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A Nordic perspective on safety culture in European aviation.

- Nordic commercial aviators on pillars supporting the safety management system.

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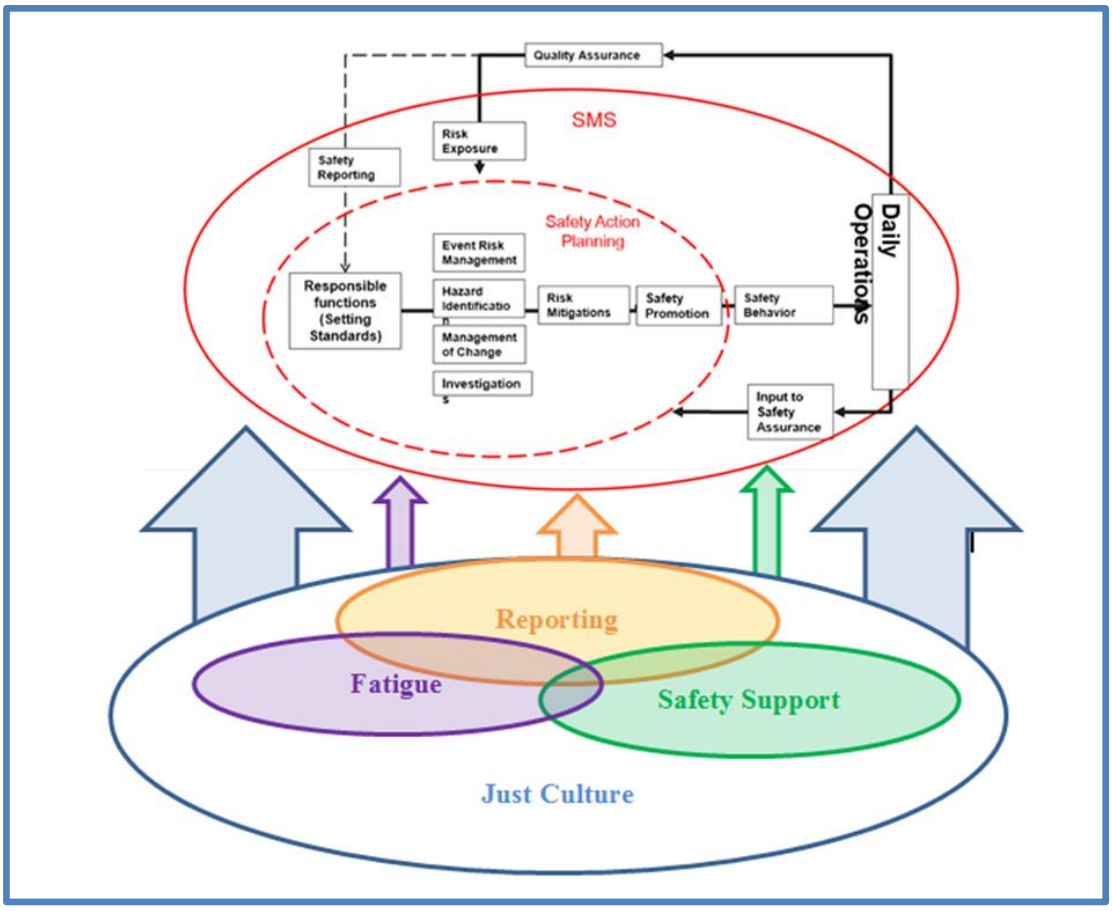

Figure 1, SMS illustrated, and some of the pillars supporting it.

ABSTRACT; EXECUTIVE SUMMARY

Introduction

European aviation has evolved from deeply regulated and state funded airlines to open skies, fierce competition, and despite EU regulation, rule shopping among airlines. The introduction of low cost carriers sparked a transition from typical towards atypical employment models for pilots, through self-employment and work agencies. The large survey performed by Ghent University described this and concerns towards safety (Jorens et al., 2015). Another survey released in November 2016 performed by London School of Economics focused on safety culture among European pilots and despite overall good results, disclosed safety concerns towards areas such as Just Culture & Reporting, Perceived Safety Support and Fatigue (Reader et al., 2016). Both surveys concluded with large in-group pilot differences.

EU through EASA has adopted the ICAO initiative to establish a Safety Management System at all levels and this system needs inputs to promote a safety culture throughout the organization (EASA, 2014, ICAO, 2013). Reporting, Just culture, Fatigue reporting and Safety Support are some of the vital areas required to have an efficient Safety Management System.

This study combines the findings in the two surveys, employment models and concerning safety culture areas, with the assumption that this will affect European flight safety work and the ability of SMS to stay effective in this respect. -But limit the population to a subset of the mentioned surveys; -Commercial pilots flying for Nordic operators, abroad or in the Nordic countries.

Research Question

How does the changing pilot employment environment affect Safety Management System effectiveness?

Method

An extensive quantitative survey, snowball sampling, were used to collect data. Analysis were performed on the four mention safety culture areas and in-group differences were also analyzed, mainly age, management role, contract type, previous contract and company type.

Results

Overall the results within the safety areas described verified the good mean scores except for the fatigue dimension, all in line with the LSE survey. The area of fatigue showed concerning results and calls for immediate attention. In-group differences showed cracks in the SMS fundament particularly within these groups:

- Company types, Low Cost Carrier's scores considerably more negative than Legacy Carriers and Helicopter versus safety areas analyzed.
- Employment contracts versus safety dimensions studied, favor typically over atypical employment contracts.
- Younger and less experienced pilots are more negative, or if you like; -the future of European aviation, is less positive towards the safety culture evolution seen in Europe today.

These findings should call for attention and further studies, but do not render the SMS totally ineffective per se.

Other findings showed a huge mistrust among all pilots towards the ability for regulators to regulate; political governance of the regulators was listed 20 times more often than terrorist acts as the greatest threat to European aviation, and the areas of employment models and fatigue respectively 50 and 45 times more often, -both areas greatly influenced and controlled by the regulators. Information and reporting at the state level showed miserable results (46 % of the pilots don't know if there is a reporting system at the state level). If these results are verified in future studies this show a failure by EU, EASA and national CAA, to implement a SSP with efficient SMS throughout European aviation, i.e. reporting inputs and/or information output to their SMS fails.

Conclusion

Despite the fact that the overall results show a good safety culture there are areas of great concern, especially employment models and fatigue. The revealed mistrust towards CAA/EASA, and the political influence, is aggregating this picture since the regulators are setting the playground in these areas. These findings will probably limit the ability for the SMS stay effective in the changing world of European aviation. The area of fatigue calls for immediate action, and the mistrust towards regulators ability to regulate calls for larger studies.

SAMMENDRAG

Introduksjon

Europeisk luftfart har utviklet seg fra et statsregulert og statsdrevet system mot et åpent og svært konkurranseutsatt system. Til tross for diverse EU-regulativ er det mulig for flyselskap å «shoppe» regler i de forskjellige EU land. Introduksjonen av lavprisselskap (LCC) og deres jakt på kostnadskutt medførte en vridning av ansettelsesforhold for piloter i Europa. Fra typiske (direkte ansatt) til atypiske kontrakter gjennom bemanningsbyråer og eller tredje-, fjerdepart osv. En stor undersøkelse fra universitetet i Gent beskrev disse ansettelsesforholdene og uttrykte bekymring i forhold til sikkerhetsaspekter (Jorens et al., 2015). I en fersk undersøkelse fra London School of Economics med fokus på Europeiske piloter og sikkerhetskultur ble det også avdekket bekymringsverdige forhold, selv om det totale bildet var godt. Bekymringene gikk hovedsakelig på arbeidsbelastning, tillitskultur, rapporteringsvillighet og opplevd støtte i sikkerhetsspørsmål.(Reader et al., 2016). Begge undersøkelser viste riktignok store forskjeller innad i pilotgruppen.

Gjennom EU direktiv har EASA adoptert ICAO sitt initiativ om å etablere et «Safety Management System» (SMS) på alle nivåer. EASA, nasjonale luftfartsmyndigheter og det enkelte selskap har alle en plikt til dette. ICAO peker på rapporteringsvillighet, herunder arbeidsbelastningsforhold, tillittskultur og støtte samt informasjon i sikkerhetsspørsmål som suksesskriterier for et effektivt SMS (ICAO, 2013).

Denne studien kombinerer de nevnte undersøkelser, ansettelsesforhold og sikkerhetskultur, i et forsøk på å se om Europeisk flysikkerhetsarbeid (SMS) kan opprettholde sin effektivitet i et endret arbeidsmiljø for piloter. Undersøkelsen begrenser seg til piloter som arbeider for Nordiske selskap, men det vil også si piloter basert utenfor Norden, men som opererer fra utenlandske baser for Nordiske selskap.

Problemstilling

Hvordan påvirker piloters endrede ansettelsesforhold effektiviteten i «Safety Management» Systemene?

Metode

Metoden som ble valgt for å samle inn data var en ekstensiv kvantitativ spørreundersøkelse, etter snøballprinsippet. Statistiske analyser ble utført på de nevnte sikkerhetskulturforhold, samt forskjeller innad i pilotgruppen. Analyser innad i gruppen begrenset seg hovedsakelig til forskjeller mellom unge og eldre, typisk og atypisk ansatte, piloter med og uten ledelsesrolle,

forrige ansettelseskontrakt (typiske og atypiske) og til slutt type av selskap(Nettverk, LCC, Helikopter).

Resultater

Resultatene for de fire sikkerhetskulturgruppene var totalt sett gode og i tråd med eller bedre enn LSE undersøkelsen. Kun forhold som omhandlet arbeidsbelastning var i området som gir rom for tolkning og til dels så bekymringsfullt at dette krever fokus umiddelbart. Ser vi på forskjeller innad i pilotgruppen er det flere grunner til bekymring, og mye taler for at det er sprekker i pilarene som kreves for et effektivt SMS, spesielt fant undersøkelsen store forskjeller innad i disse gruppene:

- Type av selskap, LCC er betydelig mer negative enn Nettverks og Helikopter piloter i alle fire sikkerhetskultur dimensjoner.
- Typisk ansatte piloter er mer positive enn atypisk ansatte i forhold til sikkerhetskulturdimensjonene.
- Yngre og mindre erfarne piloter er mer negative enn eldre og mer erfarne til sikkerhetskulturutviklingen i Europa. Det er et paradoks da de fleste i den yngre gruppen har følt dette «nye Europa» på kroppen, mens den eldre garde ikke har opplevd dette regimet i samme grad, da de i stor grad fortsatt besitter typiske ansettelsesforhold.

Disse funnene krever videre studier/validering og videre oppfølging av myndighetene. Det er ikke på dette grunnlaget grunn til å si at Safety Management Systemet per se er ineffektivt, men muligens mindre effektivt enn nødvendig på grunn av arbeidsforhold og arbeidsbelastning blant piloter.

Andre funn som tydeliggjør bildet av et brutt tillitsforhold mellom piloter, selskap og regulerende myndigheter er den politiske styringen av luftfartsmyndighetene i Europa og de enkelte land. Politisk styring av regulerende myndigheter ble angitt 20 ganger oftere enn terroristhandlinger som den største sikkerhetsfaren mot Europeisk luftfart. Ansettelsesforhold og arbeidsbelastning ble angitt henholdsvis 50 og 45 ganger så ofte som terrorhandlinger, begge disse områdene er styrt av regulerende myndigheter.

Informasjon og rapportering på myndighetsnivå viste miserable resultater (46,5 % av kommersielle piloter anga at de ikke viste at det var et nasjonalt rapporteringssystem (ikke foretaksnivå, men nasjonalt rapporteringsnivå)). Hvis dette i fremtiden viser seg å være riktig har EU/EASA/CAA mislyktes i å implementere et State Safety Program og et effektivt SMS på dette nivået, og det må derfor stilles spørsmåltegn ved effektiviteten til myndighetene i sikkerhetsspørsmål som informasjon og rapportering.

Konklusjon

Til tross for det gode totalbildet av sikkerhetskulturarbeidet er det grunnlag for bekymring når det kommer til områdene som styrer arbeidsbelastning og ansettelsesforhold, og spesielt i samhandling med muligheten til å opprettholde et effektivt Safety Management System er det grunn til bekymring. Mistilliten mot styrende myndigheter og deres evne til å regulere de nevnte forhold, samt politisk innflytelse på dette arbeidet, forverrer bildet.

Funnene i denne undersøkelsen viser at det er sannsynlig at Safety Management Systemet er under press og mindre effektivt enn nødvendig.

Arbeidsbelastning er et område som påberoper seg umiddelbar handling fra myndighetene og mistilliten blant piloter mot regulerende myndigheter krever videre studier.

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AOC	Air Operator Certificate, an operator's certificate to conduct commercial air transportation.
AM or AE	Accountable Manager or Accountable Executive. AM is used in Europe and AE is the ICAO counterpart. "A single, identifiable person having responsibility for the effective and efficient performance of the State's SSP or of the service provider's SMS"
EASA	European Aviation Safety Agency, the European Unions aviation safety agency.
EASp	European Aviation Safety Plan.
ECA	European Cockpit Association.
FTL	Flight Time Limitations, EASA regulations.
FAST	Future Aviation Safety Team, EASA
ICAO	International Civil Aviation Organization, a specialized agency of the United Nations.
Incident	*"The term 'incident' refers … to unwanted and unexpected events within the organization with an effect on safety, including also accidents and near misses"(Drupsteen and Guldenmund, 2014).*
HOFO	Helicopter Offshore Operations refers in this paper to the EU/Norwegian Offshore Operations regulation change, EU 965/2012, allowing other member states to operate the Norwegian continental shelf, without a special permit from the Norwegian CAA.
LCC/LFA	Low Cost Carrier/Low Fare Airline are used as alternative expressions.
Legacy Carriers	Traditional network airlines, traditionally state owned or partly state owned or controlled.
LSE	London School of Economics
SES	Single European Sky, European Union project aimed to increase the efficiency and capacity in European Airspace.
SME	Small Medium-sized Enterprise.

SMS	Safety Management System. ICAO, chapter 4 of annex 19, standards recommended safety system to standardize policy, assurance, risk management and promotion of aviation safety. EASA recognize the annex and develop a system based on the recommendations, but has not fully implemented a mandatory State Safety Program yet.
SMM	ICAO Safety Management Manual.
SSP	"State Safety Program". An integrated set of regulations and activities aimed at improving safety" (ICAO, 2013).
The Sharp/Blunt End:	"*The sharp end refers to the situation in which work is carried out (ATC, Pilots etc), .. the consequences of actions show them self immediately. … The blunt end is made up of the many layers of the organization that do not directly participate in what is done in the sharp end…. The two are neither calibrated nor synchronized*" (Hollnagel, 2014)
Typical/Atypical employment	Term used to describe directly employed (typical) and indirectly employed pilot contracts. Atypically contracts often run through third and fourth party work agencies not directly connected to the AOC holders (operators).

1 Introduction

1.1 Background

The European aviation business has dramatically changed in the past two decades. The branch evolved from national "sponsored" network carriers to open skies and low cost carriers, LCC. The rough competition and huge cost focus made large changes in employment models among pilots. The survey conducted at Ghent University revealed a number of typical (direct employment) and atypical employment models, the latter category ranged from "open ended contracts through work agencies" to "fixed-term work via (temporary) work agencies" and "bogus self-employment" (Jorens et al., 2015).

Eurocontrol and the European Commission launched, through London School of Economics, LSE, a survey focusing on safety culture among European pilot groups. The survey was released in late November 2016. It revealed considerable differences between typically and atypically employed pilots in Europe, especially the safety culture dimensions of *"perceived safety support", "fatigue" and "just culture and reporting"* raised concern (Reader et al., 2016, p. 24).

The evolution in aviation safety has gone from the technical era, through the human factors era and now into the organizational era (EASA also name a fourth era; the system era, ICAO embeds this into the organizational era) (EASA, 2014, ICAO, 2013). Safety culture is a main objective and target in the safety work launched through ICAO Annex 19 regulations.

The four factors pointed out above, restructure and fierce competition, new employment models for pilots and cabin crew, safety culture and the organizational focus introduced in the safety work are all factors joined in the Safety Management Systems now being implemented in Europe. Even though many companies have worked along this path for a long time, it is few studies on how this system enhances safety, and even less studies on the management views and actions than on the pilot views, or in other words "the blunt end" versus "the sharp end" (Hollnagel, 2014), and none were found addressing the SMS effectiveness versus the sharp end and the changing ball game of employment.

The safety management system (SMS), as described in chapter 4 of ICAO annex 19 and used as a roadmap for European implementation, is supported by four safety pillars:

- Safety Policy.
- Safety Assurance.
- Safety Risk Management.

- This in turn directs Safety Promotion.

The system has some vital inputs, such as audits, electronic analysis, investigation of incidents and reporting (ICAO, 2013, EU, 2014). All of them involving human actions, even the electronic analysis are filtered through humans, or in other words dependent on a safety culture throughout the organization and authorities. The political establishment are off course a vital force when setting the agenda and hence deeply responsible for the resulting safety culture.

1.2 The Research Question, -main objective of the study

How does the changing pilot employment environment affect Safety Management System effectiveness?

-A Nordic pilot perspective on safety culture pillars of European aviation.

1.2.1 Other objectives of the study

1. To validate LSE findings versus the four safety dimensions and the Nordic pilot group as a whole, and to look at in-group differences.
    a. Just Culture
    b. Reporting
    c. Perceived safety support.
    d. Fatigue
2. Respondents knowledge of own company and the company's focus areas:
    a. SMS
    b. Reporting systems
    c. Safety focus objectives
3. The Nordic pilot group view, and in-group differences, on typical and atypical employment versus
    a. Flight safety.
    b. Safety reporting and fatigue reports.
    c. Treats to European aviation.
4. Does the Nordic pilot group have information and knowledge of national authorities reporting systems? -and in-group differences.
5. Does the Nordic pilot group have confidence in EASA/CAA as a regulators and supervisory organization? -and in-group differences.

1.3 The Aviation Safety Evolution, historical background information

Newton assumption that every action has a reaction, one action leads to the other, is the basis of safety work in the western world. In other words, every incident may be explained by the chain of events, broken down to the smallest item, word, technical part and so on. Analytically breaking down the accident in clear logical sequences is the normal way to deal with safety issues especially in the west, i.e. to pin point and categorize the reason for the accident (Dekker, 2014). The tendencies for us humans to grab a single easy understandable reason, especially when it fits our inner view, are pronounced. Media, authorities, business leaders and investigators all have a tendency to seek the single reason, the blamable person, the root cause or the bad apple, and all safety reports are categorized into reasons for the incident or accident (Ibid).

Herbert William Heinrich's empirical study of 1931 is still the basis of many branches view on safety, modernized or not. The study showed a relationship between the number of accidents that causes a major injury and incidents not causing any harm. He advocated that for every accident that causes major injury there was 29 accidents with minor injuries and 300 accidents with no injuries. Many of the accidents had the same root cause and by focusing on those we could improve safety, the statistics would be much better (Heinrich, 1931). This view is still alive in major sectors like the Norwegian health sector. They have urinary tract infection as a main target. Reducing this number will by far improve the statistics the most (Helsedirektoratet, 2016), but does it enhance patient safety on an organizational level?

Many branches, like aviation, have recognized that our socio-technological organization with a complex interaction between systems and humans, and an extremely dynamic organizational structure are far more complex to predict and especially to pin point the main reason for a mishap (Dekker, 2014, p 27). Despite this the aviation authorities and the airlines still categorize incidents in their statistics (Skybrary, 2016, EASA, 2015). In contradiction to the statistics the investigator incidents reports rarely point to one single cause and often point to underlying latent errors, organizational, training flaws etc. in their reports.

1.3.1 Overall European aviation safety statistics (2014), the long term trend

What about the overall long term trend?

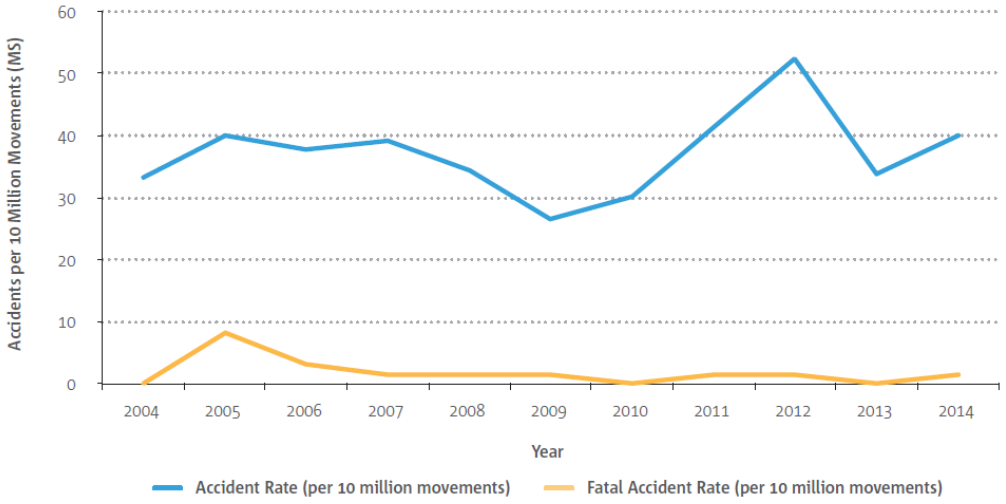


Figure 2, EASA Member States, Airplane accident rate

The yellow line depict the number of accidents in EU with fatal outcome per 10 000 000 movements, one in 2014. The blue line show the accident rate without fatal outcome, forty in 2014 (EASA, 2015). The numbers are for fixed wing aircraft excluding helicopters.
In the figure below the ICAO illustration on the long term accident trend is shown. The numbers are from ICAO member states as given by the Airplane manufacturer Airbus (Airbus, 2014). Only commercial operated flights and fatal accidents are shown.

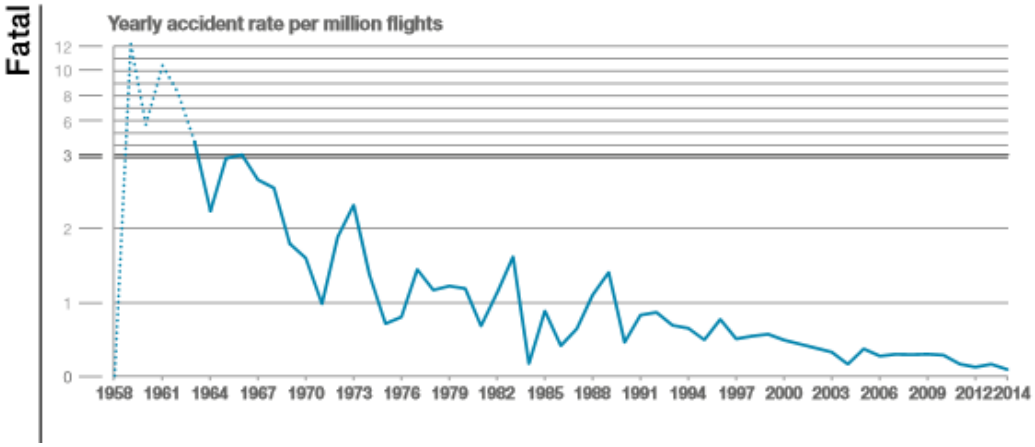


Figure 3, Historical accident rate with fatal outcome (Airbus, 2014)

All the numbers are quite impressive and often used as a reference in other branches (Townsend, 2013), and we will let the numbers speak for them self.

1.3.2 The aviation safety eras

The European aviation safety management system are based on ICAO recommendation, annex 19 of the Chicago Convention; -especially chapter 4 of annex 19 (Commission, 2015).

The ICAO Safety Management Manual, SMM, is the practical guide to implementation of SMS, both at the state and operator level.

SMM chapter 2 describes the evolution of aviation safety. The manual describes three eras of evolution, the technical, the human factors and the organizational era. In short, and with ICAO's words:

- *"Technical era, from early 1900s until late 1960s." …."The focus of safety endeavors was therefore placed on the investigation and improvement of technical factors. By the 1950s, technological improvements led to a gradual decline in the frequency of accidents, and safety processes were broadened to encompass regulatory compliance and oversight."*
- *"The human factors era, from the early 1970s until the mid-1990s: ….the focus of safety endeavors was extended to include human factors issues including the man/machine interface" …. "The application of human factors science tended to focus on the individual, without fully considering the operational and organizational context. It was not until the early 1990s that it was first acknowledged that individuals operate in a complex environment, which includes multiple factors having the potential to affect behavior."*
- *"The organizational era, from the mid-1990s to the present day. During the organizational era safety began to be viewed from a systemic perspective, which was to encompass organizational factors in addition to human and technical factors." … "This new approach is based on routine collection and analysis of data using proactive as well as reactive methodologies to monitor known safety risks and detect emerging safety issues. These enhancements formulated the rationale for moving towards a safety management approach."*

(ICAO, 2013, p 2-1)

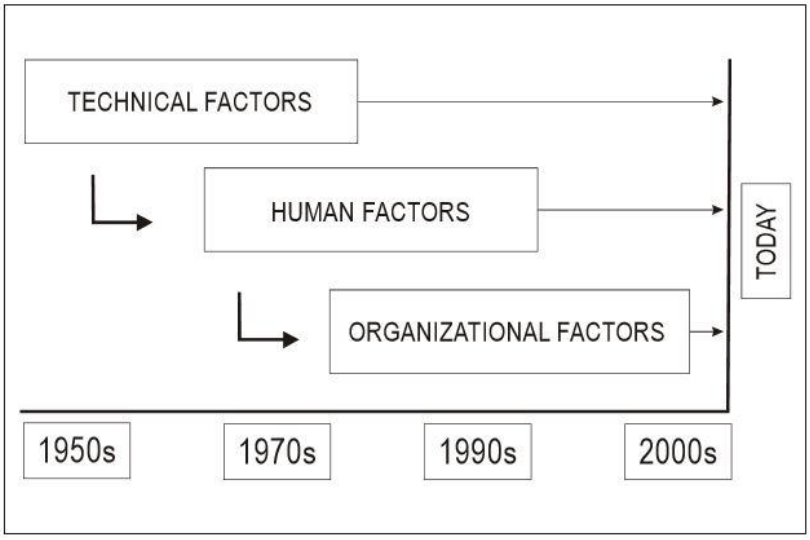


Figure 4, The evolution of the safety culture focus areas (ICAO, 2013)

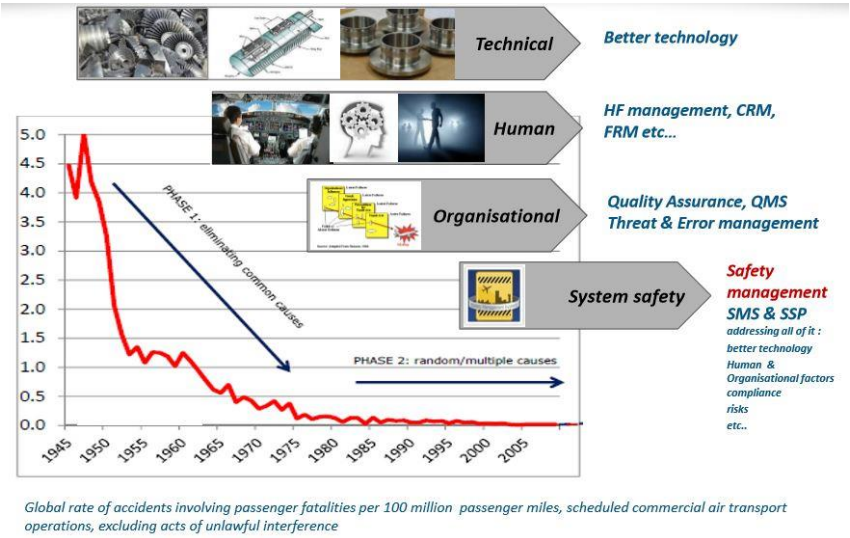


Figure 5, EASA view on the safety culture area evolution (EASA, 2014)

The EASA illustration, above, illustrate a fourth era "the system safety era". ICAO considers this a part of the "organizational era", so the difference is marginal.

