Safety Bulletins performs a central role, since a few paragraphs shared with crews and other departments will highlight different critical situations that took place in the past with the aim of do not let these happen again in future. A couple of practical VistaJet examples about how this kind of solution worked in the past concerns the TCAS RA SPI's envelope and the behaviour of the one concerning the Pitot Covers forgotten into position before departure: both, in fact, faced a great decrease respectively after a Safety Leaflet in December 2019 and one published in July 2019. As it has been stated in Chapter 1, unfortunately, and VistaJet is aware of it, a simple reminder provided via a Safety Leaflet is destinated to survive in readers' minds for a too short time frame, providing a mitigation which will not last as hoped. As a result, once again, the intervention of Safety II appears to be the solution to concretely avoid as much as possible further events to happen, as done, for example, by VistaJet itself with the pitot covers solution described at the beginning of the thesis.

Chapter 5

Conclusion

Safety Performance Indicators consist in a powerful tool that different branches in the marketplace should rely on. A judicious choice of the Indicators and a reasonable monitoring strategy can entail to have a financial increase seeing as performances' undesired outcomes would be increasingly avoided. To gather resources to control Safety Performance Indicators correctly and profitably is a step that societies and organisations should take since this effort would only bring back positive aspects in terms of finances and safe operations; it should never be forgotten how being a safe company is also a great calling card for further clients. However, as experienced in VistaJet, solutions will be always required to seek a continuous improvement even if reasonable SPIs and their management are in place. What should not go unnoticed for each organisation is to always keep the attention on its own structure, capabilities and procedures in place intended as a choice of Safety Performance Indicators that can adapt to the reality that the company is truly facing. To overturn the internal mechanisms just basing on external authorities' indications providing a featureless list of SPIs that each company should have, not only would be useless but also would lead the organisation to lose the attention on other multiple relevant aspects. Only a rational process in the choice of appropriate, realistic and reasonable SPIs will lead to a fully appreciation of all associated positive effects. This way of thinking must be extended to the whole management of the SPIs, since it has been proven how an unrelenting comparison with international standards and targets will dangerously drive the organisation towards the wrong direction.

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