The big question is; -do the statistics show the real safety trend or just a false impression of almost absolute safety? Is the absence of fatal accidents a proof of safety? Some researchers have addressed this issue and found the lack of studies on why things go right. The reverse logic of saying no accidents is the same as safety is false, the reasons for success are what we should dig into (Dekker, 2012b, 2013b, 2013a, 2014, Hollnagel, 2012, 2014, Townsend, 2013).The world is getting more and more complex and interrelated, it is hard to oversee how one component will influence another, and if a failure occurs or an "absolute correct" input is

wrong the complexity makes it almost impossible to predict the outcome (Dekker, 2013b, Hollnagel, 2014, Townsend, 2013).

The implementation of the State Safety Plan (SSP) and hence the operators mandatory Safety Management System (SMS), together with the definition of the organizational era, in safety work show that the problem is recognized by the authorities, .i.e. EASA and most European national Civil Aviation Authorities.

2 Literature review and theoretical background

2.1 Safety Management System; -Safety culture

The organizational era, or in the EASA case the "System safety era", may also be classified as a management era, where building a safety culture is one of the main objectives on all levels, from EASA/EU, state authorities, AOC holders and to the sharp end.

> *"The ultimate responsibility for the establishment and adherence to sound safety practices rests with the management of the organization. A safety culture cannot be effective unless it is embedded within an organization's own culture."*
> *(ICAO, 2013, p 2-10)*

FAA has made this illustration of the key components of the Safety Management system:

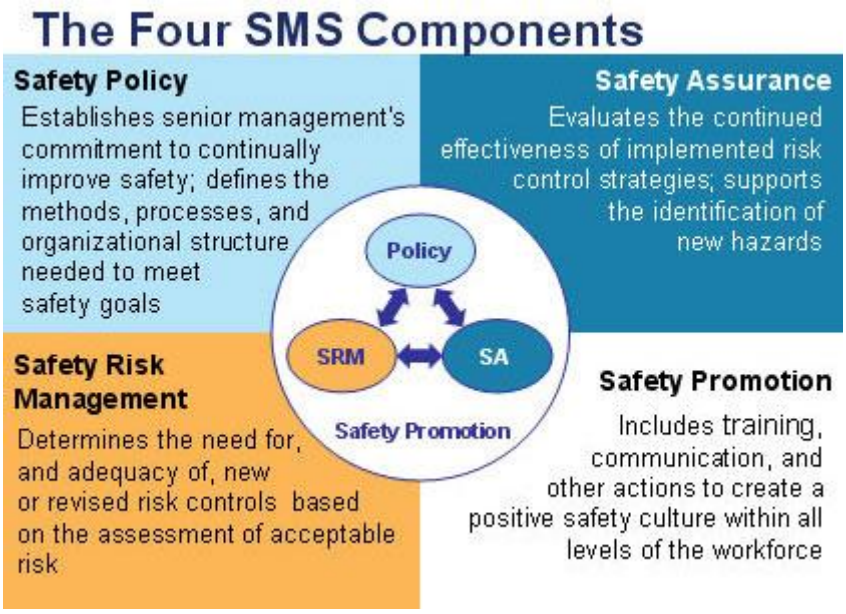


Figure 6, FAA; the four main SMS components (FAA, 2016b)

The interaction of policy, Safety Risk Management and Safety Assurance leads to safety promotion and a safety culture in that organization, all four components are tightly interlaced. The model can be applied at all organizational levels; EU directives/regulations lead to EASA EASp, CAA SSP/SMS and the operators SMS. This is briefly described below.

EASA has lounched a program called European Aviation Safety Plan (EASp), a plan to produce an EU equivalent of the ICAO State Safety Plan, SSP, where the SMS is a vital part. The EASp goal is to promote a more efficient means of discharging the obligation and would support the EU Member and associated States in developing their own SSP's (EU, 2014).

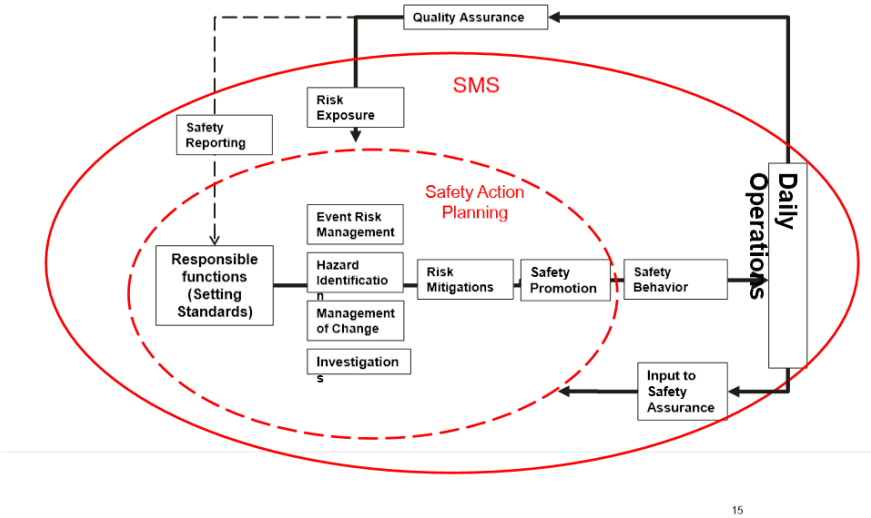


Figure 7, An operators SMS flow chart (Classroom lecture at Nord University)

The model show two main inputs to a safety management system, the safety reporting system and risk exposure evaluation process. In this paper the safety reporting will be given the most focus.

2.1.1 The difference between "Active" and "Latent" errors; -the reason for SMS

The ICAO (2013) Safety Management Manual SMM, recognize active and latent errors, where active are more obvious faults/errors conducted by for instance the crew. The reason might be complex, but often pinpointed to one error that evolved into an incident, and a potential threat to aviation safety (Dekker, 2013a).

Active errors are errors or procedural violations performed at the workplace, person and team errors or direct technical breakdown (Edkins, 1998). These errors are classically illustrated with the Swiss cheese models where the errors only have adverse effect if the holes align and the error is not caught by a "slice" of defense, the original model and the current did consider latent errors too (Reason et al., 2006):

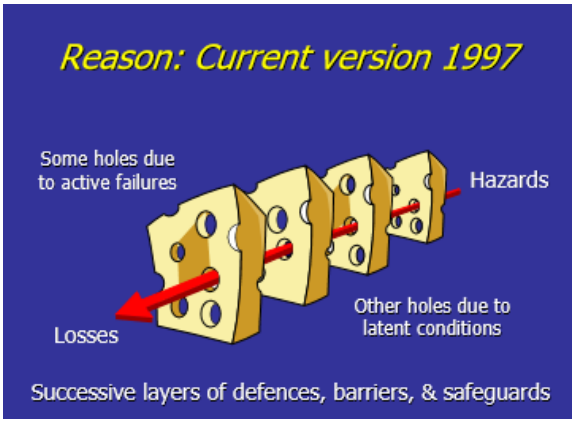


Figure 8, Reasons, current version 1997 Swiss Cheese Model (Reason et al., 2006, p. 10)

The latent errors are what the SMS and the organizational era try to address, of course together with the classic errors like technical and human factor errors etc. These latent errors are embedded in the organization, the authorities, AOC holders, manufactures, maintenance, manuals, training and procedures, crew motivation and the fear the crew might feel (towards a new contract etc.) or of course a combination of these (ICAO, 2013). The challenge increases when risk assessment involves the future and how a change will influence a complex system such as Aviation (Masson and Morier, 2012), or like Professor Dekker puts it; Aviation is considered a complex environment, and hence difficult to predict what will happen if something are changed, introduced or removed (Dekker, 2012b).

> *"Complexity is an attribute of systems or items which makes their operation difficult to comprehend. Increased system complexity is often caused by such items as sophisticated components and multiple interrelationships." (Masson and Morier, 2012, p. 19)*

Summed up; Edkins (1998) illustration of the latent error pathway/bypass as adopted from Reason (1995) may illustrate the difference in latent and active errors:

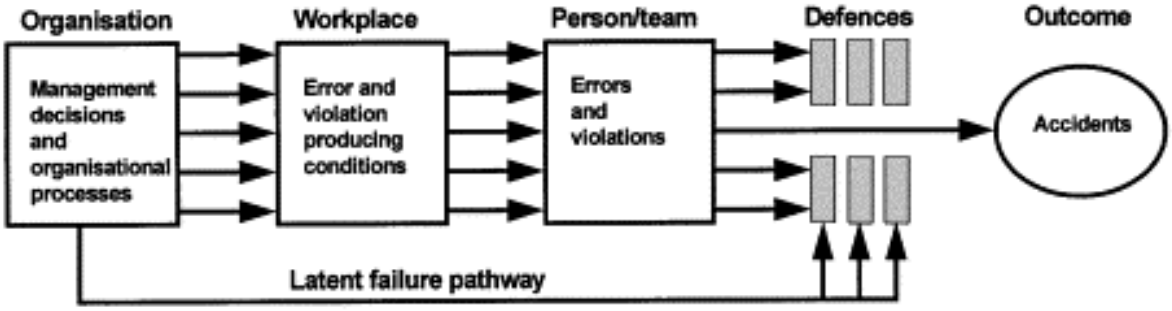


Figure 9, Latent errors bypass scenario, adopted from Reason (1995) by Edkins (1998)

2.1.2 Methods used to detect future risk, and the European SSP

Reactive and proactive methodologies are used to detect and analyze safety issues, both known and emerging issues (ICAO, 2013). The reactive consist of electronic analysis, investigations, reports and statistics. The proactive seeks actively hazardous conditions in an organization through audits, reports and methodology to predict future risks. In both the reactive and proactive system safety reports play an integrated role (FAA, 2016b).

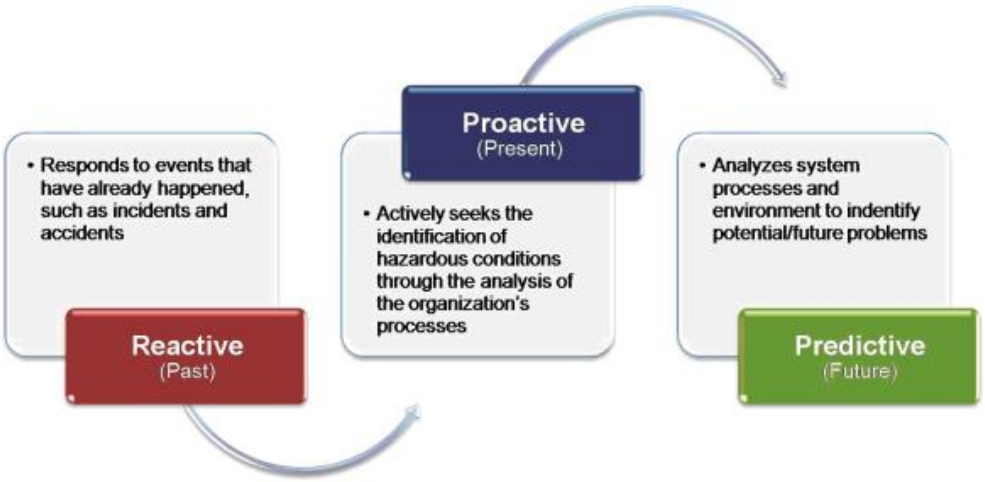


Figure 10, FAA reactive and proactive SMS processes. (FAA, 2016a)

The EU EASp initiative has the same main goals, the possibility to be proactive and to assess future risks; the SSP and SMS systems are explicit on the importance of a proactive system in addition to the reactive:

> *"(5) Experience has shown that accidents are often preceded by safety-related incidents and deficiencies revealing the existence of safety hazards. Safety information is therefore an important resource for the detection of potential safety hazards. In addition, whilst the ability to learn from an accident is crucial, purely reactive systems have been found to be of limited use in continuing to bring forward improvements…". (EU, 2014, Section 5)*

The EASp includes numerous projects, one of the notable projects is the FAST (Future Aviation Safety Team) which has put forward a methodology for assessing future risk, but it also recognizes "the learning organization".

> *"A major characteristic of a learning organisation is that it requires a pro-active, organisation-wide, integrated approach so that all of the human, organisational, industry and environmental considerations associated with future safety are managed in a wellcoordinated way." (Masson and Morier, 2012, p. 17)*
>
> *"Without an organisation-wide sharing of safety system information, the true scope of future changes, hazards, their impacts and likelihoods, and the controls and mitigations put in place to manage them may not be available for key stages of the augmented safety assessment process" (Masson and Morier, 2012, p. 17)*

SMS organizations that manage by "fear" on the other hand lack this potential for learning as Godkin et.al (2009) argues; *"arrogantly disordered organizations, however, contain cultural themes that are hostile to healthy inter-group and interpersonal conflict. One way to*

understand the prohibitions is to examine managerial assumptions and premise control" (Godkin and Allcorn, 2009, Section: "The arrogant organizational disorder").

2.1.3 Reporting a vital part of the SMS input

Reporting is considered an essential part of the SMS, both as an information channel in to the management, i.e. Safety Assurance (SA) and as a factor to change Safety Promotion or policies. The reporting system has a mandatory reporting system, and a voluntary reporting system. The mandatory system is requirements put forward by the authorities, mishaps, technical breakdown with significant operational impact, incidents and accidents and a lot more. The voluntary part is designed to get information which would otherwise not emerge to the surface, and hopefully learn from the issues before others end up in a similar situation with a less fortunate outcome (ICAO, 2013).

In the same manner as ICAO, the EU regulation "376/2014" describes and highlights the importance of reporting to retain effectiveness in the aviation safety work at all levels. The authorities (EASA), called "The Agency", the state, and the organizations are all required to establish a SSP/SMS reporting system (See citation #6 below). As mentioned, the reporting systems are in place to facilitate learning, not punishment, and to give the authorities and operators the possibility to be proactive in the aviation safety work. (EU, 2014):

> *"(6) In order to improve aviation safety, relevant civil aviation safety information should be reported, collected, stored, protected, exchanged, disseminated and analysed, and appropriate safety action should be taken on the basis of the information collected. This proactive and evidence-based approach should be implemented by the relevant aviation safety authorities of Member States, by organisations as part of their safety management system and by the Agency."(EU, 2014, Section 6)*
>
> *"(8) It is necessary to ensure that front-line aviation professionals report occurrences that pose a significant risk to aviation safety. Voluntary reporting systems should complement the mandatory reporting systems, and both should allow individuals to report details of aviation safety-related occurrences. Mandatory and voluntary reporting systems should be set up within organisations, the Agency and competent authorities of the Member States……"(EU, 2014, Section 8)*

The ICAO SMM list five basic characteristics to have an effective safety reporting system, information about the system as whole, flexibility in engagement level, willingness or

motivation for reporting issues, accountability and learning and the will to implement reforms (ICAO, 2013, p. 2-17). These are discussed in the next chapter.

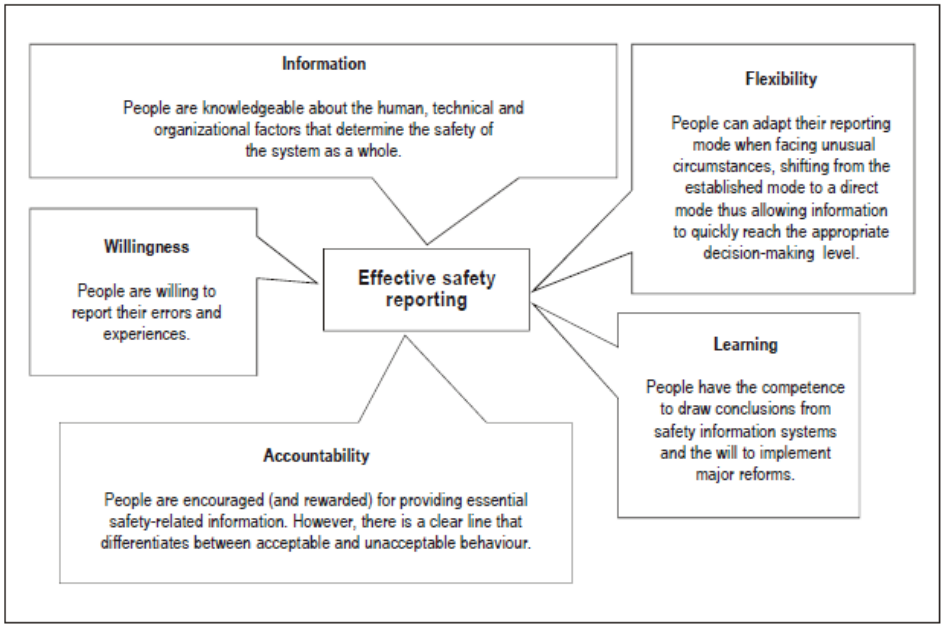


Figure 2-7. Effective safety reporting — five basic characteristics

Figure 11, Five basic characteristics of effective safety reporting (ICAO, 2013, p. 2-17)

2.2 Effective safety reporting, the five basic characteristics

The five basic characteristics are discussed below; information, flexibility, willingness, accountability and learning (FAA, 2016b). They are interrelated and this should be kept in mind when perceiving the discussion.

In addition to SMS safety reporting, this paper focuses on pilot employment models and the models influence on the effectiveness of safety reporting and learning potential. This is discussed after the description of the five basic characteristics of an effective reporting system.

Reason's words on effective reporting will serve as an introduction:

> *"Effective risk management depends crucially on establishing a reporting culture. Without a detailed analysis of mishaps, incidents, near misses, and "free lessons," we have no way of uncovering recurrent error traps or of knowing where the "edge" is until we fall over it."(Reason, 2000)*

2.2.1 Willingness and accountability in the system of "just culture"

Both the mandatory and the voluntary system have a non-punitive approach, i.e. learning not punishment is the main objective, but the ICAO SMM makes it clear, it is a dilemma:

"….Policies that distinguish wilful acts of misconduct from inadvertent errors, providing for an appropriate punitive or non-punitive response, are essential to assure the effective reporting of systemic safety deficiencies. Not only is a -absolute no blame culture unreasonable, it is not even feasible. While management gains safety information, the system will be ineffective if it interferes with appropriate punitive actions. Conversely, a culture that fails to distinguish unintentional errors/mistakes from acts of wilful misconduct will inhibit the reporting process. If personnel avoid reporting for fear of punishment, management does not gain important safety information."(ICAO, 2013, p 2-12).

The above is the essence in the "Just Culture" system, accountability and protection. This is a delicate balance between trust and accountability (Dekker, 2007). The statement also makes it clear that effectiveness cannot be retained if the organization fails to build the culture of trust, accountability and safety.

The EU regulation also promotes a "just culture" and distinguishes between willful misconduct or mishaps, and human errors.

"(20) The objective of the exchange of information on occurrences should be the prevention of aviation accidents and incidents. It should not be used to attribute blame or liability or to establish benchmarks for safety performance."(EU, 2014, Section 20)

(34) In order to ensure the confidence of employees or contracted personnel in the occurrence reporting system of the organisation, the information contained in occurrence reports should be protected appropriately and should not be used for purposes other than maintaining or improving aviation safety. The internal 'just culture' rules adopted by organisations pursuant to this Regulation should contribute in particular to the achievement of this objective. In addition, the limitation of the transmission of personal details, or of information allowing the identification of the reporter or of the other persons mentioned in occurrence reports, by a clear separation between the departments handling occurrence reports and the rest of the organisation, may be an efficient way to achieve this objective (EU, 2014, Section 34).

Even the national laws are advocating this rights and the importance of protecting a reporter or a person disclosing information in and out of investigations and so on (Samferdselsdepartementet, 2016).

This balancing act between protection of the practitioner and accountability is the key to fewer errors (Dekker, 2007). A just culture is essential, the dilemmas are mainly where and

who to draw the line between acceptable and unacceptable behavior. The expertise in the particular field has a clear role in this judgement, but how? And finally what level of protection shall we give safety data (reports/investigation data, analysis of electronical data etc.) against legal interference? These questions are not easy to answer, but Dekker argues that our tendencies to judge what seemed right at the moment to the practitioner are always judged in hindsight and from the outside in (Ibid). The "Miracle at Hudson" where the crew managed to "ditch" (the term used by pilots to land on water) an Airbus A320, may suit as an example of "Just Culture". The investigation (expertise) proved, in the simulator, it doable to return to LaGuardia Aerodrome and make a safe landing, but barely so, only when the test pilots where given all facts and instructions to start the turn immediately for a safe return they succeeded. When they were given a 35 seconds delay to grasp the fact that they had a dual engine failure, due to a flock of birds, the test pilots failed. Captain Sullenberger (practitioner) was finally freed and given credit for the miracle at Hudson River (NTSB, 2010). The fact that the investigators put them self in the shoes of Sullenberger and not only judged him in hindsight makes this a good example of just culture in the context of investigations (not portrayed so in the film "Sully"). Dekker makes it clear that the intention of a just culture is not to "free" the practitioner that fails, but to have fewer errors and learn, or in other words an improvement-oriented perspective on accountability (Dekker, 2007).

2.2.2 Motivational factors influencing work as done vs organizational commands

In this paper we will not go into a deep discussion of motivational factors, but look at some factors that affect pilot willingness towards self-reporting.

Hackman and Oldham's (1976) central work on critical psychological states on intrinsic motivation are still alive; experienced meaningfulness, responsibility for outcome and knowledge of results of the work. Another highly cited study is Deci and Ryan (1985), (2009), self-determination theory of three fundamental psychological needs: Competence, autonomy and relatedness.

Autonomy is the basic need in humans to experience self-determination, and the feeling to endorse the cause of a behavior as one's own (Deci and Ryan, 1987), and in contrast to controlling environments:

> *"When self-determined, people experience a greater sense of choice about their actions, and these actions are characterized by integration and an absence of conflict and pressure. Indeed, integration is the ultimate hallmark of autonomous regulation. By contrast, controlling events and contexts conduce toward compliance or defiance*

but not autonomy. Control, whether by external forces or by oneself, entails regulatory processes that are more rigid, involve greater pressure and tension and a more negative emotional tone, and result in learning that is more rote oriented and less integrated."(Deci and Ryan, 1987, p. 1033)

Satisfaction of competence needs, such as improving one's abilities predict performance outcomes, or with the satisfying words of competence from Deci and Ryan (1985):

"…that social-contextual events (e.g., feedback, communications, rewards) that conduce toward feelings of competence during action can enhance intrinsic motivation for that action." (Deci and Ryan, 1985, p. 70)

Not getting to emotional, relatedness, the human need to be valued, respected and seen or desired plays a clear role in intrinsic motivation (Cerasoli et al., 2016) even though Deci and Ryan (1985) played down the role originally but in their paper of 2000 they argued relatedness to be a need for meaningful relationship with others.

To sum up basic needs the extraction from Autrey (2015) serves as an example. Procedures are fine, but what matters at 3 AM when no one is watching is: -What's in it for me? (Autrey, 2015, Loc. 1027-1039)

Hollnagel (2014) makes a clear distinction between what the blunt-end (management) believe is done, "*work as imagined*" and what the sharp-end (pilots) really do, "*work as done*". This is also a motivational factor towards reporting willingness, because when the sharp-end adopts their own procedures to get the work done self-reporting could turn into culpability and disciplinary action. Again possible negative consequences might be outweighed by "what's in it for me?" -Even when the learning potential in the organization is high.

Pilots face a rigid system of regulations and procedures, and it might seem hard to image a large degree of autonomy, nevertheless it is two basic ways to pilot compliance. The procedural way and the framework approach. The latter give the pilot autonomy to operate within a framework and adopt their work based on knowledge and experience in addition to basic procedures. This is typically seen in legacy carriers. This will probably give a higher level of perceived competence than just strict procedural compliance. If we believe Hackman and Oldham or Deci and Ryan (2009), (1985, 1987) the responsible outcome of the work will probably give a higher degree of satisfaction or meaningfulness and a feeling of accountability towards the outcome.

Other factors have also been shown to be important towards self-reporting willingness, reporting system ease of use is one such factor. A study conducted among healthcare

professionals showed that the perceived usefulness, ease of use, subjective norm, and trust had a significant effect on the reporter willingness to use the system. Further findings were that management support had a direct effect on the mentioned issues, and that subjective norm had the most influence on trust. (Wu et al., 2008)

2.2.3 Information, flexibility and Learning

FAA (2016b) states that the understanding of the whole, the knowledge of the interactions and system wide implications are understood by all parties in a safety system. The flow of information, both inputs and outputs in the safety system need knowledgeable persons that are capable to extract the information and draw conclusions and learn.

Flexibility in reporting modes are essential to have an effective safety reporting system. The flexibility should be understood as mode shift, i.e. bypass reporting levels in the organization when it matters do reach the decision level quickly (FAA, 2016b).

The information flow and understanding, the flexibility of reporting modes and learning ability in the organization is tightly connected, that is through the goal of collective and individual learning. Some of the literature on the matter is highlighted below.

Collective learning is a complicated matter in a system or organization, understanding latent and active errors in an organization is one aspect as Reason (1990), (1995) argues, others like Abrahamsson et al. (2010) claims the importance of a system wide framework for analyzing emergency response, and Hollnagel (2014) puts it as the underlying reasons for an incident are not easy to detect, hence not easy to learn from. Numerous articles describe the system wide problems involved with identifying, analyzing safety risks, collecting and providing information and learning from it all (Abrahamsson et al., 2010, Sklet, 2004, Kontogiannis et al., 2000, Catino, 2008). Maslen and Hayes (2015) sum it up this way: *"…the burgeoning of research on incident reporting has captured how these systems are limited both by the information they capture and their management (Maslen and Hayes, 2015, p.2).*

Deverell (2009) concludes, very simplified, that either we have single-loop learning, i.e. learning from a single cause, or double-loop learning, i.e. not only individual learning, but underlying causes as well, and both are equally important to understand. Further the learning potential is embedded 'in' the sharp-end and it is often managed within the individual and not brought to the surface as organizational learning (Lam, 1997, Lam, 2000).

Hale and Borys (2013) concludes *"The quality management and auditing industry favour written procedures for these reasons of transparency, and hence create major incentives for companies to write weighty procedure manuals, but tend then to be blind to the gap with*

reality which a paperwork-based system audit does not pick up". The reasons Hale and Borys (2013) are referring is the difference between their two models, one model *"transparent and explicit"* the other as *"tacit knowledge and emerging set of routines"* (Ibid, 3. Conclusion) or as Hollnagel puts it *"work-as-imagined and work-as-done"*(Hollnagel, 2014, Loc 635 "Kindle version"). Pilots work are deeply regulated and procedures are the routine of the day (Hales "explicit model"), but nevertheless some of the greatest "saves" from a catastrophic outcome has required the crew to fall back to "tacit knowledge" (ATSB, 2013, p. 33-38, NTSB, 2010). This duality in some professions are also recognized by Hale and Borys (2013); *"The 'participating and supporting' and particularly the 'delegating and observing' leadership styles are suitable for a workforce with high competence and variable or high commitment, such as pilots, surgeons…"(Hale and Borys, 2013, 3. Conclusion).*

Learning from incidents and investigation reports are important, but we also have to learn from experience of more subtle character, or put differently; *"…learning from weak signals"* (Drupsteen and Wybo, 2015, p. 30). Brizon and Wybo (2009) clarifies the barriers we have to overcome to learn from experience; detection, interpretation, transmission and priority settings, in that order. Further they claim that the motivation and trust, both of the sender and the receiver, are essential for this communication to occur. If the sender has enough knowledge to detect and interpret the weak signals, but have no trust or support in the organization, it will not be emitted. Flip the coin and the receiver will not use the information if the sender is not trusted. ICAO (2013) SMM supports an anonymous voluntary reporting system to make the barriers easier to overcome for the sender.

To recap, one of the reasons why SMS was implemented is the framework to address the difficulties described above.

2.3 SMS, Errors, Reporting, Just Culture and organizational links to aviation safety summed up

The Safety Management System has been put forward to facilitate learning and hence have a proactive function in the aviation safety work. The safety culture is essential to promote reporting of errors and detect latent errors in the organization. The "just culture", non-punitive but not free from accountability system, are vital in this respect. Without learning potential and or non-detected errors and mishaps the organization has no means of being proactive in the safety work, and as a consequence the authorities will also be left with reactive safety promotion. The key element in a safety culture is that it promotes learning for the good of aviation safety in the future.

Hypothesis 1: *The SMS system need to have the characters of mutual "just culture", openness, trust and support to receive reports, in addition the systems need channels and flexibility to promote the information to the sharp-end in a trustworthy manner. If any of these factors are violated from the management the pilots will not self-report and the safety management system will lose effectiveness.*

2.4 Pilot employment models in European Aviation

Historically pilots have been directly employed by the national carriers (AKA network or legacy carriers). This was typically an open-ended contract, a stable and predictable employment model, further a rigid seniority system among pilots, giving rights such as commander upgrade, salary, vacation, aircraft type ratings etc., and made the pilots loyal to the company, i.e. it was little incentives to start at the bottom in another company.
A couple of decades ago aviation liberalization started and open skies (SES) and EU regulations on free flow of workforce, made it easy to employ pilots in atypical models, the LCC understood this to the full and numerous employment models have emerged. Today both legacy carriers and LCC use atypical models to some extent (Jorens et al., 2015).
In 2015Ghent University produced a large report on atypical employment in aviation. The 290 pages describes the employment models among European pilots and the legislation, or myriad of legislations, surrounding the employment models (Jorens et al., 2015). This paper will only explain the various employment models Jorens et al. (2015) identified and not look at the legislation, but only highlight how hard it is to overview this:

> *"Employment conditions…. Not only do discrepancies exist in this regard between national large airlines and national LCCs, additional discrepancies are furthermore observed between national LCCs vis-à-vis foreign LCCs with operating bases in the respective Member States*" (Jorens et al., 2015, p. 57)

2.4.1 Atypical employment models in aviation

To describe a "typical" employment model you only need an employer and employees, with open-ended or fixed term contracts between them, but when it comes to "atypical" models there are plentiful employment versions (Jorens et al., 2015).

Atypical employment (extracted from Ibid).

- *Self-Employed.* The basic form of non-traditional employment is the pilot self-employed model; both this and the traditional fixed-term have a limited time frame and a direct contract with the end user (airline) of the labor. Typically 6 months

contracts, may be renegotiated if the employer warrants, but salary, home base etc. is up for discussion at renewal. The legislation is however not clear as the self-employed is resident in one country, getting salary paid in another country and the firm is registered in a third country. The different EU countries have different legislation in different member states.

- *Fixed-term work via (temporary) work agencies.* Introducing a work agency or maybe a temporary work agency complicates the picture further, a fourth country legislation is one problem, but more important to the pilot is the breakup of the direct connection to the AOC holder. Illustration of this in a bogus self-employment model with three parties:

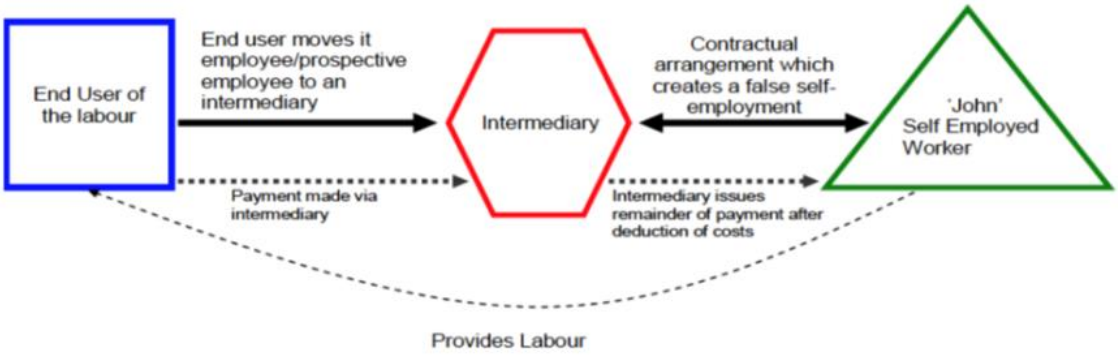


Figure 12, Bogus self-employment via intermediary agencies model (Jorens et al., 2015, p. 40)

- *Bogus self-employment.* Introducing a fourth party, and possible a fifth legislation, has become common, that is additional breakup of the work agency where the "employee" only deliver the labor service to the work agency, which formally deliver service to the AOC holder, and all other contracts as salary etc. go through an intermediate agency. An illustration is appropriate:

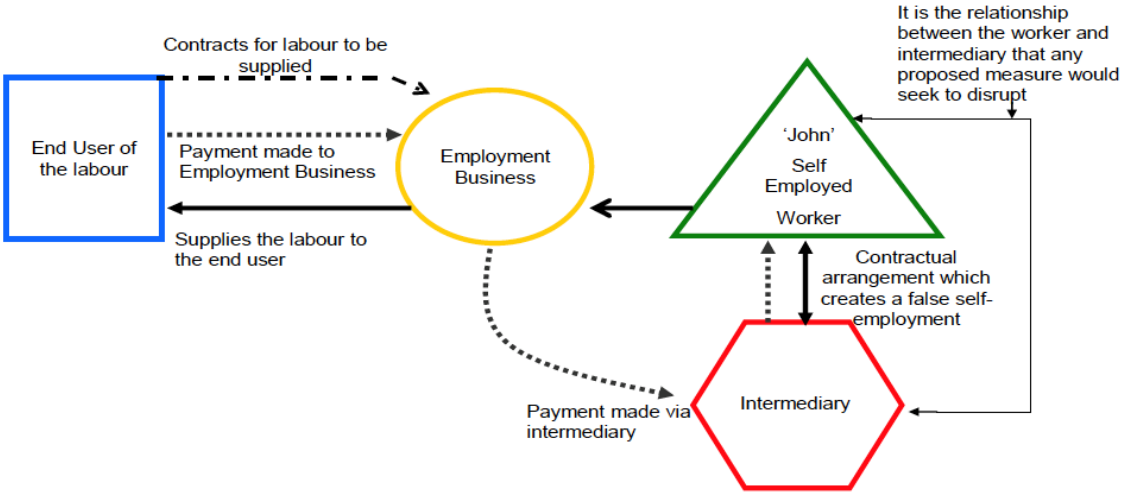


Figure 13, Atypical employment; complex employment relationships (Jorens et al., 2015, p. 38)

- *Zero-hour contracts.* To complicate the matter there are other aspects too. A zero-hour contract implies you are called in to perform one flight, if this is supplied through a system of "bogus self-employment" through a temporary work agency etc. the employee rights are quite scarce.
- *Pay to Fly (PtF).* These contracts make the employee pay for the right to accumulate a number of flying hours. Typically a contract guarantees a number of flying hours. (Flying hours is crucial to get a new and possibly better contract). In such contract the employee doesn't get paid, but pay the airline for the right to fly.

(Jorens et al., 2015)

An airline, that is the mother company, may have several Airline Operating Certificates and in ***each*** of these we could have a service provider structure like this:

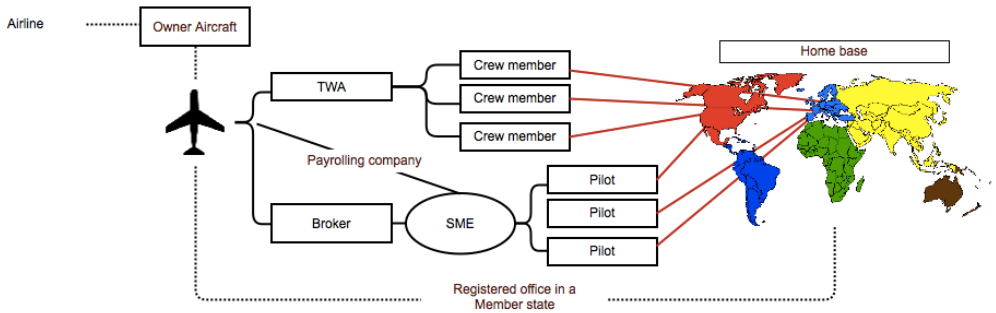


Figure 14, AOC holder and flight crew structures (Jorens et al., 2015, p. 208)

A pilot facing this setup would probably have difficulties grasping what legislation governs his employment. This citation might suit to illustrate the difficulties an employee face:

> *"An airline registered in European **country A** might hire a worker from **country B** and base this worker in **country C**. The worker in question might be hired via a (temporary work) agency under a 'contract for services' as a self-employed person in order to reduce labour costs (e.g. social insurance payments) and in order to shift business risks from the airline onto the worker." (Jorens et al., 2015, p. 38)*

The grouping used in the result and discussion part of this paper is typical or atypical employment contracts. Jorens et al. (2015) found that younger and/or less experienced pilots hold atypical contract to a greater extent than older and/or more experienced pilots.

2.4.2 Safety reporting, employment models and fear of retaliations

EU regulation no 376/2014 recognize the possibility that fear of self-incrimination is a possibility:

> *"(43) Individuals may be discouraged from reporting occurrences by the fear of self-incrimination and the potential consequences in terms of prosecution before judicial authorities."(EU, 2014)*

An independent review on Network Rail found under-reporting of accidents (lost-time injuries) from staff and middle management to be driven by real and perceived pressure and fear (RSSB, 2011). Two of the more noticeable, to aviation, factors listed was *"frequent company reorganizations"* and *"the procurement strategy used to drive down costs and improve efficiency leading, for example, to the primary contractor companies making much greater use of temporary („zero-hours") type contract staff."* (RSSB, 2011, p.5) The parallel to aviation must be considered when employees are "transferred" from direct employment to some sort of atypical work agency/SME model.

> *"Atypical… Additionally, as a result of abuse with respect thereto, which potentially amounts to social dumping vis-à-vis flight and cabin crew members, such atypical relations furthermore endanger not only the health and safety of those employed, but equally so the safety of air operations. This is in stark contradiction to the European legislative provisions in this regard" (Jorens et al., 2015, p.40)*

The lack of studies among pilots and the link between employment models, fear of negative consequences, and safety reporting create some difficulties, but the large survey (6633 European pilots responding, (Jorens et al., 2015)) gives a clue to the current state of the affairs.

Jorens et al. (2015) found pilots decision-making process towards "*objections regarding flight safety, liability, or regarding health & safety*" (Ibid, p 144) to be influenced by employment

models, 37 % stated that their own employment status influenced the decision-making process, and 46 % meant their colleagues employment status may affect their ability to make decisions. The differences between Low Fare Airlines and traditional airlines are further described like this:

> *"..... 20% of the respondents stating to be self-employed strongly disagreed with the statement ..... Of these 20%, 83% indicated that they fly for an LFA. Furthermore, another 26.6% 'generally' disagrees with said statement, of which 90% (!) indicated they fly for an LFA. In 85.2% of the cases, the respondents stated this is decided by the registered office of the airline.*
>
> *When asked if they were sometimes reluctant to take such decisions out of fear of possible negative consequences for their professional careers, 64.3% of respondents answered in the affirmative!*
>
> *When asked if they think colleagues are sometimes reluctant to take such decisions for fear of possible negative consequences for their professional career, even more respondents, i.e. 79.7%, answered affirmatively!" (Jorens et al., 2015, p. 217)*

The above citation will serve as an indication of fear as a motivational factor for not self-reporting issues, and an indication that fear of retaliations, contract termination, decision making etc. is widespread in European aviation.

2.4.3 Pilot employment models & fear of self-reporting summed up

Hypothesis 2 below tries to sum up typical, atypical employment models, fear of retaliations and safety pitfalls due social dumping issues.

Hypothesis 2: *Differences within contract types, age groups, experience level, position and roles and the type of company will show differences towards self-reporting willingness, perceived safety support, fatigue issues and just culture, and hence indicate differences towards the possibility to retain SMS effectiveness.*

3 Methodology

3.1 Choosing the method

3.1.1 Structural background information

The structure of this paper is based on the findings in the London School of Economics (LSE) pilot safety culture survey conducted in 2016 (Reader et al., 2016) and the Ghent survey of 2015 on atypical employment models in European aviation (Jorens et al., 2015).

The LSE survey is a undertaking of Future Sky Safety, which in turn is an EU-funded transport research program in the field of European aviation safety (Reader et al., 2016) and the Ghent report is an action financed by the European Commission (Jorens et al., 2015) .

Both studies based their reports on quantitative data collected among European pilots, 7239 (14% of population) and 6633 respectively (Reader et al., 2016, Jorens et al., 2015).

This study has four key elements, reporting, just culture, support from management and fatigue; this is further divided into differences between pilots groups (age, experience, employment contract, previous contract, company type and management role as the primary divisions). The four key elements are derived from some of the most notable findings in the LSE survey (mean scores differences in the spider diagram below).

> *"... over half of the sample of pilots (50.05%) felt that fatigue was not taken seriously within their organisation (while 28.83% neither agreed nor disagreed) and less than 20% agreed that their company cares about their well-being".*
>
> *(Reader et al., 2016, p 6)*

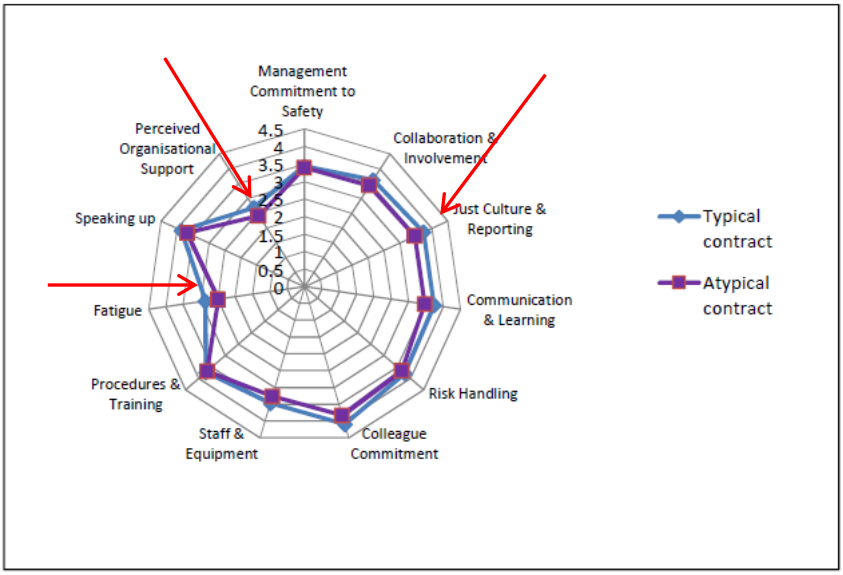


Figure 15 LSE: Means all safety dimensions by Contract type (Reader et al., 2016, p. 24)

The LSE survey found the mean values for "fatigue" (2.82) and «perceived organizational support" (2.65) to be below what is considered concerning (Ibid). In addition it is possible to read out some differences to the interwoven items of "just culture" and "reporting" between typical and atypical employment models.

To get a better understanding of the key findings in the LSE and Ghent reports among Nordic pilots, i.e. pilots flying for major Nordic operators through typical and atypical employment models, this paper also base its results on quantitative data. The reason is mainly to be in line with the other studies and to have a comparison possibility (validate findings) due to equal demographic categorization.

Further the move from one clearly defined system to a more differed system of employment models (E. M. Giemulla, 2011) and the applicability in Nordic countries, which have traditionally had a strong management and union cooperation and strict legislation in this field, is of great interest, i.e. do employment models restrict/influence this openness.

Based on the theoretical discussion it is reason to believe that the efficiency of the Safety Management System is greatly dependent on the key elements in this study, i.e. reporting, just culture, safety support and fatigue (FAA, 2016b).

3.1.2 Qualitative and Quantitative measurement, -extensive/intensive methods

When designing a study we soon run in to a clear distinction between quantitative and qualitative methods (Johannessen et al., 2004, p. 35). While the qualitative method "*do not attempt to quantify their results through statistical summary"*(Marczyk et al., 2005, Loc. 232 of 3236, ebook), the quantitative approach, on the other hand, makes *"use of statistical analyses to obtain their findings" (Ibid, Loc. 232).* Qualitative methods typically use observations and interviews in gathering data, and is often used first to later use a quantitative approach to prove a hypothesis (Ibid).

While an interview is characterized by in depth intensive questions on an idiographic level, a questionnaire is characterized by extensive group study, i.e. nomothetic (Ibid), and the goal is to identify the views "*of the average member of the group being studied" (Ibid, Loc. 236).*

Typically the social science relies on a quantitative method (Ibid).

3.1.3 Snowball sampling

The Ghent University used a quantitative snowball sampling method (Jorens et al., 2015, p. 8) which LSE adopted in their survey method (Reader et al., 2016, p. 41). Snowball sampling is a technique for finding hard to reach subjects. One subject leads to another and the snowball

grows as it rolls, *"this is an especially useful technique when the researcher wants to contact people with unusual experiences or characteristics who are likely to know one another"* (Vogt and Johnson, 2011, p. 368).This technique is often used to reach hidden populations (Morgan, 2008, p.816), such as atypically employed pilots (Jorens et al., 2015) .

Advantages of Snowball Sampling

- *The chain referral process allows the researcher to reach populations that are difficult to sample when using other sampling methods.*
- *The process is cheap, simple and cost-efficient.*
- *This sampling technique needs little planning and fewer workforce compared to other sampling techniques.*

Disadvantages of Snowball Sampling

- *The researcher has little control over the sampling method….*
- *Representativeness of the sample is not guaranteed….*
- *Sampling bias is also a fear of researchers when using this sampling technique. Initial subjects tend to nominate people that they know well….*

(NN, 2017)

3.1.4 The method chosen; -Descriptive Extensive Snowball sampling

This paper uses a descriptive approach where the study categorize phenomena or views on safety support, reporting, fatigue and the cross reference category of just culture, this may lead to an understanding in views regarding the member of the average group (Marczyk et al., 2005).

By using an electronic questionnaire we will reach a large population, where we have a broad gathering of views, or in other words an extensive approach.

The quantitative method is based upon an inductive method where the empirical findings will back the theoretical background (Johannessen et al., 2004, p. 55).

3.2 Methodological framework & Designing the research

3.2.1 A cross-sectional electronic design and analysis

The research question may be understood as a phenomenological question and a phenomenological research approach (Johannessen et al., 2004, p.86) could have been used on a smaller population, but both the Ghent and the LSE surveys use a large cross-sectional design. Choosing a similar approach makes it possible to compare and possibly validate the

results. Validity of such an approach is further discussed in the "Quality and validity & Selection" of informants chapter below.

The population (also discussed in "Quality and validity & Selection of informants") is a subset of the two other surveys, but still quite large (N=339). The subset consists of pilots flying for Nordic operators, directly or indirectly through third parties, and divided into two main groups; those with an unlimited permanent (typical) employment and those with atypical employment contracts. The relative large population is suited for an electronical questionnaire.

An electronic survey has these characteristics:

- Relatively easy to get a large number of respondents in a small time frame.
- Reduce the possibilities of interpretation and influencing answers from respondents.
- The standardization of pre-coded questions and answers makes it possible to evaluate category differences and equivalences.
- Statistical analysis is easy to make and to illustrate in graphs and/or tables.

(Johannessen et al., 2004, p. 277)

The questionnaire, survey and analysis, where managed through the "Questback" survey platform (Questback, 2017). (The electronic survey was available between January 23th and February 28th 2017. Reminders where sent from some of the below listed unions in section 3.4.2).

3.2.2 Survey structure, the big picture

The survey can be broken down in these main parts. (Described in the "Data collection,…" chapter and the individual questions in clusters are found in the "Result" part):

1. Respondents demographics, i.e. base country, nationality, age, company (AOC), type of company, contract type, years at current employer, part-time, title, management role, income, block hours, aircraft type, and if less than 5 years at current employer then the survey ask for contract type at previous employer.

   The demographic variables are equal to the LSE survey (Reader et al., 2016, p. 39) , except for income and contract type at previous employer, and the wording has been slightly altered to suit the pilot language when it comes to flying experience. To reduce the number and suit the research question some of the LSE demographics questions were skipped. The LSE survey have a similar but not equal to the demographic layout of the Ghent study (Jorens et al., 2015, p. 91-138)

Copying most of the described demographic layout will make it possible to make comparisons in this and future studies, i.e. validate possible findings in the future.

2. Company demographics: The research questions focuses on one of the pillars in the Safety Management System; General reporting, information (support and safety promotion) and reporting / handling of fatigue issues. Hence additional company demographics focus mainly on reporting structures, i.e. implementation of SMS, reporting systems (voluntary, mandatory, confidential), pilot agreements, CAA reporting system, and the characteristics (proactive/reactive). These questions are unique to this survey.
3. Questions focusing on perceived safety support, reporting, just culture and fatigue relative to the research question. In addition there are some questions dependent on previous answers.

The total number of questions is quite large (54), but not all questions are asked all participants, the logic ask different questions depending on previous answers, such as contract type, number of years on current contract etc. All questions except two have pre-coded answers, but some have the possibility to give an "other" statement. For instance there is no category for retired pilots, but their answers might still be valid and categorized within the "other" group. The two open ended questions at the end of the questionnaire gives the participants the possibility to disclose other issues.

3.3 Challenges, limitations & mitigations

The pilots on atypical contracts are extremely hard to reach because many lack union membership (Jorens et al., 2015) and are self-employed, because of this the survey was forwarded to OSM (OSM, 2017) one of the largest providers of contract pilots to the Nordic marked, but no answer was received nor was it registered links etc. on their web-page, see Appendices: "Mail to OSM".

However, some of the pilots reached from the unions have friends and colleagues, whom fly on atypical contracts outside the Nordic countries, but still for Nordic operators, the survey therefore asked the respondents to forward a link to these pilot colleagues. The uncertainties in total number reached makes it difficult to put an exact number on the total population, further the population varies from season to season, some operators terminate contracts during winter months and hire or lease pilots during summer season.

Only one union provided their number of members, despite reminders to do so.

The survey was further limited to only the major issues disclosed in the LSE survey, there are a lot of aspects of interest, but all of these lay outside the scope of this paper; -do employment models reduce/enhance the effectiveness of the Safety Management System. Many of the questions are equal to the LSE survey, i.e. pilot demographics and a couple of questions in each section, however company demographics, such as SMS and reporting systems are unique to this survey and so are most of the other questions on each of the subjects of management safety support, just culture, reporting and fatigue.

Other challenges are, of course, my lack of experience in the field of scientific research and my experience as a professional pilot on an unlimited permanent contract for 27 years.

The first challenge has been mitigated by advises from my institution, University Nord, in analyzing, and in checking questions before release. The questionnaire were also tested by other pilots and once again changed based on the feedback before release. The assistance from Ph.D. Tom Reader at LSE in releasing the questions, not their data, before finalizing their own report was of great help. This resulted in a more pinpointed questionnaire in line with the research question.

The second challenge was a two edged sword, first I might be biased because of my long experience in aviation, and on the other side I have seen the evolution in aviation employment, safety work and not leased seen the pendulum swing when it comes to focus/happiness/frustration among old and new pilots for nearly three decades. To enhance an objective picture I have used the LSE survey as a basis for my survey, electronic gathering without the possibility to interfere respondents, and to mitigate my bias towards some sort of employment model I have used equal and neutral questions when it comes to questions where I use a logical criteria to provide different questions based on previous answers, for instance "if you had a *permanent contract* would you...." versus "if you had a *temporary contract* would you….". This second challenge is further discussed in the ethics chapter (3.7) and in the validity of the questionnaire and survey as a whole is discussed in the next chapters.

3.4 Quality and validity & Selection of informants

3.4.1 External and internal validity & generalization; -the survey in general

Most researchers agree that the three general goals of scientific research are description, prediction, and understanding/explanation (Marczyk et al., 2005, Loc 223).

The LSE survey describes relationships between categories of pilots (based on employment models) (Reader et al., 2016) and "trust/mistrust" towards basic pillars of the safety management system as theorized above. Especially the subjects of safety support, fatigue and just culture are pointed out as noteworthy. The validity of the LSE survey are greatly based on Eurocontrol long lasting studies into this subjects, but slightly altered to suit pilots and not only air traffic controllers (Ibid). The Eurocontrol surveys *"that has been psychometrically validated in the European Air Traffic Management industry"* and used extensively on air traffic controllers and in the LSE pilot safety survey (Reader et al., 2016, p. 15). This internal validation is extrapolated to this paper.

External validity of this paper and the LSE findings may be done by generalization or replication (Marczyk et al., 2005). This paper tries to replicate or describe such relationships between the focus eras and the subset of pilots, those who fly for Nordic operators, and hence validate or discard the findings. Such findings will make an external validation of the LSE survey and vice versa. The external generalization may be limited due to cultural differences, even within Europe, and Tear et al. (2016) found this to be a valid consideration. The principles found in the mentioned study have not been extended to this paper and not done by the LSE survey either. The Scandinavian (Nordic) work environment is characterized by openness, flat hierarchy and the willingness to speak up is high, hence the pilot views in this survey might not be representative for other groups, such as eastern or southern European pilot groups (Tear et al., 2016). Limitations due to cultural differences, and external generalization limitations outside the Nordic pilot group, should be held in mind when reading this survey:

> *"As organizations become increasingly multi-national, internal policies and actions the organization makes must take into account national culture, specifically with a focus on power distance. We show that power distance affects the safety perceptions of some occupations within an organization but not others. We also show that power distance can lead to greater differences in safety culture perceptions between superiors and subordinates". (Ibid, p. 1626)*

Generalizing on the subject may further be done with similar studies among different subset, or replicated in its entirety, but if the compasses, of this paper and the LSE survey, align, the general reliability indicates an increased confidence in the findings (Marczyk et al., 2005). The value of replication cannot be overstated, and is a strong indication of reliability (generalization) and we may have greater confidence in the results (Ibid, location 213).

Generality outside of those studied *cannot* be done directly (Johannessen et al., 2004, Marczyk et al., 2005), but the similarities in structure of safety management in different branches make this an interesting question, i.e. safety culture across branches. Even with this limitation of generalization in mind I would like to point out the possible generality to healthcare (Kohn et al., 2000, Hollnagel, 2014, Gordon et al., 2012, Deilkås, 2014, Frøyshov, 2016, Helsetilsynet, 2016) and other branches such as off-shore (Petroleumstilsynet, 2016), HMS (Dekker, 2013b, Dekker, 2014, Dekker, 2012b, Dekker and Woods, 2010, Townsend, 2013) and the nuclear industry(Autrey, 2015, Hayes and Maslen, 2015, Hollnagel, 2014), to mention some. Politically, large unions (Parat, 2016, LO, 2015) media and politicians, are focusing on temporary work force regulations and the impact on safety issues. A quick search on the Norwegian term "midlertidig ansatte" (temporary employed) in Norwegian newspaper articles, January 1st 2016 to December 31st 2016, revealed 452 articles on this search term alone (ATEKST, 2017). The large number of books, "political focus" and articles emphasize this possible external generalization.

The internal validity in this paper, i.e. make it implausible to make alternative conclusions or findings, is harder to prove, but it may seem hard to argue against findings such as mistrust towards the safety management system among the users, the experts or if you like "the sharp end" (Hollnagel, 2014, Dekker, 2007, Autrey, 2015); here the pilots. Both the Ghent and LSE surveys discovered differences between typical and atypical employed groups, but both surveys suffered from quite low response rate, 12-14% of the total European pilot population (Jorens et al., 2015, Reader et al., 2016), and only a fraction of this group where atypically employed (Ibid). This survey predicts similar problems. To mitigate this, the group of typically employed pilots has been divided into two groups, -one group with less than 5 years of employment, and another with 5 or more years. The first group is asked additional questions about their previous contract (atypical and typical) and this makes it possible to emphasize the views from the atypically employed pilots.

The internal validation towards the research question is further discussed below, first some words on the selection and collection of informants.

3.4.2 Selection and collection method of informants

To reach most of the pilots operating for Nordic airlines/operators, the survey was distributed through pilot unions in the Nordic countries. Most are umbrella organizations with members/sections from numerous companies. Some of the "sub-unions" did not participate,

hence the total number of members in the listed organizations do not reflect the population reached in the survey.

- Norway: LO and Parat who are mother organizations for different unions in Norwegian aviation. Both typically and atypically employed members, but the vast majority is typically employed.
- Sweden: SPF a mother organization for different unions in Sweden. Mainly typical employed pilots, but atypically members too.
- Denmark:
  DPF: Mainly typically employed pilots.
  DALPA: No response.
- FPA, Finnish mother organization for different Finnish pilot unions, reluctant at first, distributed the survey only the last few days of the survey response window.

In an effort to reach more atypically employed pilots a request to participate where sent to the Spanish and British umbrella associations. These associations organize a large number of the atypically employed pilots flying for Nordic operators, even though the AOC is registered elsewhere (mainly Ireland).

- BALPA: British Air Line Pilot Association, number of sub-divisions flying for Nordic operators. No known response.
- SEPLA: Spanish airline pilot association. Organize several pilot groups flying for Nordic operators. No known response.

None of the above organizations provided the number of members, except one LO member union.

All participating respondents were urged to forward the survey to atypically employed pilots in their network.

Another challenge is the quite large number of surveys among European pilots in recent years, which increase the possibility of a relatively small participation rate. To front this challenge a pledge to remind their members to participate was sent to the above organizations.

3.4.3 Validity pilot population and subsets:

Validity refers to what degree the research reflects the research question (Marczyk et al., 2005), and in this case the research question refer to differences between pilot employment models when it comes to the pillars of the SMS. The categorization used, typically and atypically employment, is directly derived from the Ghent study (Jorens et al., 2015) and further used, among other divisions, in the LSE study (Reader et al., 2016). Both the fact that

my categorization of pilots refers the research question and its use by other large studies, hence validated by them, makes this categorization valid and accurate when referring to my research problem.

The reliability, i.e. the consistency of the measurement (Marczyk et al., 2005) when it comes to the pilot categorization, the quality may be assured in an equal way. The use of pre-coded answers in categorization enhance this consistency, but some historical facts may negatively influence this measurement; -It looks like the Ghent study have triggered temporary work agencies to use "permanent contract" in advertising pilot jobs, even when the jobs actually fall into the category of "fixed term employment", i.e. same as permanent in most aspects but time limited, and/or "through a work agency". This may bias the respondents to choose "permanent employment contract" and reduce the consistency of this measurement (see recommendations).

The Ghent survey found the European Cockpit Association (ECA, 2016) respondents to be most reliable (Jorens et al., 2015, p. 9). This paper uses a similar population, a subset of ECA member associations. The reliability will further increase with a higher number of respondents, outliers and its effect on statistical regression may then be minimized.

The EASA (EASA, 2015) statistics show an excellent record when it comes to fatalities in aviation, especially the fall in such accidents during the period 1960-1990 and thereafter on an extremely low rate of approximately $1{:}10^{-7}$. The "young" generation, whom has "grown up" with this excellent statistics and rhetoric from the authorities, might be biased to take this for granted and older pilots may be biased to think everything was better in the old days, pre-new-employment models. Dekker (2012b), Townsend (2013)and Hollnagel (2014) argues that a successful outcome of a risky operation has nothing to do with statistics, but the work as done, every time, and the basis towards this success is the safety culture. Therefore pilots was further categorized in age, years in aviation, flying hours and company type groups, this makes it possible to look at "generation differences". The fact that older, and more experienced, pilots tend to have typical employment contracts (Jorens et al., 2015), than those with less experience makes this distinction possible. This categorization may further validate the research question.

3.4.4 Validity of concepts building the safety culture; SMS, reporting etc.:

Validation of concepts, i.e. in this study SMS, reporting, just culture, safety support and fatigue, depend on the interaction between the dependent and independent variables and their connection to the research question.

Dependent/independent variables in short:

Dependent variables are, in short, influenced by independent variables, for instance in this study the dependent variable SMS effectiveness is influenced by the willingness to self – report (Marczyk et al., 2005, Loc. 564).

Independent variables, on the other hand, are independent of the outcome being measured, i.e. the willingness to self-report, in itself, is independent of the outcome of the effectiveness in the safety management system (Ibid).

Some continuous variables where converted to categorizing variables, such as age, income, experience etc. these where grouped in intervals.

Mandatory SMS organizations, Authorities and companies, validity:

The Safety Management System, as theorized earlier, is a mandatory system for Airline Operator Certificate (AOC) holders and Civil Aviation Authorities (CAA). The guidelines are in Europe regulated by EASA and at a national level defined in the national legislation (Samferdselsdepartementet, 2016, §2-16 mm, EU, 2014, EU, 2010). The variables of SMS and Company demographics are crucial for validating the research question. The variables "SMS effectiveness", "Civil Aviation Authorities" and "company" are dependent on a large number of independent variables and grouped in the tables found in the results section. The dependent variables, SMS, CAA and Company together with the independent variables are used in multivariate analysis. The variables are directly linked to the research question hence valid in this context. The external validity across safety related branches is not clear, but the health, oil, nuclear and entrepreneur sectors are looking to the aviation sector in organizing the safety management (Townsend, 2013, Dekker, 2012a, Hollnagel et al., 2013, Autrey, 2015). Revealing concerns and pitfalls in the aviation sector is consequently of external value. Trust is a key value (Ibid) in all safety work and especially reporting willingness (EU, 2014), consequently a consistent trust/mistrust across independent variables from the reporters, i.e. the pilots, will enhance the reliability of findings towards the dependent variables mentioned.

3.4.5 Trustworthiness; Reliability of pilot groups and answers

To gain confidence in the survey and urge the respondents to answer honestly (Johannessen et al., 2004), the survey where published with an information page, at the start and end of the survey, which pointed out the following:

- Title, institution name and information about the candidate, level and objective of the research question.

- Anonymity; both the respondents and company names and connections thereof would not be revealed in the report.
- Voluntary participation.
- Timeframe of the survey.
- Estimated time to complete survey.
- Candidate contact information, phone number and e-mail address.
- Thanks for participating.
- Information about LSE survey, and
- A request to forward the survey to fellow pilots, especially those on atypical contracts.

(Ibid)

Validity and reliability of pilots, authorities and the SMS have been clarified above. The reliability of the answers is harder to evaluate, but as mentioned a large degree of trust/mistrust will be a good indication when it comes to the frustration level among pilots. The survey used a "Likert-type" scale from 1 to 5, strongly disagree, disagree, neutral, agree, strongly agree, on most questions concerning the confidence in a large number of issues. This was consistent with the LSE survey. The number of alternatives is manageable in the analysis and not to hard grasp for the respondent (Ibid).

The respondents may of course have different views on the meaning of aviation safety; -What is safety? Furthermore not all pilots may be aware of the safety management system, statistics and reporting systems available, this is relevant in the context of SMS effectiveness, i.e. if users of the implemented system are unaware of the functions, the safety information and safety feedback, the SMS probably lack effectiveness. To enhance the understanding of pilot safety views an open ended question where appended at the end of the survey. The comments give this survey a possibility to evaluate the reliability of the respondents and disclose other areas of concern.

Grouping of answers

Answers was grouped to suit the research question, not all possibilities where investigated in this paper. In other words it is the sum of the objective views within the clusters that is analyzed, not individual views or questions within these dimensions.

The questionnaire went through a pretest as described earlier (the institution and pilots where given the opportunity to forward their views and suggestions before final release) to enhance the validity and reliability. The next chapter reveals the variable fundament supporting the research question.

3.5 Data collection, grouping, variable levels

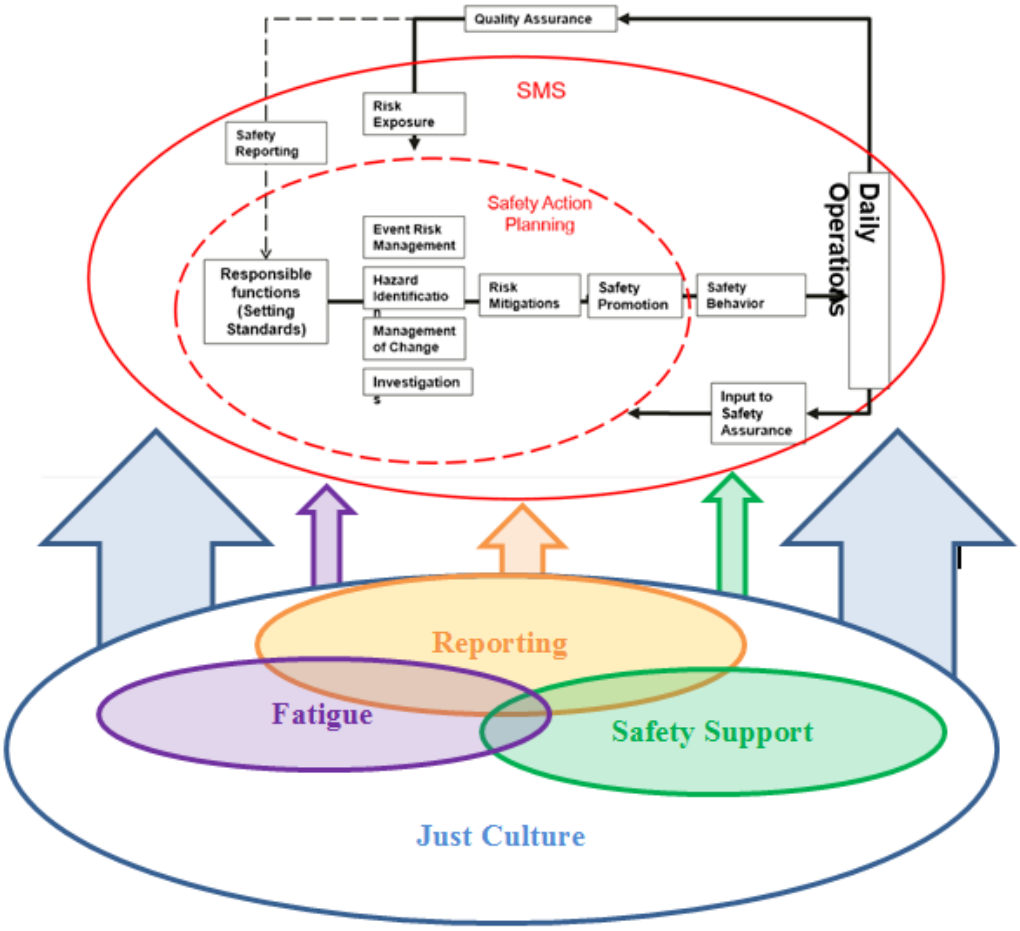


Figure 16, The grouping of questions supporting the research question

The above figure illustrates the Safety Management System and interaction between the grouping of questions and this system. “Just culture” is, as theorized above, a fundamental characteristic of an effective SMS. This basic feature supports the three other main objects studied in this paper; fatigue, reporting willingness, and perceived safety support. This grouping together with employment models builds the data collection used to evaluate the research question.

Main sections of the data collection:

- Pilot demographics.
- Reporting.
- Safety support.
- Fatigue.
- Just culture.
- Miscellaneous questions, which fit several of the above categories.

- Company SMS demographics.
- Civil Aviation Authorities (CAA) demographics.

The actual questions in each of the safety culture clusters are found in respective result chapters, and the tables have been reduced to only question used in analyzing the research question. The full list of questions and answers are found in the appendix.

3.5.1 Norwegian legislation aspects on data storage and collection

Collecting and storing sensitive information, such as personal data, may trigger concession or notification requirements in Norway. Norwegian legislation prohibits electronically storing of personal data that may identify a person. –But if the persons are anonymous, i.e. it is not directly or indirectly possible to identify persons participating in the survey, no such concession is required. (Johannessen et al., 2004, Johannessen, 2009, p.36-37)

In this survey it is not possible to identify persons directly or indirectly based on combination of answers, hence no concession or notification is needed.

EASA, CAA on the other hand may be identified, as they are official institutions, but this does not trigger approval either.

3.5.2 Data analysis, statistical methods

Data analysis process flow logic used in the analysis (additional explanation below the flow description):

1. Export data from Questback to IBM SPSS.
2. The data will be screened for errors, i.e. check inputs to be within allowable range, and if so it will be used in the analysis, else the item will be discarded.
3. Descriptive statistics will be performed on relevant data, i.e. data used in this paper.
   The categorical variables checked (frequency checking, T-Test, ANOVA):
   a. Age, Flying Hours, Job title, Years employed. (Used to group experienced and not so experienced pilots).
   b. Type of Company. (Used to group operators, Network, LCC, Helicopter etc.).
   c. Contract type, previous contract type (only if less than 5 years at current employer), Management role. (Used to group pilots).
   d. Where company names are given the company names will be substituted with numbers, this data has been removed in this report.

   All value variables except those not used will be checked (Descriptive statistics).

The open ended question (no. 53) will be extensively modified due to the sensitive character and categorized into new category variables, i.e. two new variables will categorize the highest and the second highest threat to European aviation. Those pointing to more than two safety issues, giving identifying names or non-relevant comments will be discarded after extraction of the variables mentioned above.

4. Modify data for further analysis, including reverse negatively worded questions, grouping of data and adding up group scores.

Group comparisons, demographics and analysis strategy

Numerous culture groupings are possible due to the large demographics collection. The ones focused on are: Age, Position, Management Role, Company type, Contract type and Previous Contract type. All except one, Company type, consisted of two groups after recalculation. "One-way ANOVA" will be used to analyze the Company Type group, and "Independent-Samples T-Test" analyzing the other groups.

Independent-Samples T-Test strategy:

1. Check homogeneity of variance using a Levene's test.
    a. If significant variance above .05 continue using numbers in first line assuming equal variance.
    b. If below p=.05 use numbers in second line and assume unequal variance.
2. Check if the zero hypothesis is valid (sig two-tailed)

One-Way ANOVA strategy:

1. Check homogeneity of variance using a Levene's test.
    a. If equal variance proceed with "Schaffe" post hoc comparisons.
    b. If unequal variance:
        i. Check robustness of variance using the conservative "Welch and Brown-Forsyth" test.
        ii. If ok proceed with "Games-Howell" post hoc comparisons.

The above strategies are in line with the LSE safety culture survey (Reader et al., 2016, p. 43).

Clusters used

The grouping of questions in safety culture dimensions were used for:

- Just Culture
- Reporting
- Fatigue
- Perceived Safety Support

The grouping follows LSE dimensions, but in the LSE survey the two first were grouped together.

The logic in the safety cluster grouping is illustrated below:

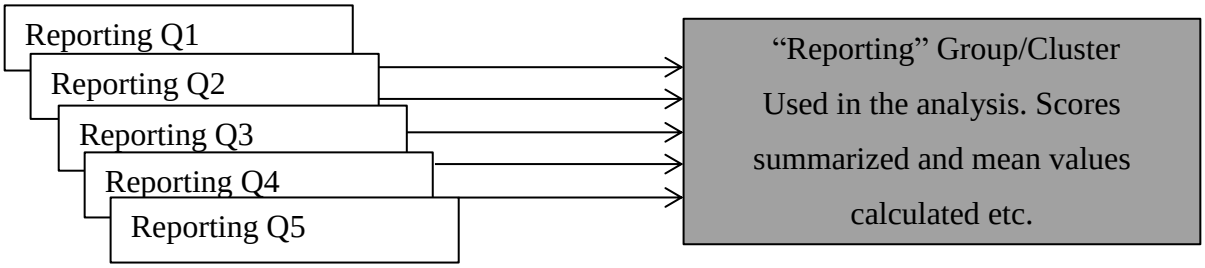


Figure 17, Grouping illustration valid for Reporting, Just Culture, Safety Support and Fatigue

For all T-Tests and ANOVA tests results this report use recommendations from Pallant (2016); Reference for the recommendations: Independent-samples t-test (Ibid, Loc. 6130) and for ANAOVA (Ibid, Loc. 6439).

General checking of data:

Pallant (2016) recommendations for checking data in SPSS will be used; frequency, descriptive statistics, scale responses within margins, means, ranges and standard deviations for all relevant items will be checked for reliability. Were possible pair-wise deletion of missing data will be used. Reversing of negative worded question was also done before conducting IBM SPSS analysis.

Effect sizes of group calculations were performed were appropriate using Cohen's d.

3.6 Other involved parties

Other involved parties than described above, i.e. pilots working for Nordic operators, are:

- European national CAA, mainly the Nordic Civil Aviation Authorities.
- European Aviation Safety Agency, EASA.

All of these organizations may be recognized and identified in the results section, question 19, 52 and 53. Only European authority organizations may be identified. The pilots and their companies on the other hand is 100 % unidentifiable.

3.7 Researchers biases & Ethical considerations

Traditionally pilots have been directly employed by their Airline (AOC Holder), given a seniority number and the career governed by this number ever after; Privileges such as choosing aircraft type, long-haul/short-haul, promotion to captain, salary advancement, pensions, vacation, rotations and so on are all according to your number on the list. Today

different employment models gives pilots the opportunity to swap employers at a larger scale, but still the best payed and safest jobs (social security systems, pensions, health insurance etc.) are found at the traditional network carriers with seniority lists, hence the real possibility to swap employer is limited (Jorens et al., 2015).

Twenty seven years of seniority in the same company, on a typical contract, gives me little choice than continue on such a contract. My comfort zone would severely be challenged if I elected, or was forced, to change this into some sort of self-employed contract through a third or fourth party work agency.

My long experience and employment contract type may bias me to look upon typical permanent contracts as better towards safe operations and safety culture building. On the other side it also puts me in a position to evaluate trends and changes in the safety work the last three decades, and last but not least, my life inside the cockpit door gives me a unique opportunity to catch what is boiling in colleagues heads and pin point areas of concern.

My position might prejudice my views on the questions raised, but if this survey prove them false, nothing would be better towards the safety work in European aviation. –And if the research questions reveal a problem this would be an encouragement for action, either politically or to motivate new surveys to enlighten us more. Anyhow this survey may put European aviation in a less flattering light, and it may be on the edge of whistle blowing, and I am aware of the consequences this might have on my career, especially if I elect to seek a new employer in the open marked, but I hope and believe in just culture in this respect too.

In the role as a researcher I noticed Townsend (2013) recommendations on using sensitive data, and tried to put his views first when conducting this survey.

- *Strict anonymity of participating companies and personnel.*
- *Preservation of company confidential information.*
- *A trusting relationship of equals based on mutual respect and inter-dependence.*
- *Humility.*
- *A two-way dialogue.*
- *The ability to listen.*
- *No preconceived notions.*
- *The ability to cope with challenge and disagreement.*
- *The ability to stand back from the detail and see overall patterns of data.*
- *Not passing judgement on any one individual or company.*

(Townsend, 2013, Loc. 1670)

Not all of the recommendations are equally relevant in my quantitative survey, but anonymity of persons and companies are vital. All company names are deleted in the report, and neither relevant in the context of the research question.
The open-ended questions might disclose findings that should be treated with confidentiality, e.g. company names, confidential company information, competition advantages, offending language etc. based on the guidelines adapted above, all of these questions will therefore be deleted in the report, but categorized and labeled based on my interpretation, only the value of each category will be reported.

4 Results

The survey where conducted from January 23th to February 28th 2017, and a total of 339 valid answers were received. IBM SPSS statistics version 24 was used to analyze the results.
For comparison reasons the structure follow the LSE safety culture survey(Reader et al., 2016, p. 68), but with fewer questions in each cluster. The interpretation of "mean" values in each safety cluster should be as follows:

Below 2.5: this is considered concerning, most respondents are negative (Ibid),
2.5 to 3.5: open for interpretation (Ibid)
Above 3.5: is considered positive (Ibid)

For some questions the scale were reversed to compensate for negative wording.

Short statistical summary:

- Mean: The average score of all respondents in the group, i.e. the level of agreement with the question. Reversed item indicates a reversed scale do to negative wording in the question, i.e. consistency relative to flight safety, high number is better in this aspect.
- Standard deviation indicates the spread in responses. High number indicates high spread.
- Range is the scale of possible responses, Minimum (min) is the lowest used response, and Maximum (Max) is the highest response in the range.
- Independent-samples T-Test is used to compare two independent groups versus some continuous variable. When three or more groups ANOVA were used to make the comparison.
- The p.-value indicates the level of significance, i.e. is the difference due to chance.
- Effect size is used to describe the strength of the difference between the groups. Cohen's d were used, guidelines for interpretation:
    - small 0.1 to 0.29
    - medium 0,30 to 0,49
    - large 0,50 to 1,0

(Pallant, 2016)

It is important to point out, that possible findings, supporting correlations between effectiveness in the SMS and employment models do not indicate a direct prediction of the safety level on a particular flight etc., but maybe, and only maybe, a flight safety problem in an organization or civil aviation authority. The correlation can only be used to predict the potential for the safety management system to stay effective, or as Marczyk et al. (2005) puts it *"Correlation Does Not Equal Causation"*.

4.1 Population, gross subset, fallout, net subset, demographics results

The Nordic pilot population in commercial aviation is hard to estimate, many hold a valid license, but not all use it for a living. Snowball sampling exaggerates this uncertainty, when it comes to the number reached. My best estimate of the total number reached is N_{total} = 2000-3000 commercial pilots.

This gives a respond rate in the range 11% to 17 %, and this is in line with the LSE (14% (Reader et al., 2016, p. 45)) and Ghent (more than 10% (Jorens et al., 2015, p.13)) respond rates. The Ghent survey concludes on this number like this; "*The high participation rate makes it possible to give a clear overview of the current aviation sector*" (Ibid).

4.2 Pilot/Company demographics & Main clusters supporting the research question

The results for the listed groups are given in the following order:

- Pilot demographics & Company SMS demographics
- Just culture & Reporting.
- Safety support.
- Fatigue.

4.2.1 Pilot demographics & Company demographics

Base and nationality demographics

97 % of the respondents were based in Nordic countries; this number was higher than sought despite considerable efforts to reach pilots flying for Nordic operators on foreign bases. Numbers are shown in the table and the graph below.

Pilots based in country			
		N	N %
DP1 Base	Denmark	66	19,5
	Norway	191	56,3
	Sweden	44	13,0
	Finland	28	8,3
	Total Nordic based pilots	329	97,1
	Belgium	3	0,9
	Bulgaria	1	0,3
	Ireland	1	0,3
	United Kingdom (UK)	3	0,9
	Other	2	0,6
	Total number of pilots outside Nordic bases	10	2,9
	Total	339	100,0

Table 1, Pilots based in country

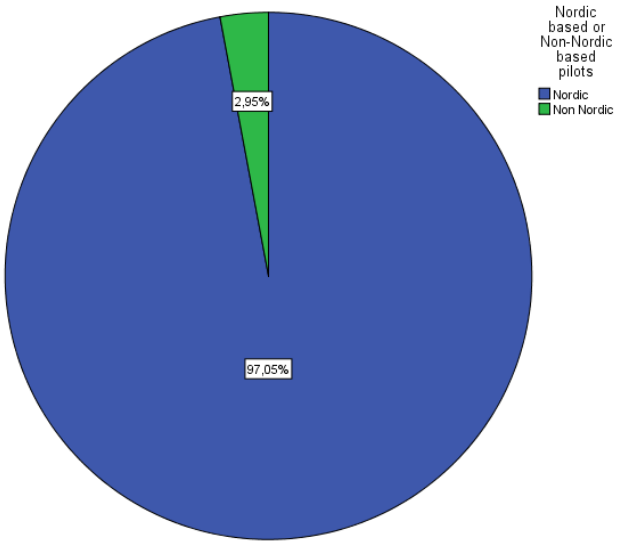


Figure 18, Nordic vs Non-Nordic based pilots

Similarly the nationality was skewed with 97.6 % Nordic pilots. This was expected because many of the pilots flying for Nordic operators "abroad" are Nordic by nationality.

Pilot Nationality			
		N	N%
DP2 Nationality	Danish	54	15,9
	Norwegian	177	52,2
	Swedish	70	20,6
	Finnish	28	8,3
	Icelandic	2	0,6
	Total Nordic pilots	331	97,6

	Belgian	3	0,9
	Croatian	1	0,3
	French	1	0,3
	Hungarian	1	0,3
	Italian	1	0,3
	Polish	1	0,3
	Total outside Nordic nations	8	2,4
	Total	339	100,0

Table 2, The nationality of the respondents

Pilot age, title, contract type, management role, years, block hours, previous contract

The following table shows the pilot demographics. The Age category is evenly distributed with one third below 30 years and one third above 50 years and the rest between 30 and 50 years of age. 58 % are captains and the rest flight officers (copilots, first or second officers). A vast majority (94%) have what is called a permanently contract, this issue are further discussed in the "discussion" part of this report. 6% of the respondents holds a management role. 21 % of the pilots have been employed less than 5 years at their current company, and 13 % has collected less than 3000 flying hours. Those with less than 5 years employment at current employer were asked about the contract type they had with their previous employer, N=70. 49 % had an atypical contract and 40% a typical contract, while 11% did not have a previous contract. This together with experience, number of years in business, age show young and less experienced pilots hold atypical contracts at a higher rate.

Pilot Demographics				
			N	**N %**
DP3	**Age**	18-30	37	10,9
		31-40	66	19,5
		41-50	114	33,6
		51-60	116	34,2
		61+	6	1,8
		Total	339	100,0
DP9	**Title**	Captain	195	57,5
		First Officer	142	41,9
		Second Officer	2	0,6
		Total	339	100,0
DP6	**Contract type**	Typical		
		Permanent	320	94,4
		Atypical		
		Pay to fly	1	0,3
		Zero hours contract	2	0,6
		Fixed term contract	7	2,1

		Self-employed	5	1,5
		Total atypical	15	4,4
		Other	4	1,2
		Total	339	100,0
DP10	**Management Role**	Yes (flight operations)	3	0,9
		Yes (training manager)	3	0,9
		Yes (other)	15	4,4
		Total Management	21	6,2
		No	318	93,8
		Total	339	100,0
DP11	**Years employed**	Less than 1 year	10	2,9
		1-4 years	61	18,0
		Total less than 5 years	71	20,9
		5-10 years	60	17,7
		11 + years	208	61,4
		Total more than 4 years	268	79,1
		Total	339	100,0
DP13	**Block hours**	0-300 hrs	2	0,6
		301-1000 hrs	17	5,0
		1001-3000 hrs	25	7,4
		Total less than 3000 hrs	44	13,0
		3001-5000 hrs	42	12,4
		5001-10000 hrs	75	22,1
		10000+ hrs	177	52,2
		Total more than 2999 hrs	294	86,7
		Total	338	99,7
		Missing	1	0,3
DP12	**Employed less than 5 years, previous contract** **N=70**	Typical		
		Permanent	28	40,0
		Atypical		
		Pay to fly	1	1,4
		Zero hours contract	11	15,7
		Fixed term contract	12	17,1
		Self-employed	10	14,3
		Total atypical	34	48,6
		Other	8	11,4
		Total	70	100,0

Table 3, Pilot demographics

Company SMS demographics

Company & Safety Management System demographic questions and distribution is shown in the following table. The vast majority 87% of the companies had, according to the pilots,

implemented a Safety Management System, 12 % of the pilots did not know if their company had such a system. The SMS has the characteristics of being both proactive and reactive. More or less all companies had implemented a mandatory, voluntary and confidential reporting system with scores in the high 80's (percent) for all three categories of reporting systems, and 75% had an agreement with the pilots safeguarding their anonymity. The pilot group was divided in three main groups in respect to company type; Network (71%), Low Cost Carriers (LCC, 10%) and Helicopter (10%). This division is less skewed than the other demographic groups.

Company demographics				
			N	**N%**
DC2	SMS implemented	Yes	296	87,3
		No	3	0,9
		I don't know	39	11,5
		Total	338	99,7
		Missing	1	0,3
		Total	339	100,0
DC3	SMS characteristics	Proactive	83	24,5
		Reactive	39	11,5
		Both Proactive and Reactive, equally so.	130	38,3
		I don't know	42	12,4
		Total	294	86,7
		Missing	45	13,3
		Total	339	100,0
DC4M	Mandatory reporting system	Yes	299	88,2
		No	18	5,3
		I don't know	13	3,8
		Total	330	97,3
		Missing	9	2,7
		Total	339	100,0
DC4V	Voluntary reporting system	Yes	297	87,6
		No	12	3,5
		I don't know	20	5,9
		Total	329	97,1
		Missing	10	2,9
		Total	339	100,0
DC4C	Confidential reporting system	Yes	289	85,3
		No	18	5,3
		I don't know	26	7,7

		Total	333	98,2
		Missing	6	1,8
		Total	339	100,0
DC5	Agreement safeguarding a just reporting environment	Yes (Union/Collective agreement)	253	74,6
		Yes (Company policy agreement, no Union)	51	15,0
		No	15	4,4
		I don't know	20	5,9
		Total	339	100,0
DP5	What type of company do you work for?	Network	242	71,4
		Low cost LCC	35	10,3
		Helicopter	33	9,7
		Total Network/LLC/Helicopter	310	91,4
		Charter/leisure	3	0,9
		Cargo	2	0,6
		Business/General Aviation	6	1,8
		Other	18	5,3
		Total Others	29	8,6
		Total	339	100,0

Table 4, Company demographics & company SMS characteristics

Question DC6 below prioritize what pilots consider to be the main focus area within their safety organization. Low numbers indicate high priority. Human factors and Pilot Procedural errors are prioritized first and Latent Errors within the organization after the two mentioned categories. This is contradictory to one of the reasons to implement a Safety Management System; -to detect latent errors. An additional ANOVA analysis where conducted to detect differences in the company type group. No significant differences were noticed, except a small difference between LCC and Network with post hoc Games-Howell test and the focus area Pilot Procedural error. Indicating LCC had a slightly higher focus on this than the network carriers.

DC6 In my company's safety organization I consider the main focus area towards flight safety performance to be:						
Overall average			Prioritized as			
Focus areas	Mean	N	1st	2nd	3rd	4th
Latent/organizational errors	2,32	302	26,2%	20,2%	48,7%	5,0%
Pilot Procedural errors	1,92	311	37,0%	37,9%	21,2%	3,9%
Human factor errors	1,80	317	39,7%	41,0%	18,3%	0,9%
Other	3,72	200	3,0%	3,5%	12,0%	81,5%

Table 5, Priority of company safety focus areas, low Mean value indicates high priority

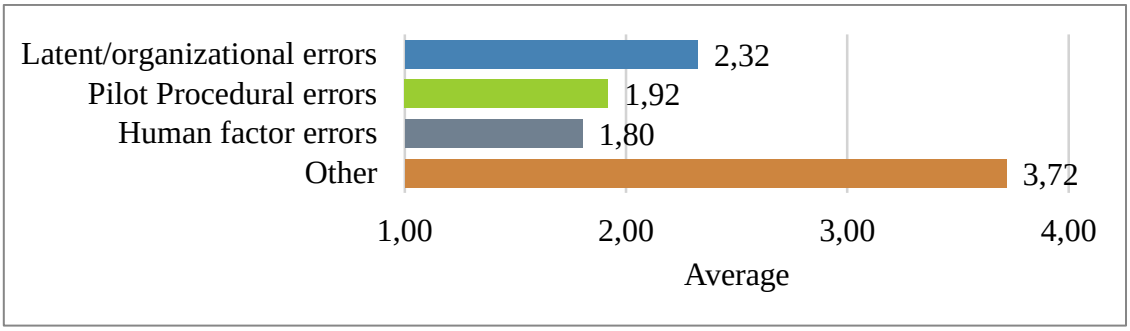


Figure 19, Overall average scores of company safety focus areas (low numbers better)

Before proceeding reading the results, some final words of caution:

Skewness in the groups referred is quite large, and the typical/atypical group and the management role/non-management role group fall outside the acceptable skewness statistic criteria of -2 to 2.

Skewness in groups used			
	N	Skewness	
	Statistic	Statistic	Std. Error
Age below 40 or 40+	339	-,857	,132
Captain or FO	339	,306	,132
Typical & Atypical employment contract	339	4,736	,132
Management or Not	339	-3,651	,132
Previous Contract type	339	-1,434	,132
Network, LCC or Helicopter	339	1,542	,132

Table 6, Statistical skewness within groups analysed

4.2.2 Just culture & Reporting clusters analysis

Just Culture Cluster

Questions analyzed in the cluster of Just Culture are described in the tables below. Individual questions are shown in the first table and the sum of all the questions in the cluster in the second table.

Individual questions, Just Culture:

All questions received responses covering the full range (1-5) of options. Missing results are low, $N_{missing}$ = 0-5, N_{total} = 339. Mean values are in the high range, values above 3.5 are considered high, and individual mean values range from 3.53-4.13. Even though all questions indicate a positive view, the standard deviation indicates a lot of variation among pilots.

The table below shows the results and the questions included in the Total Just Culture Cluster.

Individual questions in the Just Culture Cluster						
	N	Range	Min.	Max.	Mean	SD
JC1: The company's report investigation team makes a clear distinction between a deliberate/gross violation and an unintentional error/mistake.	338	4	1	5	3,97	,831
JC2: If there is NO "reckless conduct, gross negligence or willful misconduct" performed the organization and the pilots always have a sheared responsibility when a mishap occur.	337	4	1	5	3,53	,916
JC3: Pilots who report safety-related occurrences are treated in a just and fair manner by my company.	339	4	1	5	4,13	,863
JC4: If there is NO "reckless conduct, gross negligence or willful misconduct performed", self-reporting errors would have NO consequences to my career.	339	4	1	5	3,86	,975
JC5: If I reported an error I am confident my company would treat me according to "just culture" principles, i.e. make a clear distinctions between human errors and "reckless conduct/ gross negligence/willful misconduct".	336	4	1	5	3,88	,944
Valid N (listwise)	334					

Table 7, Just Culture question by question

The total Mean and standard deviation for the Just Culture cluster is shown below. The mean value (3.86) is considered to be high (above 3.5)

Total scores for the Just Culture Cluster						
	N	Range	Min.	Max.	Mean	SD
Total Just Culture Cluster	339	4	1	5	3,86	,718
Valid N (listwise)	339					

Table 8, "Just Culture cluster" total mean score

Total Reporting Cluster

Questions analyzed in the cluster of Reporting are described in the tables below. Individual questions are shown in the first table and the sum of all the questions in the cluster in the second table.

Individual questions, Reporting Cluster:

All questions received responses covering the full range (1-5) of options. Missing results are low, $N_{missing}$ = 0-5, N_{total} = 339. Mean values are in the high range, values above 3.5 are considered high, and individual mean values range from 3.50-4.71. In the high end we have the encouragement to file reports (Mandatory (4.71), Voluntary (4.25)) and at the low end if pilots always file mandatory fatigue reports (R5) at M=3.5. Even though all questions indicate a positive view, the standard deviation indicates a lot of variation among pilots, especially R5. The table below shows the results and the questions included in the Total Reporting Cluster.

Individual questions in the Reporting Cluster						
	N	Range	Min.	Max.	Mean	SD
R2M: My company encourage me to file reports about?: Mandatory flight safety issues	338	4	1	5	4,71	,645
R2V: My company encourage me to file reports about?: Voluntary flight safety issues	337	4	1	5	4,25	,847
R2C: My company encourage me to file reports about?: Company related issues	336	4	1	5	4,04	1,029
R3: My company always submits pilot reports, with a required authority reporting issue, to the authorities?	337	4	1	5	4,01	1,004
R5: I always file a fatigue report when it is required by the authorities.	338	4	1	5	3,50	1,128
JC3: Same as in JC Cluster	339	4	1	5	4,13	,863
JC4: Same as in JC Cluster	339	4	1	5	3,86	,975
JC5: Same as in JC Cluster	336	4	1	5	3,88	,944
Valid N (listwise)	330					

Table 9, "Reporting Cluster", question by question

The total Mean and standard deviation for the Reporting cluster is shown below. The mean value (4.04) is considered to be high (above 3.5)

Total Reporting Cluster.						
	N	Range	Min.	Max.	Mean	SD
Total Reporting Cluster	339	4	1	5	4,03	,683
Valid N (listwise)	339					

Table 10, Reporting Cluster total mean score

Objectives of the reporting system (own company)

The below table show an additional question were the reporting system objectives are prioritized. Low mean numbers indicate high priority. Individual and organizational learning (1.63) is prioritized first followed by Trend analysis (2.17) and the requirement to Fulfill Obligations towards authorities (2.26). The objective to Put Blame (4.06) is prioritized last with the category "other". Below the table a chart illustrating the priorities are shown.

R1: In my opinion; -The main objectives of my company's reporting system is:								
	Overall average			Prioritized as				
Focus area	SD	Mean	N	1st	2nd	3rd	4th	5th
Learning	0,9	1,63	317	60,9%	19,6%	15,5%	3,8%	0,3%
Put blame	1,17	4,06	177	8,5%	3,4%	5,1%	39,5%	43,5%
Fulfill obligation towards regulators.	0,9	2,26	292	27,4%	21,9%	48,3%	2,1%	0,3%
Trend	0,75	2,17	316	14,6%	58,9%	22,8%	2,5%	1,3%
Other	0,77	4,23	170	1,8%	1,2%	6,5%	53,5%	37,1%

Table 11, The Reporting system objectives prioritized; low "Mean" value indicates high priority

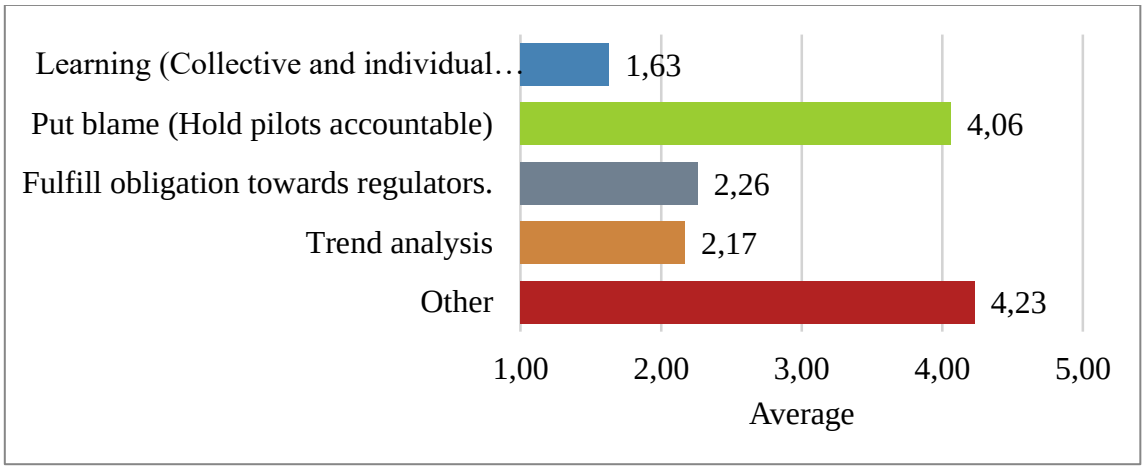


Figure 20, The Reporting system objectives prioritized

To check differences between company types (Network and LCC) an independent T-Test was conducted on the reversed mean values (for consistency with all other tests). An ANOVA test was run on all company types. Both test showed no significant differences, except for the T-Test. The mean values to illustrate the difference in focus areas are shown below. Both LCC and Network carriers prioritize learning first, but LCC carriers focus more on the fulfillment of obligation than to detect trends. Another noticeable non-significant difference shown in the spider diagram is the higher focus on putting blame by LCC as perceived by the pilots employed.

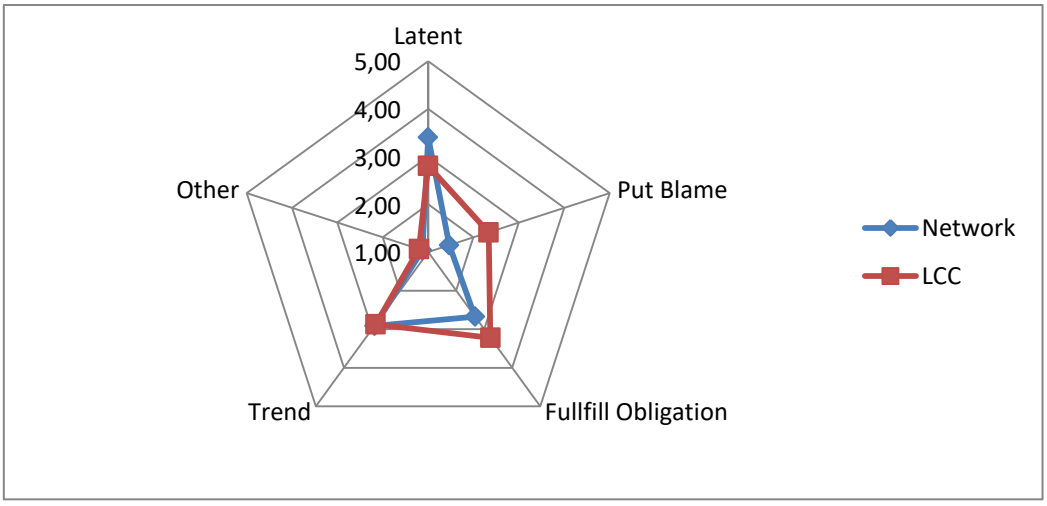


Figure 21, Differences between company type and the Mean scores of reporting objectives

Fatigue and mandatory reporting

The issue of fatigue reporting was used to check if pilots actually file mandatory reports. The question shows 19.5 % always follow the requirement to file a report. If you include the "agree" score in this group 56.4 % follow the requirement, while 20.6 % do not fulfill their obligation towards mandatory reporting and 22.8% are neutral.

R5: I always file a fatigue report when it is required by the authorities.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	18	5,3	5,3	5,3
	Disagree	52	15,3	15,4	20,7
	Neutral	77	22,7	22,8	43,5
	Agree	125	36,9	37,0	80,5
	Strongly Agree	66	19,5	19,5	100,0
	Total	338	99,7	100,0	
Missing	System	1	,3		
Total		339	100,0		

Table 12, Do all pilots file fatigue reports when it is mandatory?

The mean value (3.5) is at the limit of the range indicating room for interpretation (2.5-3.5).

R5, Descriptive statistics						
	N	Range	Min.	Max.	Mean	SD
I always file a fatigue report when it is required by the authorities.	338	4	1	5	3,50	1,128
Valid N (listwise)	338					

Table 13, Mean score; do all pilots file fatigue reports when it is mandatory?

To further validate if pilots do file mandatory fatigue reports all of the respondents answering other than “strongly agree” (N_{subset}=272) to the above question (R5) were give an additional question asking to estimate the number of skipped fatigue reports the last 12 months. The answers indicate 181 pilots out of the 272 asked had skipped one or more mandatory reports the last 12 months. 8 participants’ selected the “no answer” option. This result is in contrast to the R5 question above. An independent sample T-Test found no differences between those employed in LCC and Network, when analyzing skipped reports. Similar T-tests were conducted between age groups, position groups, previous contract groups and current contract type groups all showed non-significant differences towards skipping mandatory reports. Out of curiosity a similar T-Test was run on the Management role groups, this test showed the same pattern, those pilots with management roles skip mandatory fatigue reports at the same rate as non-management pilots (61 % vs other pilots at 67 % skip rate). The distribution is shown in a table further down.

The tables and graphical illustrations of skipped mandatory reports are shown below.

R6: Your previous answer indicates you don't always file fatigue reports when required, approximately how often have you skipped a fatigue report the last 12 months?			
Number of skipped reports		Frequency	Cumulative Percent
Valid	0	80	29,7
	1-3	120	74,3
	4-6	38	88,5
	7-10	11	92,6
	10+	12	97,0
	No answer	8	100,0
	Total	269	
Missing	System	3	
Total		272	

Table 14, Number of skipped mandatory fatigue reports the last 12 months

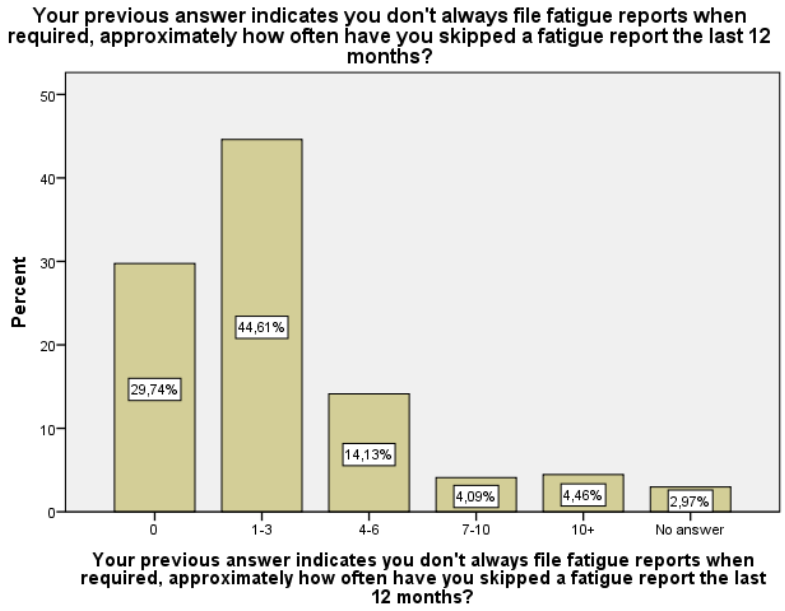


Figure 22, The percentage is based on respondents answering 1-4 in question R5

Skipped reports or No reports skipped	Management Role		Non-Management	
	Count	%	Count	%
No skipped reports	7	39%	73	29%
One or more skipped	11	61%	170	67%
No Answer	0	0%	8	3%

Table 15, Pilots with management role, skip rate of mandatory fatigue reports

4.2.3 Safety support cluster analysis

Questions analyzed in the cluster of "Pilot perceived safety support" are described in the tables below. Individual questions in the first table and the sum of all the questions in the group in the second table, the latter is illustrated graphically.

Individual questions:

All questions received responses covering the full range (1-5) of options. Missing results are low, $N_{missing}$ = 0-5, N_{total} = 339. Mean values are in the high range, values above 3.5 are considered high, and individual mean values range from 3.53-4.09. In the high end we have "willingness to speak up" and "the ability to learn". In the lower end, but still at high values, we have "feedback" and "support when stepping down from duty due to fatigue". Even though all questions indicate a positive view, the standard deviation indicates a lot of variation among pilots.

Individual questions in the safety support cluster:						
	N	Range	Minimum	Maximum	Mean	SD
S1: In my company; Voicing concerns about safety is encouraged.	337	4	1	5	3,96	,923
S2: In my Company; We get timely feedback on the safety issues we raise.	339	4	1	5	3,53	,977
S3: I am prepared to speak to my direct manager when unsafe situations are developing.	339	4	1	5	4,09	,920
S4: Information about safety-related changes within this company is clearly communicated to staff.	335	4	1	5	3,79	,900
S5: We learn lessons from safety related incident or occurrence investigations.	335	4	1	5	4,06	,733
S6: People in this company share safety related information.	334	4	1	5	3,86	,812
F1: My company fully supports my decision if I step down from duty because of fatigue.	336	4	1	5	3,74	1,032
Valid N (listwise)	330					

Table 16, "Perceived Safety Support" cluster, question by question

Total pilot perceived safety support cluster analysis:

In the table below we have the sum of the questions above. The Mean value (3.83) indicates a favorable view overall on perceived safety support from the company. Standard deviation indicates a quite large variation. The favorable view is illustrated in the bar chart below. A total of 90 % are favorable towards own company safety support. Only a small fraction is found in the other end.

Total pilot perceived safety support.						
	N	Range	Minimum	Maximum	Mean	SD
Total Perceived Safety Support	339	4	1	5	3,83	,747
Valid N (listwise)	339					

Table 17, Mean score of "Perceived Safety Support" cluster

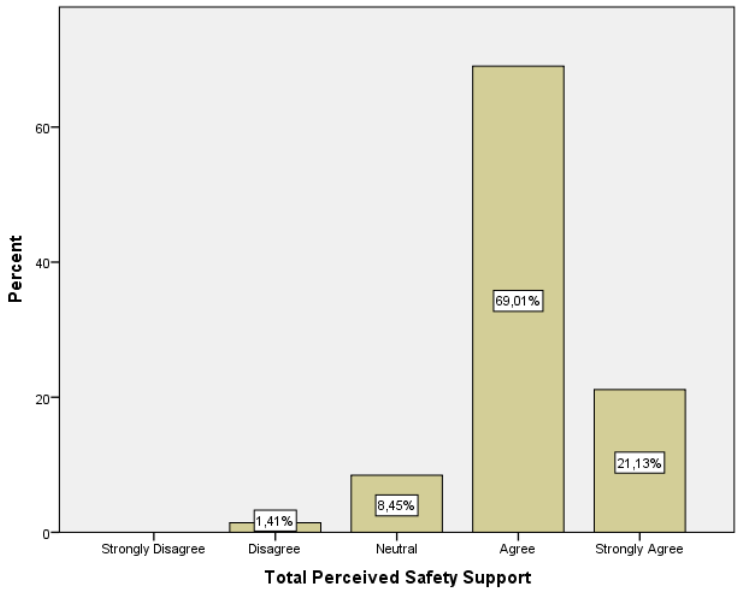


Figure 23, Distribution of responses in the total pilot "perceived safety support" cluster

4.2.4 Fatigue cluster analysis

This cluster mainly consist of six questions, where two are directly safety related and the rest indirectly safety related i.e. cultural questions. One of the questions is also included in the reporting cluster (R5). The two questions directly related to flight safety has been reversed to have a consistent scale, negative answers is considered bad for flight safety. In the tables this gives a consistent expression and an easier comparison.

Results for questions related to fatigue and reporting is given in separate tables in section 4.2.2 above.

In addition all participants, depending on contract type, where given an additional question related to fatigue and employment model. This is illustrated in separate tables and graphs.

Fatigue individual questions analysis:

The response rate where high with $N_{missing}$ in the range of 0 to 3, and N_{total} = 339, valid N =334. All questions utilized individually the full scale of options (1-5).

The general picture is diverged and "Mean" values differ from 2.22 to 3.8, and with rater high standard deviation also indicating large individual differences.

The first four questions have high mean values and are considered positive, except for "F4: The issue of fatigue is taken seriously by this company." This falls into the range where we have room for interpretation (2.92) and in the lower half of this interval, but with a high standard deviation.

The two last questions have been reversed (F2_rev & F5_rev), this is done to have consistency in the table, i.e. a low number indicates a concerning value. (This paper considers

a tired pilot a risk to safety; similarly if a pilot colleague is fatigued to a level where safety is at risk, this too is considered negative). These two questions have a means at 2.2 and 2.64, and both have high standard deviation indicating considerable differences among pilots. These two questions are grouped together and analyzed further later.

Individual questions in the fatigue cluster						
	N	Range	Minimum	Maximum	Mean	SD
F1: My company fully supports my decision if I step down from duty because of fatigue.	336	4	1	5	3,74	1,032
F3: I would feel comfortable to complete a fatigue report.	338	4	1	5	3,80	,985
F4: The issue of fatigue is taken seriously by this company.	337	4	1	5	2,92	1,076
R5: I always file a fatigue report when it is required by the authorities.	338	4	1	5	3,50	1,128
F2_rev: Pilots in this company are often tired at work (reversed scale)	338	4	1	5	2,22	,919
F5_rev: Colleagues are sometimes fatigued to a level where flight safety is at risk (reversed scale)	339	4	1	5	2,64	,985
Valid N (listwise)	334					

Table 18, "Fatigue cluster", question by question

The total fatigue cluster analyzed:

The questions above have been clustered together and given in the table below. The mean value is 3.12 and hence gives room for interpretation and some concern. The standard deviation is lower than for other clusters, but still large (.751).

The summarized numbers of the fatigue cluster does not give a clear answer and therefore additional analysis was performed, and results are given below the table.

Total fatigue (the above questions)						
	N	Range	Minimum	Maximum	Mean	SD
Total Fatigue	339	4	1	5	3,12	,751
Valid N (listwise)	339					

Table 19, Fatigue cluster total mean score

Other fatigue questions directly related to safety.

The questions "pilots in this company are often tired at work" & "colleagues are sometimes fatigued to a level where flight safety is at risk" have been summed together below and received a mean value of 2.43 (reversed scale, low number is negative) which falls in the category of concern, or as Reader et al. (2016) puts it "*thus indicating urgent action should be taken for improvement" (Ibid p.21).* The standard deviation indicates a large variation among pilot views and both questions are highly subjective in interpretation. One pilot might be exhausted while the other is fine, due to external factors like sleep patterns, social problems etc. The negative numbers are further illustrated in the graph below the table; this graph indicates 63 % consider fatigue to be a direct flight safety problem and only 6.7 % does not see fatigue as a problem.

Fatigue where safety is at risk (Reversed F2 & F5)						
	N	Range	Minimum	Maximum	Mean	SD
Total Fatigue Safety at Risk	339	4	1	5	2,43	,867
Valid N (listwise)	339					

Table 20, Fatigue questions directly safety related, reversed mean value

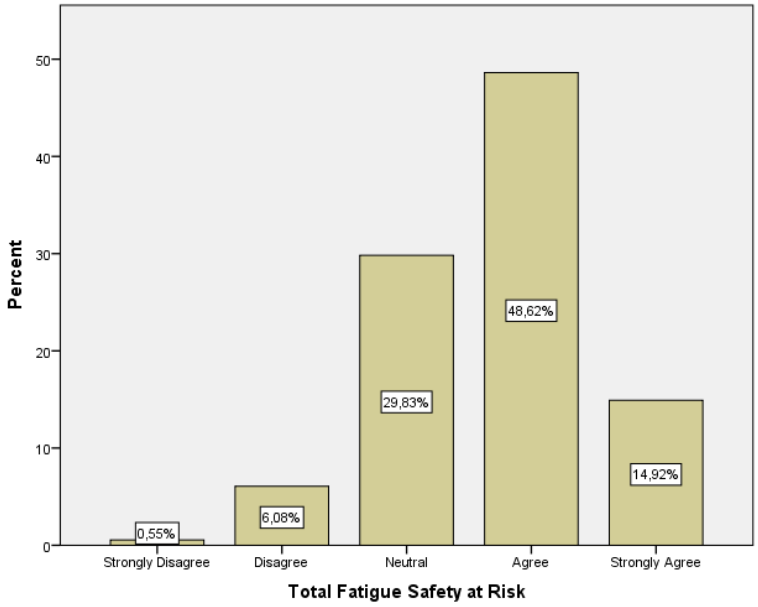


Figure 24, Total fatigue where safety is at risk, (positive answers are negative vs flight safety)

4.3 SMS safety culture clusters overall, descriptive statistics and reliability

This section summarizes the overall results of the four dimensions analyzed above. As described the questions were grouped together in four safety culture dimensions (clusters). The groups were called Just Culture, Reporting, Fatigue and Perceived Safety Support; the clusters were given the notation "Total" to distinguish them from individual questions.
For some questions the scale were reversed to compensate for negative wording.

Total safety culture clusters means

The figure and table below represent the four safety cluster mean values (3.83-4.03), and all are considered positive, except for Total Fatigue (3.12) which gives room for interpretations. The standard deviation values indicate considerable differences among pilots for all clusters.

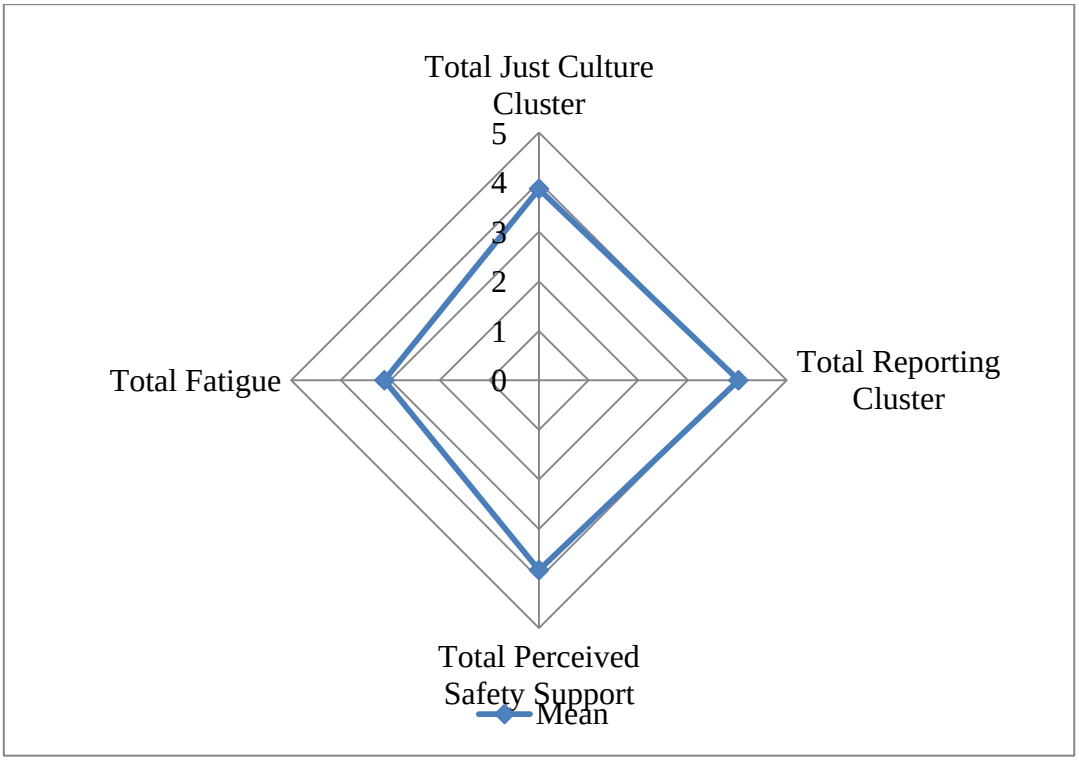


Figure 25, Mean scores for all safety clusters

Descriptive Statistics & reliability							
	N	Range	Min.	Max.	Mean	SD	alpha
Total Just Culture Cluster	339	4	1	5	3,86	,718	0,846
Total Reporting Cluster	339	4	1	5	4,03	,683	0,865
Total Perceived Safety Support	339	4	1	5	3,83	,747	0,903
Total Fatigue	339	4	1	5	3,12	,751	0,751

Table 21, Safety clusters descriptive statistics and reliability

Total safety culture cluster correlations

The table below show Pearson correlation and indicates significant correlations between the safety clusters. It should be noted that the sample size is medium, and the value of this is questionable.

		Total Reporting Cluster	Total Just Culture Cluster	Total Fatigue	Total Perceived Safety Support
Total Reporting Cluster	Pearson Correlation	1	,846**	,757**	,807**
	Sig. (2-tailed)		,000	,000	,000
	N	339	339	339	339
Total Just Culture Cluster	Pearson Correlation	,846**	1	,655**	,787**
	Sig. (2-tailed)	,000		,000	,000
	N	339	339	339	339
Total Fatigue	Pearson Correlation	,757**	,655**	1	,699**
	Sig. (2-tailed)	,000	,000		,000
	N	339	339	339	339
Total Perceived Safety Support	Pearson Correlation	,807**	,787**	,699**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	339	339	339	339

**. Correlation is significant at the 0.01 level (2-tailed).

Table 22, Safety Clusters correlations

4.4 SMS safety culture clusters versus groups, -in-group differences

This section analyze in-group differences, i.e. differences between captains and Flight Officers, Contract Type, Management Role or not, above/below Age 40 and Company Type (Network, LCC, Helicopter).

The analysis will show spider diagrams where there are differences between groups. Where no or small differences are found the graphs are skipped. For all clusters the values are displayed according to Pallant (2016) recommendations for Independent-samples t-test (Ibid, Loc. 6130) and for ANAOVA (Ibid, Loc. 6439).

4.4.1 Job title versus safety culture clusters

The pilot group was reduced to two groups before conducting the analysis, Captains and First officers, because many companies use the term second officer the first 1-4 years and thereafter first officer even though both are copilots, i.e. “First officers” in the analysis below represent both second and first officers; the second officer group was very small (2).

Levene's Test of equality of variance were satisfied for all four clusters, together with high Sig. (2-tailed) values this makes it uncertain if there are significant differences between the groups, except the Total Fatigue Cluster with p=.016.

An independent –samples T-Test was conducted to compare the safety clusters scores for Captains and First officers. There was no significant difference, except for the Total Fatigue Cluster versus Captains and First Officers. Mean, SD, t, p and Cohen's d are shown below for each cluster.

Means by job title

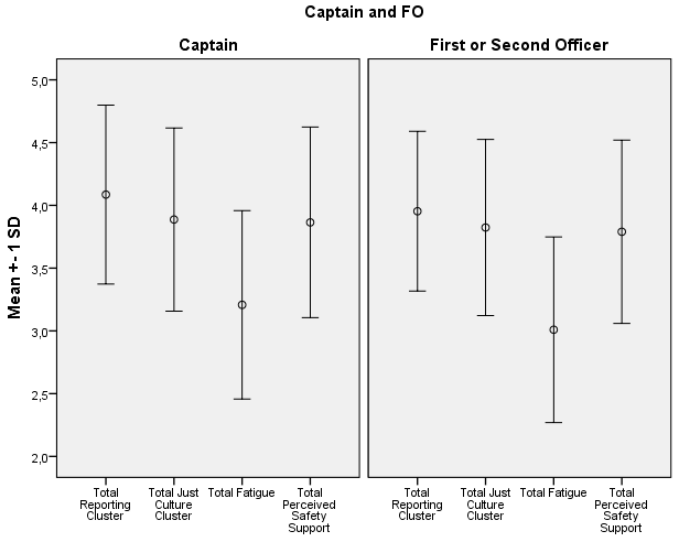


Figure 26, Captain and FO Mean & SD values versus Safety clusters

Safety culture clusters Mean & SD by job title				
	Captain or FO	N	Mean	SD
Total Reporting	Captain	195	4,09	,712
	First or Second Officer	144	3,95	,636
Total Just Culture	Captain	195	3,89	,730
	First or Second Officer	144	3,82	,702
Total Fatigue	Captain	195	3,21	,750
	First or Second Officer	144	3,01	,740
Total Perceived Safety Support	Captain	195	3,86	,760
	First or Second Officer	144	3,79	,730

Table 23, Safety culture clusters Mean & SD by job title

Job title versus Total Reporting Cluster

There were no significant differences in scores between Captains (M=4.09 & SD=.712) and First officers (M=3.95 & SD=.636; t(337)=1.774, p=.08, two-tailed) versus the total reporting

cluster. The magnitude of difference in the means (MD=.133, 99% CI: -.061 to .327) is small with Cohen's d = 0.208.

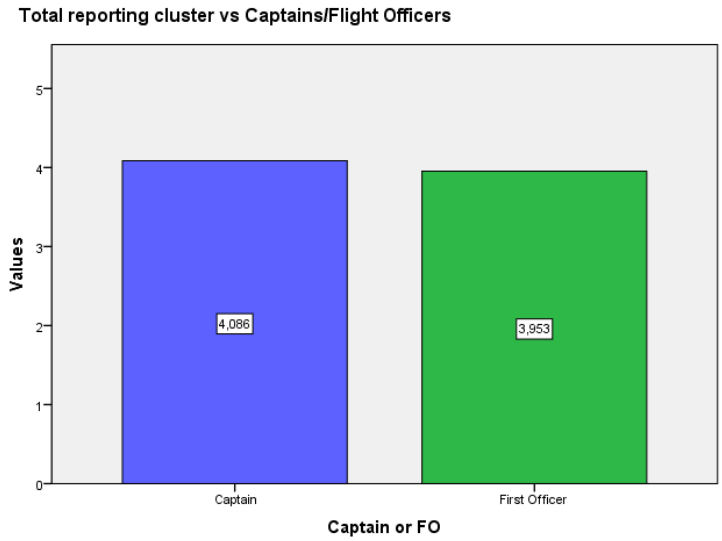


Figure 27, Total Reporting cluster vs Captains/FO, example of small differences, such graphs are skipped below

Job title versus Total Just Culture, Perceived and Safety Support

Since the significant differences were non-existing for all the clusters except Fatigue only the values for each cluster will be referred below. Figures would appear as above and in spider charts where there are significant differences.

Just Culture:

There were no significant differences in scores between Captains (M=3.89 & SD=.730) and First officers (M=3.82 & SD=.702; t(337)=.806, p=.41, two-tailed) versus the **Just Culture cluster**. The magnitude of difference in the means (MD=.064, 99% CI: -.141 to .268) is very small with Cohen's d = 0.098.

Perceived Safety Support:

There were no significant differences in scores between Captains (M=3.86 & SD=.760) and First officers (M=3.79 & SD=.730; t(337)=.911, p=.363, two-tailed) versus the **Perceived Safety Support cluster**. The magnitude of difference in the means (MD=.075, 99% CI: -.138 to .287) is very small with Cohen's d = 0.094.

Job title versus Total Fatigue Cluster

There were differences in scores between Captains (M=3.21 & SD=.750) and First officers (M=3.01 & SD=.740; t(337)=2.422, p=.016, two-tailed) versus the **Fatigue cluster**. The Sig (2-tailed) value of 0.016 is below the cutoff value of p=0.05, values below the cutoff is considered as a significant difference. However the magnitude of difference in the means (MD=.198, 99% CI: -.014 to .411) is small with Cohen's d = 0.268.

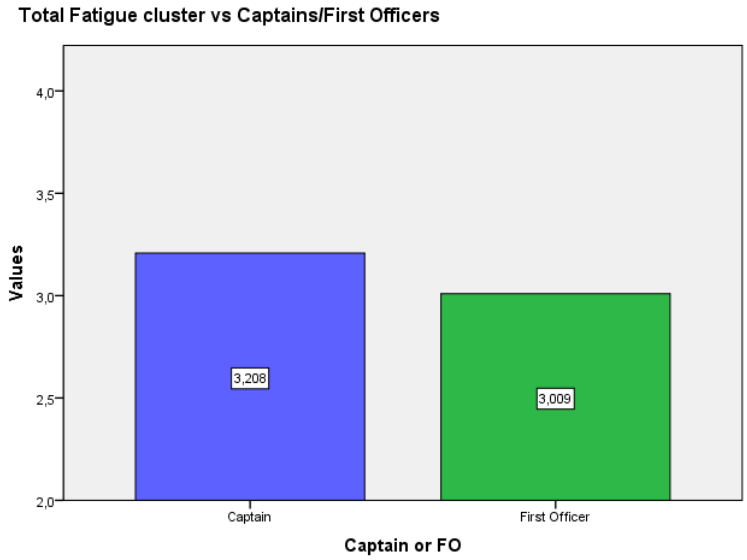


Figure 28, Total Fatigue cluster vs Captains/First Officers; both Mean values are below 3.5

The captain group is scores slightly higher than the first officer group; both groups are below the value 3.5 which is considered to be the upper limit for interpretation when using a 1-5 Likert scale.

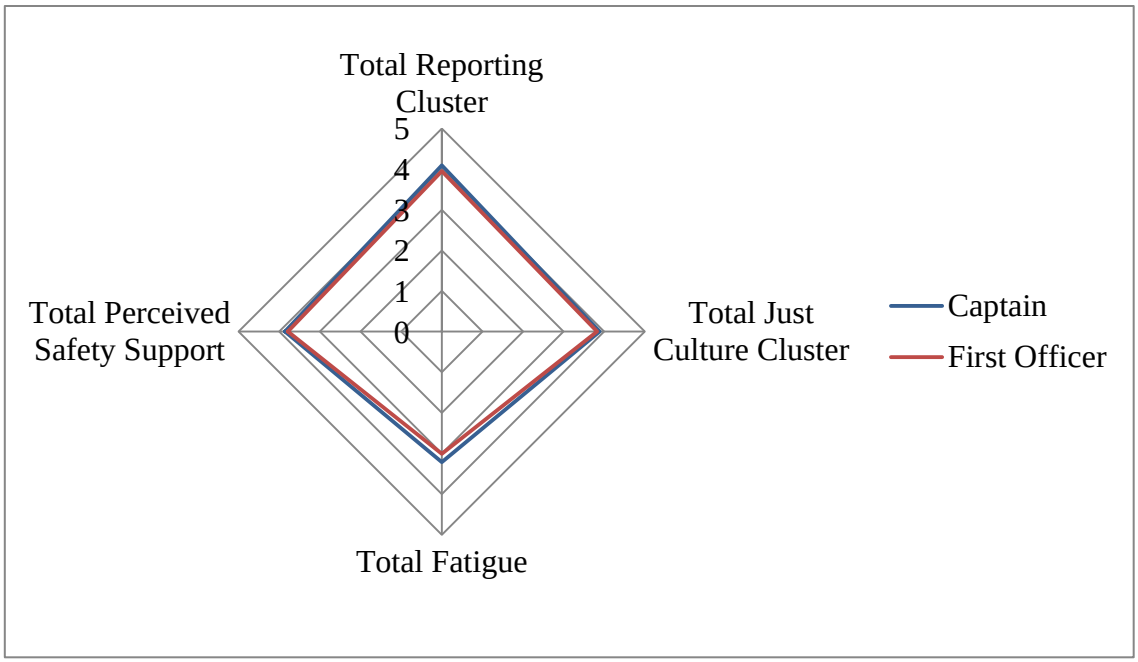


Figure 29, The Fatigue clusters versus job titles

4.4.2 Contract type versus safety culture clusters

The contract types were reduced to two groups before conducting the analysis, Typical and Atypical, and the other group (N=4) excluded from the analysis.

Levene's Test of equality of variance was satisfied for the Fatigue cluster, the other clusters did not meet the criteria of equality of variance. All groups came out with low Sig. (2-tailed) values ($p<0.05$) except the Safety Support cluster ($p=0.1$).

An independent –samples T-Test was conducted to compare the safety clusters scores for those on Typical and Atypical contracts. There were significant differences and Mean, SD, t, p and Cohen's d are shown below for each cluster.

Mean values by contract type

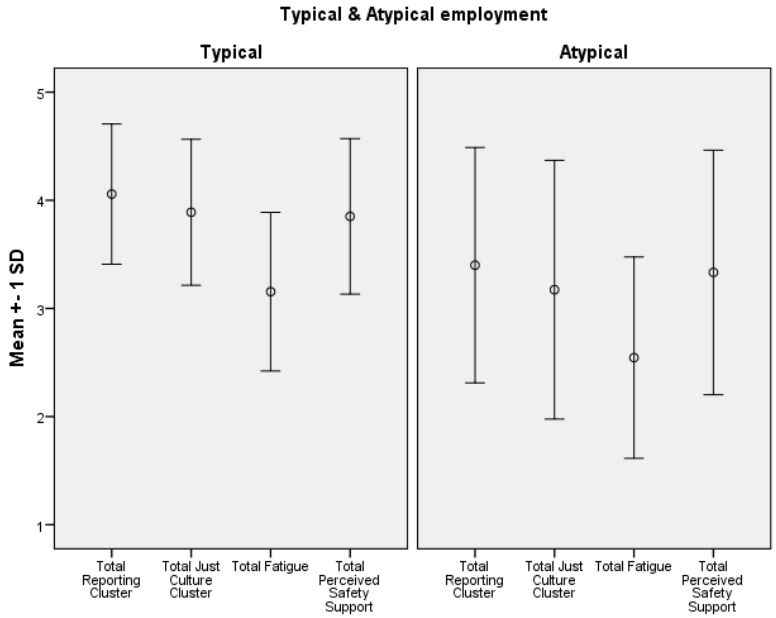


Figure 30, Safety Clusters Mean scores by Contract type

Mean scores are lower and standard deviation larger for those with atypical contracts. Both groups have the same pattern, with low scores for the total fatigue cluster. SD is larger for those on atypical contracts.

Safety Clusters Mean & SD by contract type				
	Typical or Atypical	N	Mean	SD
Total Reporting	Typical	320	4,06	,649
	Atypical	15	3,40	1,088
Total Just Culture	Typical	320	3,89	,675
	Atypical	15	3,17	1,197
Total Fatigue	Typical	320	3,16	,734
	Atypical	15	2,54	,931
Total Perceived Safety Support	Typical	320	3,85	,719
	Atypical	15	3,33	1,131

Table 24, Safety clusters Mean & SD scores by Contract type

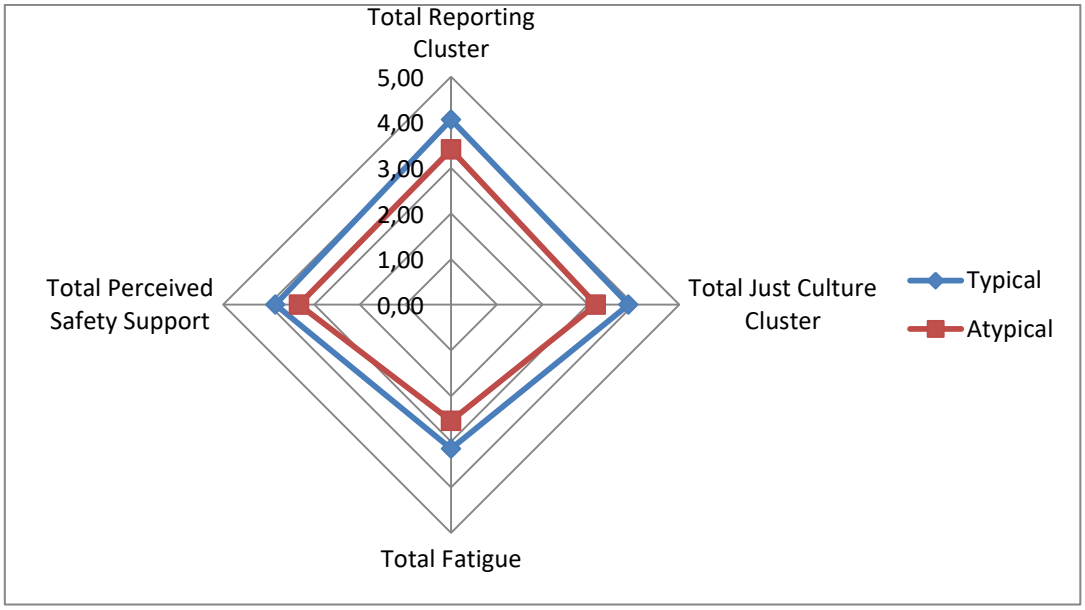


Figure 31, Safety Cluster mean scores versus Contract types (other excluded)

Contract type versus Total Reporting Cluster

There were significant differences in scores between those on Typical (M=4.06 & SD=.649) and those on Atypical contracts (M=3.40 & SD=1.088); t(14.471)=2.323, p=.0035, two-tailed) versus the **total reporting** cluster. The magnitude of difference in the means (MD=.658, 99% CI: -.181 to 1.497) is high with Cohen's d at 0.760.

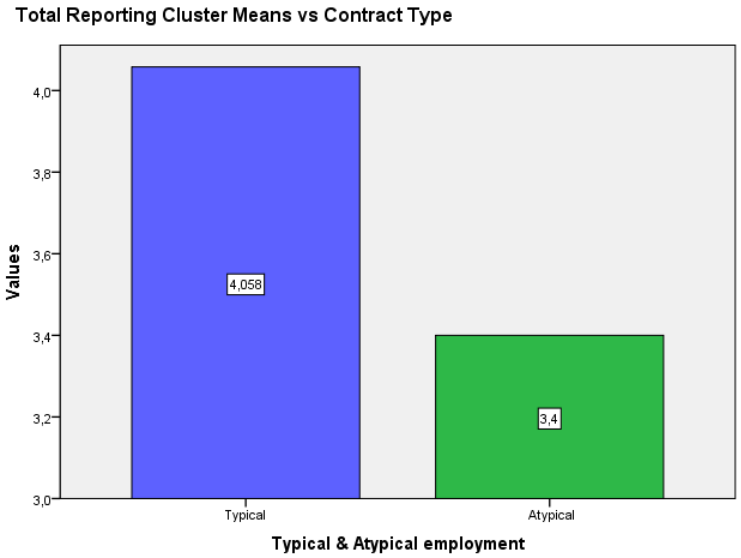


Figure 32, Total Reporting cluster mean score versus Contract types

Contract type versus Total Just Culture Cluster

There were significant differences in scores between those on Typical (M=3.89 & SD=.675) and those on Atypical contracts (M=3.17 & SD=1.197); t(14.420)=2.299, p=.0037, two-tailed) versus the total **Just Culture** cluster. The magnitude of difference in the means (MD=.716, 99% CI: -.207 to 1,639) is high with Cohen's d at 0.68.

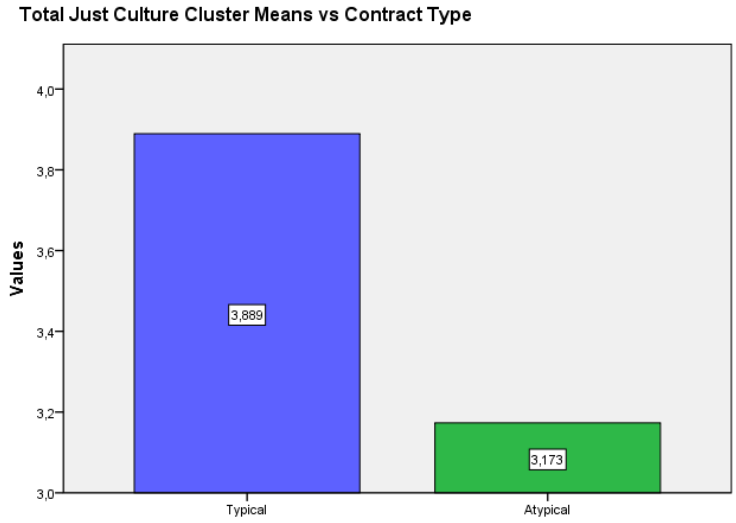


Figure 33, Total Just Culture cluster mean score versus Contract Types

Contract type versus Total Perceived Safety Support Cluster

There were significant differences in scores between those on Typical (M=3.85 & SD=.719) and those on Atypical contracts (M=3.33 & SD=1.131); t(14.536)=1.757, p=.01, two-tailed)

versus the total **Perceived Safety Support** cluster. The magnitude of difference in the means (MD=.518, 99% CI: -.354 to 1.391) is high with Cohen's d at 0.562.

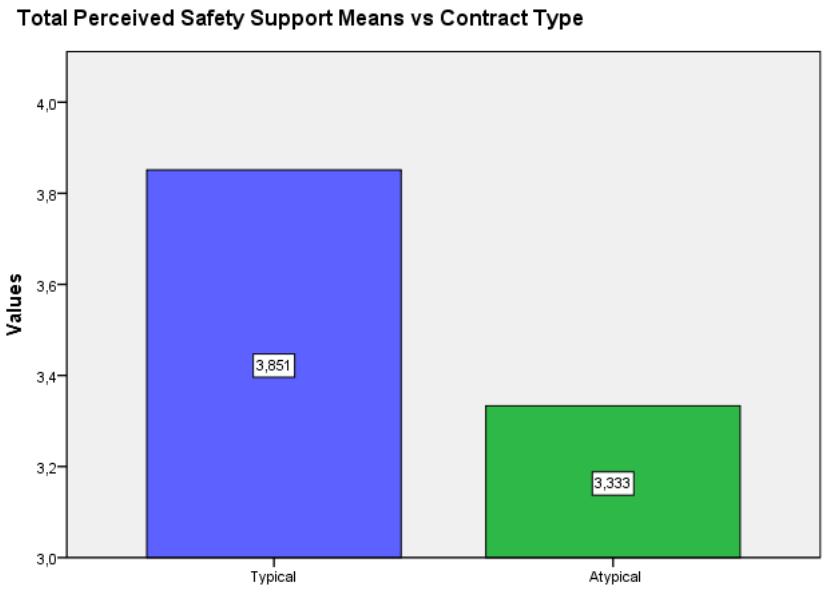


Figure 34, Total Perceived Safety Support mean score versus Contract Types

Contract type versus Total Fatigue Cluster

There were significant differences in scores between those on Typical (M=3,16 & SD=.734) and those on Atypical contracts (M=2.54 & SD=0.931); t(333)=3.112, p=.02, two-tailed) versus the total **Fatigue** cluster. The magnitude of difference in the means (MD=.611, 99% CI: -.102 to 1.119) is high with Cohen's d at 0.745.

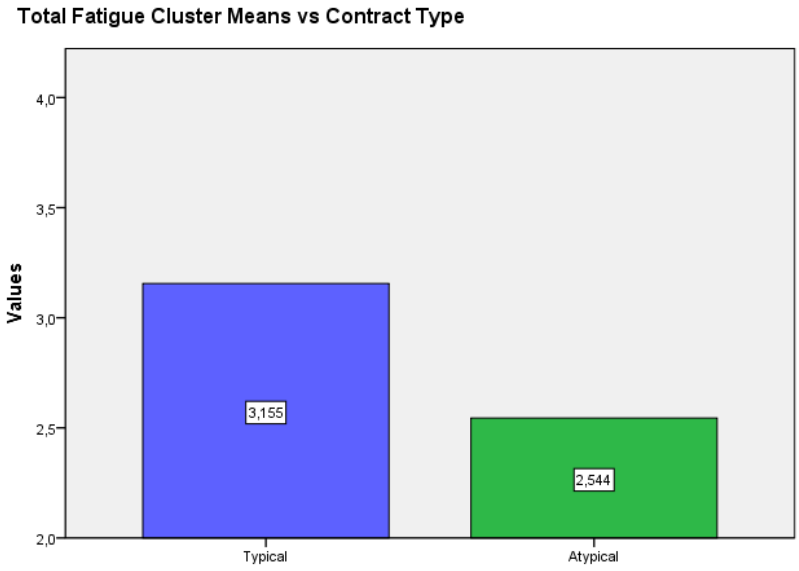


Figure 35, Total Fatigue Cluster mean score versus Contract Types

The fatigue cluster mean values for both typical and atypical contracted pilots are in the caution range, between 2.5 and 3.5. These leaves room for interpretation and is commented further in the discussion part.

4.4.3 Management role versus safety culture clusters

The management role group was reduced to two groups before conducting the analysis, Management Role and Not in Management.

Levene's Test of equality of variance was satisfied for all clusters. All groups came out with high Sig. (2-tailed) values ($p>0.05$), indicating the zero hypothesis is valid, i.e. small differences between the groups.

An independent –samples T-Test was conducted to compare the safety clusters scores for those with a Management Role and pilots Not in Management. There were no significant differences found, and Mean, SD, t, p and Cohen's d are shown below for each cluster.

Mean values by Management Role

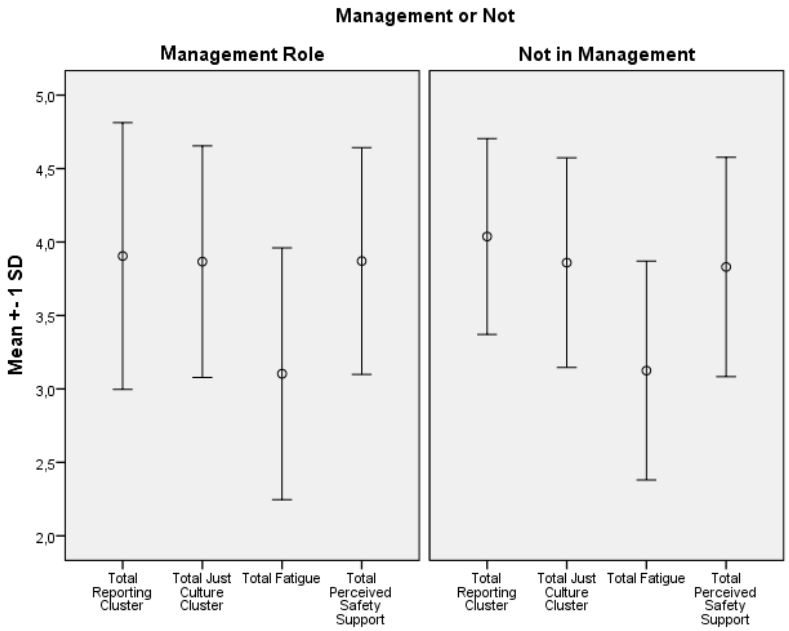


Figure 36, Safety Clusters Mean & SD scores versus management role

The management pilots are slightly more negative towards the Total Reporting cluster than non-management pilots. In the other clusters none or very small differences were found. Both groups display the same pattern, with the Fatigue cluster in the caution range (2.5 to 3.5). Mean and SD values are given in the table below.

Safety Clusters vs Management Role or Not in Management				
	Management or Not	N	Mean	SD
Total Reporting	Management Role	21	3,90	,908
	Not in Management	318	4,04	,667
Total Just Culture	Management Role	21	3,87	,788
	Not in Management	318	3,86	,714
Total Fatigue	Management Role	21	3,10	,857
	Not in Management	318	3,12	,745
Total Perceived Safety Support	Management Role	21	3,87	,772
	Not in Management	318	3,83	,747

Table 25, Safety Cluster Mean & SD scores versus management role

Management Role versus Total Reporting Cluster

There were no significant differences in scores between those with management role (M=3.90 & SD=.908) and those not in management (M=4.04 & SD=.667); t(337)=-0.863, p=.39, two-tailed) versus the total **reporting** cluster. The magnitude of difference in the means (MD=.133, 99% CI: -.532 to .266) is very small with Cohen's d = 0.178.

Management Role versus Total Just Culture Cluster

There were no significant differences in scores between those with management role (M=3.87 & SD=.788) and those not in management (M=3.86 & SD=.714; t(337)=0.043, p=.97, two-tailed) versus the total **Just Culture** cluster. The magnitude of difference in the means (MD=.007, 99% CI: -.413 to .426) is very small with Cohen's d = 0.01

Management Role versus Total Perceived Safety Support Cluster

There were no significant differences in scores between those with management role (M=3.87 & SD=.772) and those not in management (M=3.83 & SD=.747); t(337)=0.241, p=.90, two-tailed) versus the total **Perceived Safety Support** cluster. The magnitude of difference in the means (MD=.041, 99% CI: -.396 to .477) is very small with Cohen's d = 0.053.

Management Role versus Total Fatigue Cluster

There were no significant differences in scores between those with management role (M=3.10 & SD=.857) and those not in management (M=3.12 & SD=.745); t(337)=-0.127, p=.81, two-tailed) versus the total **Fatigue** cluster. The magnitude of difference in the means (MD= -.022, 99% CI: -.461 to .417) is very small with Cohen's d = 0.025.

4.4.4 Experience level versus safety culture clusters

Three different groupings where analyzed, Flying Hours, below/above 40 years and below/above 30 years of age. All groups displayed significant differences and only the group

below/above 40 will be presented with all scores, the other groups are only illustrated with a graph displaying mean and standard deviation.

The Flying Hours group was reduced to two groups before conducting the analysis, Pilots with Less than 3000 block hours and those with 3000 or more block hours. Levene's Test of equality of variance was satisfied for any of the safety clusters. All groups came out with high Sig. (2-tailed) values ($p>0.05$) in the independent-samples T-Test, indicating the zero hypothesis is valid, i.e. small differences between the groups. (Actually a fourth group where analyzed, with a breakpoint at 1000 hours, displaying the same distribution as for 3000 hours. No numbers are given for the fourth group).

The Age grouping (30 years of age as breakpoint) was reduced to two groups, age at or below 30 and 30+. Levene's Test of equality of variance was satisfied for the total Just Culture and Safety Support clusters, while the Reporting and Fatigue clusters did not assume equality of variance. All groups came out with low Sig. (2-tailed) values ($p<0.05$) in the independent-samples T-Test, indicating differences between the groups.

The Age grouping (40 years of age as breakpoint) was reduced to two groups, age at or below 40 and 40+. Levene's Test of equality of variance was satisfied for the Perceived Safety Support cluster and all other clusters do not assume equal variance. All groups came out with low Sig. (2-tailed) values ($p<0.05$) in the independent-samples T-Test, indicating differences between the groups.

An independent –samples T-Test was conducted to compare the safety clusters scores for those at age 40 or below and those at age 40+. There were significant differences found, and Mean, SD, t, p and Cohen's d are shown below for each cluster. In addition the Mean and SD is graphically illustrated below for Flying Hours and Age (bp=30) group.

Mean values & SD by Flying hours (3000), Age (30) and Age (40), the latter fully analyzed.

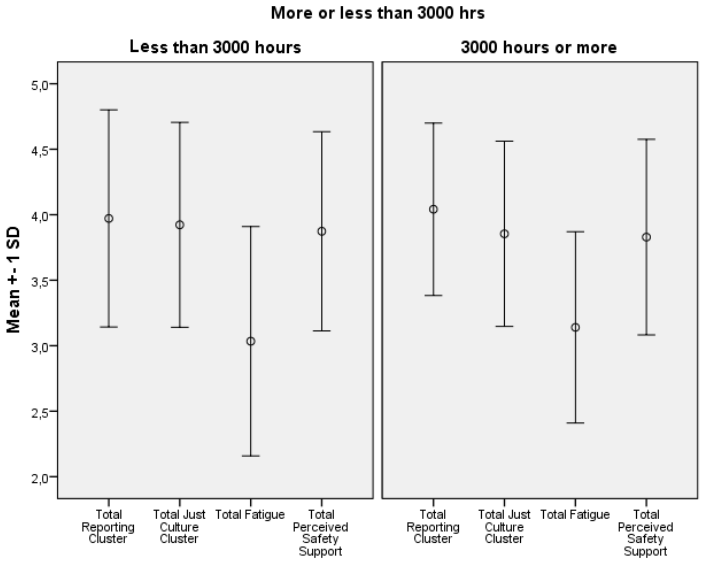


Figure 37, Safety Cluster Mean & SD versus flying hours

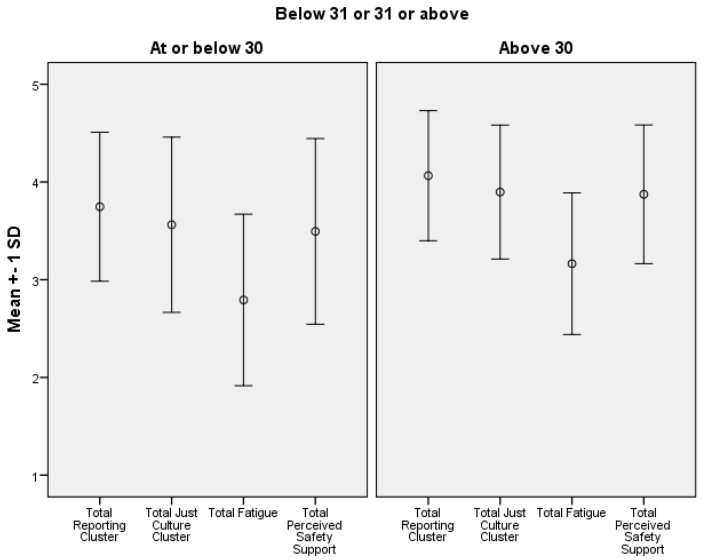


Figure 38, Safety Clusters M & SD scores versus age (30)

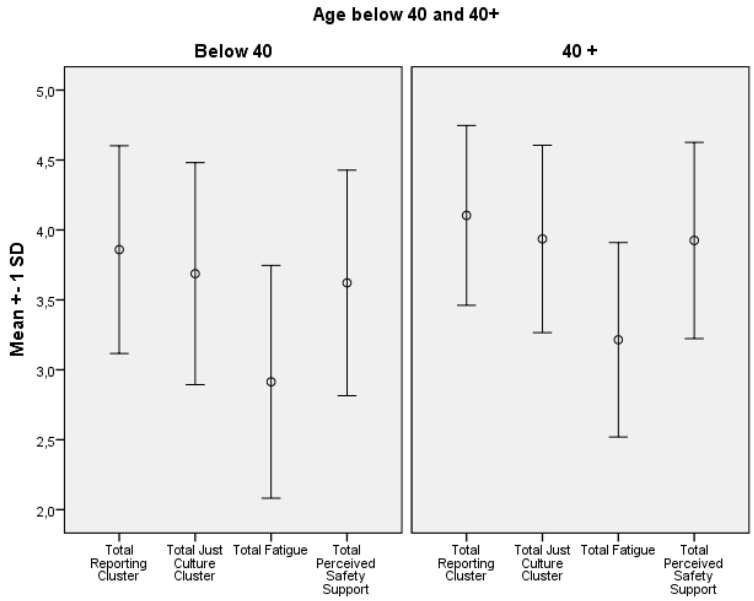


Figure 39, Safety Clusters Mean & SD scores versus Age (40), fully analysed below

The age graphs, 30 and 40, display the same differences and the pattern for all three groupings are similar, fatigue scores are lower than the other clusters. Mean and standard deviation for the Age group is found below (age at or below 40).

Safety Culture Clusters M & SD vs Age(40)				
	Age below 40 or 40+	N	Mean	SD
Total Reporting	Below 40	103	3,86	,743
	40 +	236	4,10	,643
Total Just Culture	Below 40	103	3,69	,794
	40 +	236	3,94	,670
Total Fatigue	Below 40	103	2,91	,832
	40 +	236	3,21	,695
Total Perceived Safety Support	Below 40	103	3,62	,806
	40 +	236	3,92	,702

Table 26, Safety Culture clusters vs Age (40)

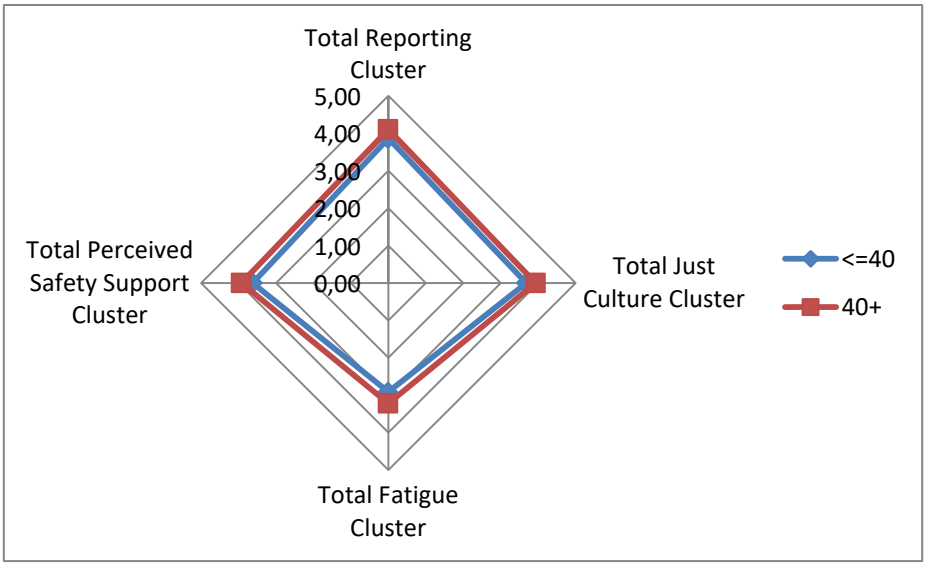


Figure 40, Safety Culture clusters Mean scores versus Age, those above 40 generally more positive.

Age (40) versus Total Reporting Cluster

There were significant differences in scores between those at or below 40 years (M=3.86 & SD=.743) and those above 40 years (M=4.10 & SD=0.643); t(172)=-2.90, p=.004, two-tailed) versus the **total reporting** cluster. The magnitude of difference in the means (MD=-.245, 99% CI: -.464 to -0,025) is medium with Cohen's d at 0.346.

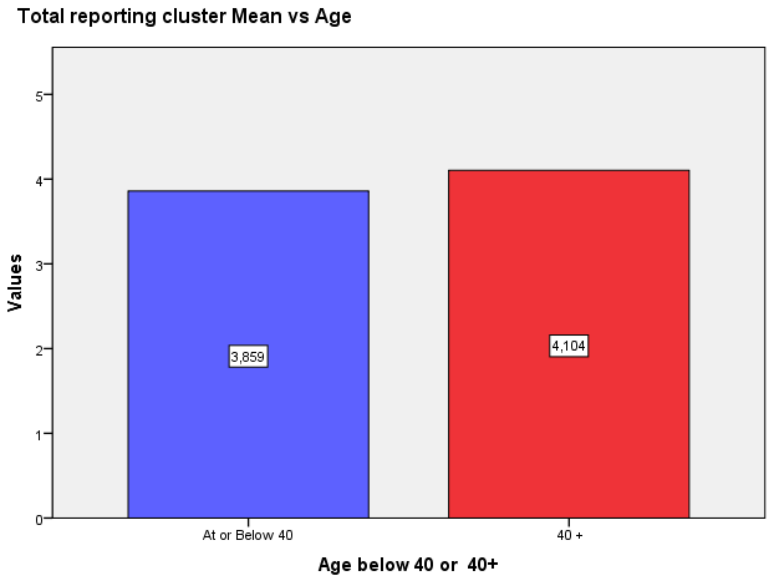


Figure 41, Total Reporting cluster versus Age (40)

Age (40) versus Total Just Culture Cluster

There were significant differences in scores between those at or below 40 years (M=3.69 & SD=.794) and those above 40 years (M=3.94 & SD=0.670); t(168)=-2.772, p=.006, two-

tailed) versus the **total just culture** cluster. The magnitude of difference in the means (MD=-.248, 99% CI: -.482 to -.015) is medium with Cohen's d at 0.342.

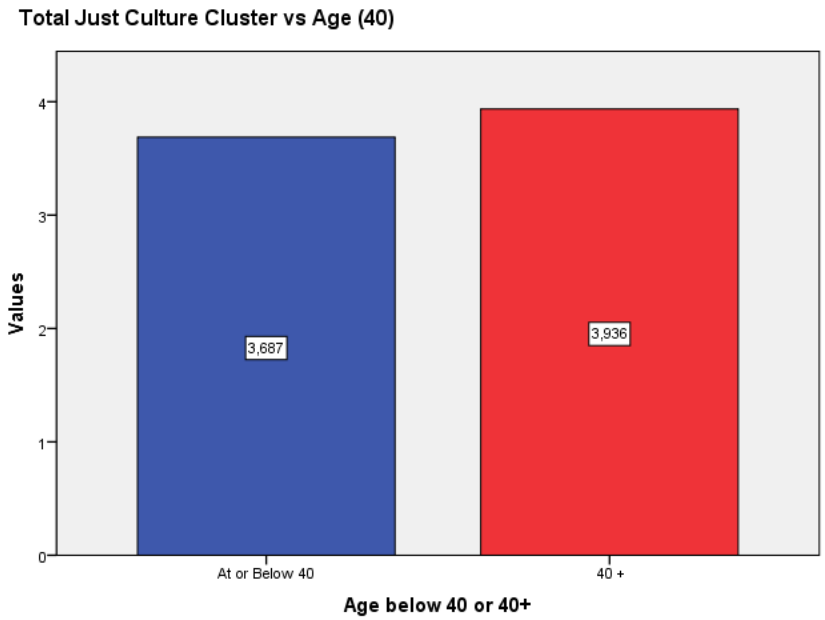


Figure 42, Total Just Culture Cluster mean score vs Age (40)

Age (40) versus Total Perceived Safety Support Cluster

There were significant differences in scores between those at or below 40 years (M=3.62 & SD=.806) and those above 40 years (M=3.92 & SD=0.702); t(337)=-3,498, p=.001, two-tailed) versus the **total perceived safety support** cluster. The magnitude of difference in the means (M= -.304, 99% CI: -.528 to -0.079) is medium with Cohen's d at 0.398.

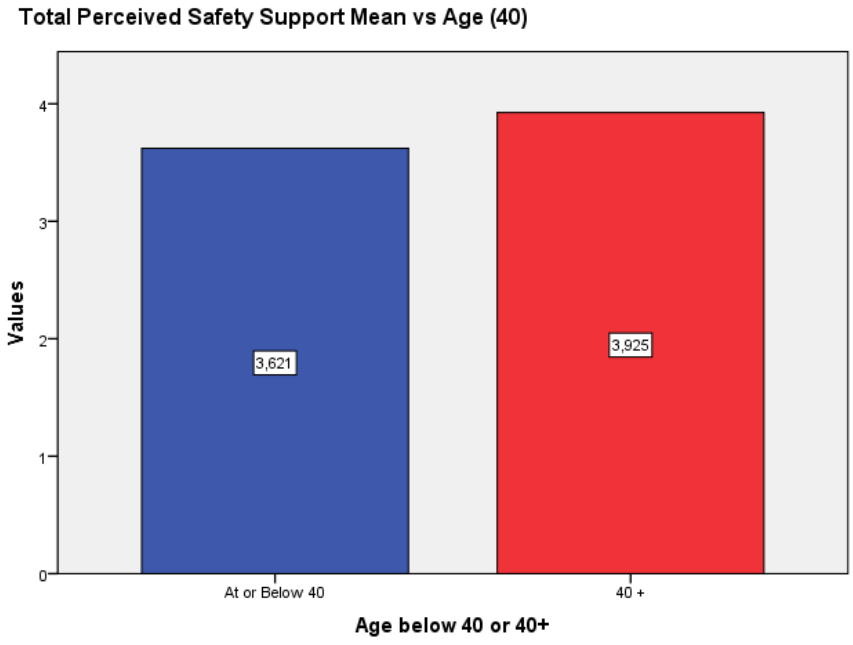


Figure 43, Total Perceived Safety Support mean score versus Age (40)

Age (40) versus Total Fatigue Cluster

There were significant differences in scores between those at or below 40 years (M=2.91 & SD=.832) and those above 40 years (M=3.21 & SD=0,695); t(167)=-3.209, p=.002, two-tailed) versus the **total fatigue** cluster. The magnitude of difference in the means (MD=.300, 99% CI: -.544 to -0.056) is medium with Cohen's d at 0.393.

The mean values are in the caution range and offer room for interpretation.

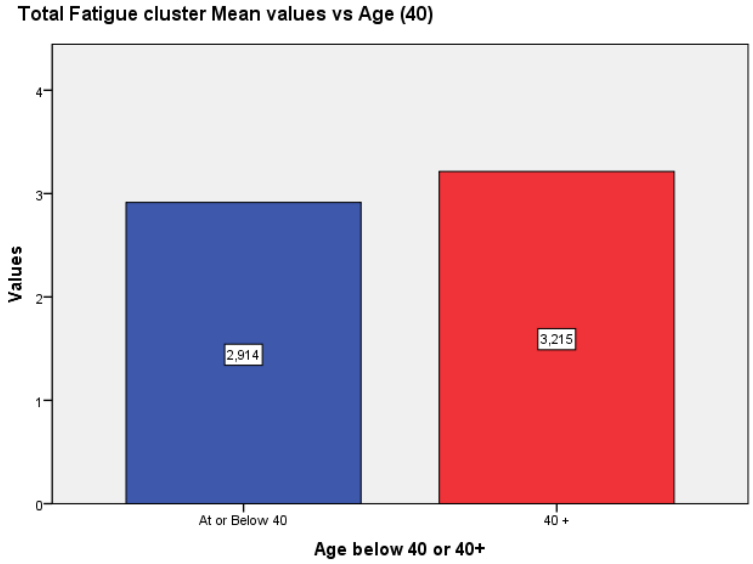


Figure 44, Total Fatigue mean score versus Age (40)

4.4.5 Company type versus safety culture clusters

ANOVA, Analysis of variance, where performed on the safety culture clusters and the type of company, the number of types was reduced to four groups, Network, Low Cost Carriers (LCC), Helicopter and other (General aviation, Business etc.). Only the three first are commented on in this paper.

Levene's test of homogeneity of variance showed that the total just culture cluster violated the test. Welch & Brown-Forsythe test indicated robustness in equality of variance and a post hoc test were conducted using Games-Howell for this cluster, for the other clusters no violation occurred and a Scheffe post hoc test was executed.

Mean and Standard deviation

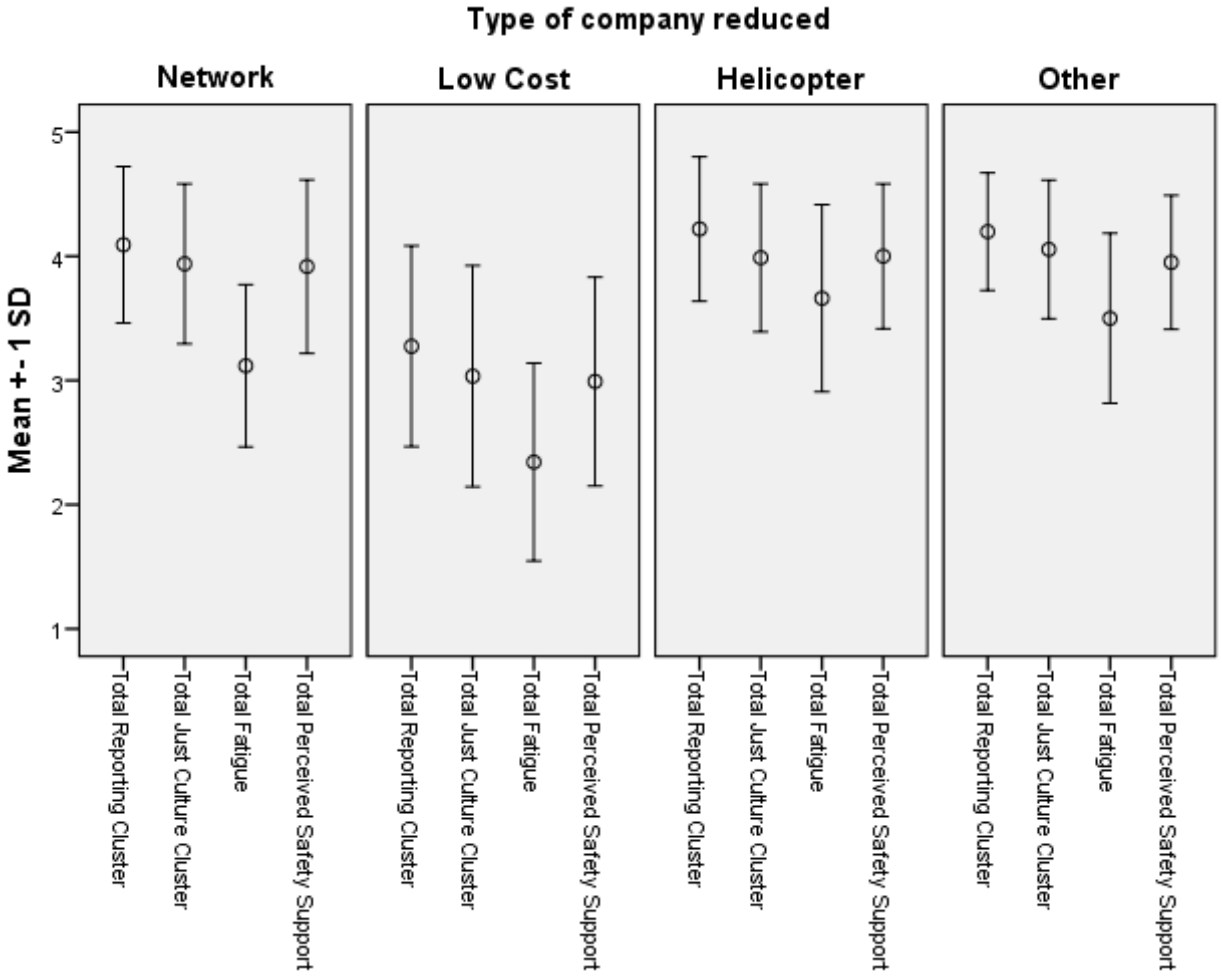


Figure 45 , Safety Clusters mean & SD scores versus type of Company.

The general pattern is equal in all groups, with the mean value of the fatigue cluster considerable lower for all groups, Network and Helicopter groups are more positive than LCC pilots overall. Mean and Standard deviation values are given below.

Mean & SD for all groups versus safety culture clusters				
		N	Mean	SD
Total Reporting	Network	242	4,09	,630
	Low Cost	35	3,28	,809
	Helicopter	33	4,22	,582
	Other	29	4,20	,473
	Total	339	4,03	,683
Total Just Culture	Network	242	3,94	,644
	Low Cost	35	3,03	,890
	Helicopter	33	3,99	,596
	Other	29	4,06	,558

	Total	339	3,86	,718
Total Fatigue	Network	242	3,12	,653
	Low Cost	35	2,34	,796
	Helicopter	33	3,66	,753
	Other	29	3,50	,684
	Total	339	3,12	,751
Total Perceived Safety Support	Network	242	3,92	,699
	Low Cost	35	2,99	,841
	Helicopter	33	4,00	,584
	Other	29	3,95	,539
	Total	339	3,83	,747

Table 27, Safety Clusters Mean & SD scores versus company type

The ANOVA test showed between group differences for all groups.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Total Reporting	Between Groups	22,904	3	7,635	18,955	,000
	Within Groups	134,926	335	,403		
	Total	157,830	338			
Total Just Culture	Between Groups	27,012	3	9,004	20,513	,000
	Within Groups	147,041	335	,439		
	Total	174,052	338			
Total Fatigue	Between Groups	35,004	3	11,668	25,114	,000
	Within Groups	155,640	335	,465		
	Total	190,643	338			
Total Perceived Safety Support	Between Groups	27,809	3	9,270	19,311	,000
	Within Groups	160,805	335	,480		
	Total	188,614	338			

Table 28, ANOVA figures for Safety Clusters versus Company Type

Multiple Comparisons

Dep.Var.		(I) Type of company reduced	(J) Type of company reduced	Mean Difference (I-J)	Std. Error	Sig.	99,9% Confidence Interval Lower Bound	99,9% Confidence Interval Upper Bound
Total Reporting	Scheffe	Network	Low Cost	,817*	,115	,000	,35	1,29
			Helicopter	-,127	,118	,761	-,61	,35
			Other	-,106	,125	,868	-,61	,40
		Low Cost	Network	-,817*	,115	,000	-1,29	-,35
			Helicopter	-,945*	,154	,000	-1,57	-,32

			Other	-,923*	,159	,000	-1,57	-,27
		Helicopter	Network	,127	,118	,761	-,35	,61
			Low Cost	,945*	,154	,000	,32	1,57
			Other	,021	,162	,999	-,64	,68
		Other	Network	,106	,125	,868	-,40	,61
			Low Cost	,923*	,159	,000	,27	1,57
			Helicopter	-,021	,162	,999	-,68	,64
Total Just Culture	**Games-Howell**	Network	Low Cost	,905*	,156	,000	,26	1,55
			Helicopter	-,049	,112	,971	-,51	,41
			Other	-,116	,112	,726	-,58	,35
		Low Cost	Network	-,905*	,156	,000	-1,55	-,26
			Helicopter	-,954*	,183	,000	-1,68	-,22
			Other	-1,021*	,183	,000	-1,75	-,29
		Helicopter	Network	,049	,112	,971	-,41	,51
			Low Cost	,954*	,183	,000	,22	1,68
			Other	-,067	,147	,968	-,65	,52
		Other	Network	,116	,112	,726	-,35	,58
			Low Cost	1,021*	,183	,000	,29	1,75
			Helicopter	,067	,147	,968	-,52	,65
Total Fatigue	Scheffe	Network	Low Cost	,775*	,123	,000	,27	1,28
			Helicopter	-,544*	,126	,000	-1,06	-,03
			Other	-,382	,134	,045	-,93	,16
		Low Cost	Network	-,775*	,123	,000	-1,28	-,27
			Helicopter	-1,319*	,165	,000	-1,99	-,64
			Other	-1,157*	,171	,000	-1,86	-,46
		Helicopter	Network	,544*	,126	,000	,03	1,06
			Low Cost	1,319*	,165	,000	,64	1,99
			Other	,162	,173	,833	-,55	,87
		Other	Network	,382	,134	,045	-,16	,93
			Low Cost	1,157*	,171	,000	,46	1,86
			Helicopter	-,162	,173	,833	-,87	,55
Total Perceived Safety Support	Scheffe	Network	Low Cost	,926*	,125	,000	,41	1,44
			Helicopter	-,083	,129	,937	-,61	,44
			Other	-,033	,136	,996	-,59	,52
		Low Cost	Network	-,926*	,125	,000	-1,44	-,41
			Helicopter	-1,008*	,168	,000	-1,69	-,32
			Other	-,959*	,174	,000	-1,67	-,25
		Helicopter	Network	,083	,129	,937	-,44	,61
			Low Cost	1,008*	,168	,000	,32	1,69
			Other	,049	,176	,994	-,67	,77

Other	Network	,033	,136	,996	-,52	,59
	Low Cost	,959*	,174	,000	,25	1,67
	Helicopter	-,049	,176	,994	-,77	,67

Table 29, Multiple comparisons of mean scores versus company types

One way between-groups analysis on the total Reporting cluster

There were significantly differences ($p<0.05$) in the three company types, $F(3,335)=18.995$ at $p=0.000$ for the total Reporting cluster. A Scheffe post hoc showed significant differences between LCC (M=3.28 & SD=0.809) and Network (M=4.09 & SD=0.30), and between LCC and Helicopter (M=4.22 & SD=.582), the Mean differences where high. The multiple comparisons table above show the post hoc numbers. Other comparisons showed no significant differences.

Cohen's d for Network/LCC = 1.46 and Cohen's d for LCC/Helicopter= 1.35. Both figures are considered a large effect size (larger than SD).

One way between-groups analysis on the total Just Culture cluster

There were significantly differences ($p<0.05$) in the three company types, $F(3,335)= 20.513$ at $p=0.000$ for the total Just Culture cluster. A Games-Howell post hoc showed significant differences between LCC (M=3.03 & SD=0.890) and Network (M=3.94 & SD=0.644), and between LCC and Helicopter (M=3.99 & SD=.596), the Mean differences where high (.905 and .954 respectively). The multiple comparisons table above show the post hoc numbers. Other comparisons showed no significant differences, except the "other" group.

Cohen's d for Network/LCC = 1.19 and Cohen's d for LCC/Helicopter= 1.292. Both figures are considered a large effect size (actually larger than SD).

One way between-groups analysis on the total Perceived Safety Support cluster

There were significantly differences ($p<0.05$) in the three company types, $F(3,335)=19.311$ at $p=0.000$ for the total perceived safety support cluster. A Scheffe post hoc showed significant differences between LCC (M=2.99 & SD=0.841) and Network (M=3.92 & SD=0.699), and between LCC and Helicopter (M=4.00 & SD=.584), the Mean differences where high (MD=-.926 and MD=-1,008 respectively). The multiple comparisons table above show the post hoc numbers. Other comparisons showed no significant differences.

Cohen's d for Network/LCC = 1.21 and Cohen's d for LCC/Helicopter= 1.42. Both figures are considered a large effect size (larger than SD).

One way between-groups analysis on the total Fatigue cluster

There were significantly differences ($p<0.05$) in the three company types, $F(3,335)=25.114$ at $p=0.000$ for the total Fatigue cluster. A Scheffe post hoc showed significant differences between LCC (M=2.34 & SD=0.796) and Network (M=3.12 & SD=0.653), and between LCC and Helicopter (M=3.66 & SD=.753), the Mean differences where high (MD= -.775 and MD=-1.319 respectively). In addition there were a significant difference between Network and Helicopter (MD=0.775 (high)). The multiple comparisons table above show the post hoc numbers. Other comparisons showed no significant differences.

Cohen's d for Network/LCC = 1.08 and Cohen's d for LCC/Helicopter= 1.70(!). Both figures are considered a large effect size (larger than SD).

The effect size for Network/Helicopter; Cohen's d= 0.768, and this in the high range.

Noteworthy is the mean value for LCC at 2.34 calling for immediate attention according to Reader et al. (2016). The Network value (3.12) is in the middle of the caution range (2.5 to 3.5).

None of the groups were guaranteed at type 1 error level, and the harmonic mean of the group was used.

The spider diagram illustrates mean differences between all groups and clusters. Note the difference between Network and Helicopter vs the total Fatigue cluster.

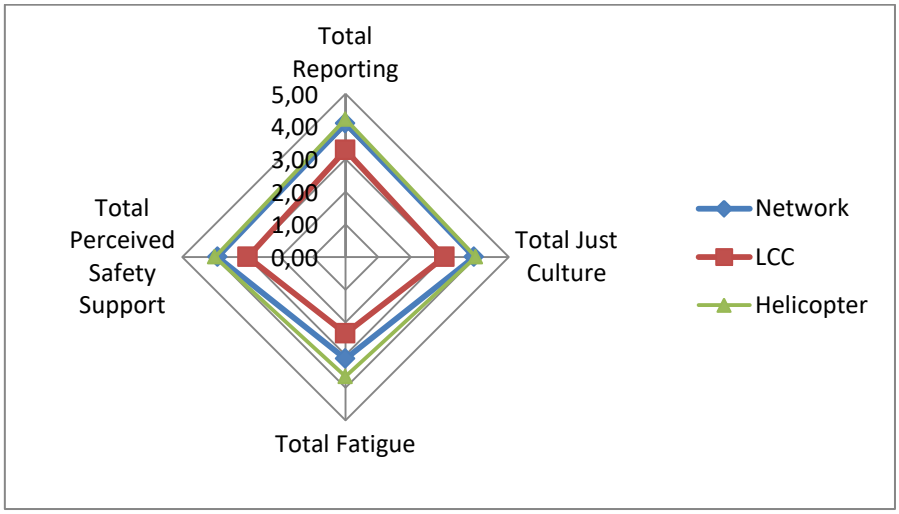


Figure 46, Mean scores differences for all Safety Culture clusters versus Company types

Below you will find graphs illustrating the differences cluster by cluster

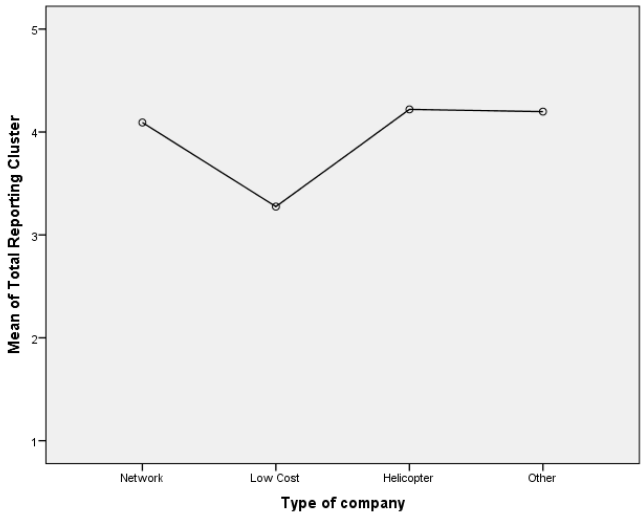


Figure 47, Reporting cluster mean scores versus company type

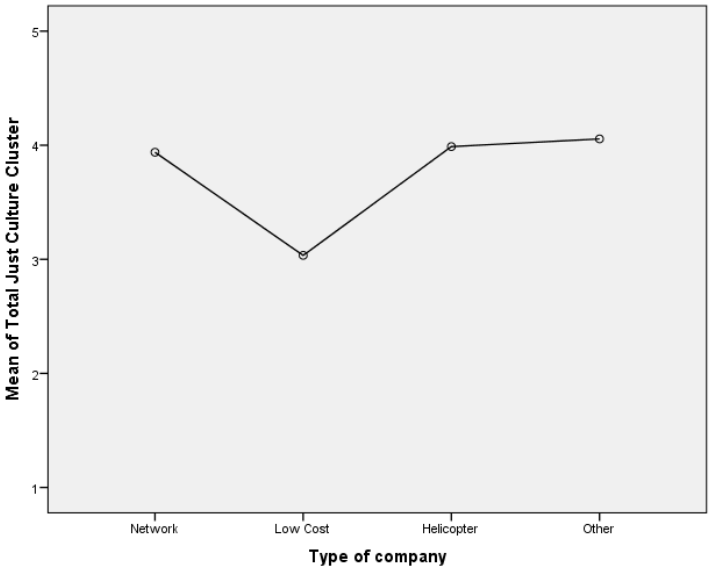


Figure 48, Just Culture cluster mean scores versus Company type

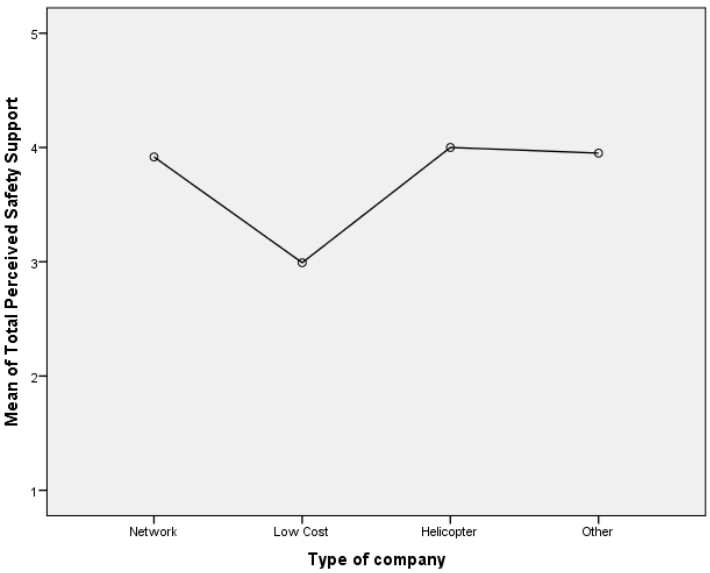


Figure 49, Perceived Safety Support cluster mean scores versus Company type

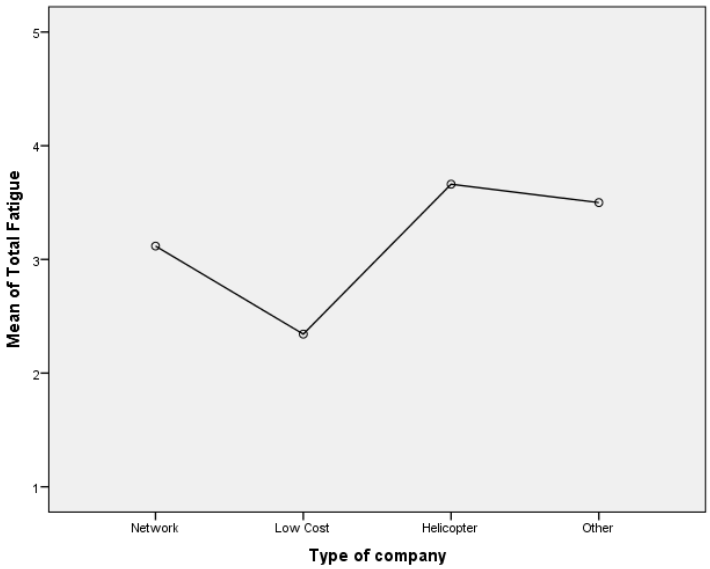


Figure 50, Fatigue cluster mean scores versus Company type

4.5 Other results describing the research question

4.5.1 CAA/EASA findings

Pilots knowledge of essential SMS features, like reporting, at the state level where tested. The results are given below; only 54 % answered either yes or no indicating they are familiar with the CAA Safety Management System. Almost 46 % replied they did not know. Information and reporting is an essential part of an effective Safety Management System and this result is discussed in section 5 of this paper. $N_{missing}$ = 1, indicating 99,7% response rate.

Is there a voluntary pilot reporting system in the country (CAA) where your company's AOC is registered?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	173	51,0	51,2	51,2
	No	10	2,9	3,0	54,1
	I don't know	155	45,7	45,9	100,0
	Total	338	99,7	100,0	
Missing	System	1	,3		
Total		339	100,0		

Table 30, Pilot's knowledge about state level SMS features

Pilots were asked if they considered EASA or national CAA to be politically governed to a degree that flight safety is jeopardized. The response rate was 99.7 % or $N_{missing}$ =1 and the full range (1-5) of the scale were used. The mean value was high 4.06 or if reversed for

consistency, the mean was 1.94(!). Low numbers indicates a concern or urgent action is needed. The standard deviation was high indicating a considerable variation among pilots.
To check if there were differences between groups, independent-samples T-Tests were run on age, contract, position, previous contract and management role groups. Only the "position" group showed a slight chance of differences. No other significant differences between groups were disclosed.
The table below shows the mean and standard deviation:

	N	Range	Minimum	Maximum	Mean	SD
The national aviation safety authorities (CAA/EASA) are politically governed to a degree that flight safety is jeopardized.	338	4	1	5	4,06	1,031
Valid N (listwise)	338					
Reversing the response for consistency, low numbers are negative vs flight safety						
Above question reversed	338	4	1	5	1,94	1,031
Valid N (listwise)	338					

Table 31, Are CAA/EASA organizations politically influenced to a degree were flight safety is at risk?

To clarify the nationality of the organization the pilots was thinking of in the question above a follow up question were asked. The options were national CAA and EASA at the European Union level. The chart below shows Nordic Countries and EASA distribution, other valid countries is grouped within "other". The chart only reflects the count rate, and is not compared to the nationality of the pilots. ($N_{missing}$ =12 and N_{valid} = 327).

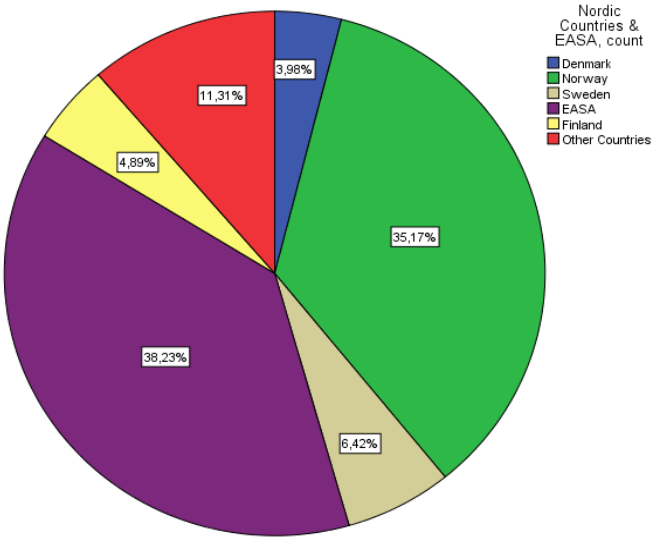


Figure 51, Political governance versus Organization referred, percentage of total count

Norway and EASA stands out with 35% and 38% respectively, but the low response rate from Sweden, Denmark and Finland compared to Norway render the national numbers skewed and should be viewed together with the cross tabulation below.

Calculating the percentage of respondents thinking of their national CAA or EASA respectively (using the cross tabulation below) gives these numbers:

Norway: CAA_{NOR} 61.8% EASA 30.6 %

Sweden: CAA_{SWE} 40.9 % EASA 40.9 %

Denmark: CAA_{DEN} 18 % EASA 57.4 %

Finland: CAA_{FIN} 57.7 % EASA 42.3 %

At the "positive" end we have Danish CAA with 18 % of Danish based pilots viewing their national CAA politically governed to a degree where flight safety is jeopardized. On the negative side we have Norway with a huge mistrust towards the national CAA and political governance, 61.8 %. The political governance (EU) of EASA is substantial and higher among EU countries (Sweden, Denmark, and Finland) than Norway which is an EASA member but not a member of the EU.

(The column named "Other Countries" (N=37) is dominated to 81% by the Irish CAA).

The table below shows a cross tabulation of the figures referred above:

What country are you based in? * Nordic Countries Cross tabulation

Count

		CAA Nordic Countries and EASA						
		Denmark	Norway	Sweden	EASA	Finland	Other Countries	Total
What country are you based in?	Denmark	11	0	3	35	0	12	61
	Norway	0	115	0	57	0	14	186
	Sweden	1	0	18	18	0	7	44
	Belgium	0	0	0	1	0	2	3
	Bulgaria	0	0	0	0	0	1	1
	Finland	0	0	0	11	15	0	26
	Ireland	0	0	0	0	0	1	1
	UK	0	0	0	3	0	0	3
	Other	1	0	0	0	1	0	2
Total		13	115	21	125	16	37	327

Table 32, "Base" country cross tabulated with Nordic countries and EASA

4.5.2 Employment models

Employment models vs Flight safety (Misc3)

The question received a very low mean score M=1.62 and N=337. The standard deviation showed a considerable difference among pilots and 85% of the pilots believe the contract type affect flight safety. The skewness in the employment contract group is probably reflected in the question responses.

Independent-samples T-Tests were conducted on the age, contract type, position, previous contract and management groups to check for differences. Age and position showed differences, both groups not satisfying the equal variance assumption.

The pilots with a age below 40 (M=1.4, SD=.884) showed a difference to those with age above 40 (M=1.71, SD=1.286); t(17)=2.251, p=.001, two-tailed) versus the employment models and flight safety question. The magnitude of difference in the means (MD=.316, 99% CI: -.555 to -.77) is considered high with Cohen's d at 0.63.

The Captains (M=1.74, SD=1.256) showed a difference to Flight Officers (M=1.44, SD=1.062); t(9)=2.366, p=.0019, two-tailed) versus the employment models and flight safety question. The magnitude of difference in the means (MD=.300, 99% CI: .051 to .549) is low with Cohen's d at 0.27.

Both t-tests show younger pilots and pilots holding flight officer positions to be more negative towards flight safety and employment models.

Misc3 Descriptive Statistics						
	N	Range	Min.	Max.	Mean	SD
Pilot employment models do not affect flight safety.	337	4	1	5	1,62	1,187
Valid N (listwise)	337					

Table 34, Do Employment models affect Flight Safety?

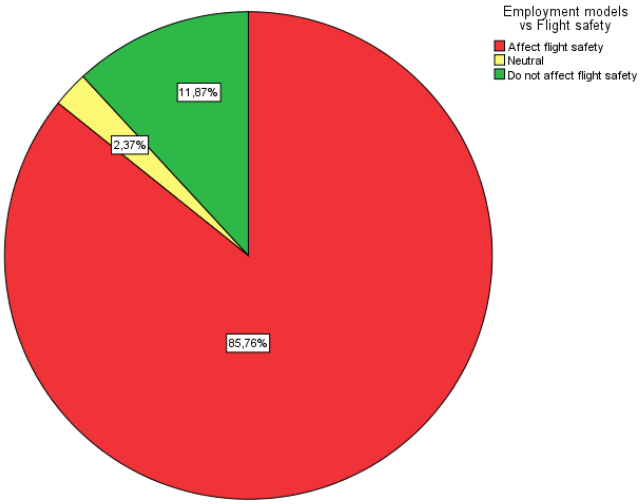


Figure 52, Does pilot employment models affect flight safety? (Red = negative effect)

The above findings is consistent with the findings towards the below question, but the skewness among the respondents is probably reflected, i.e. biased towards own type of contract.

To check if the pilot group was more positive towards atypical or typical employment models in the question above an additional question was asked based on what contract the pilots currently had, i.e. those on typical contract was asked question R4T and those on atypical contract R4P. Both groups indicate a more negative attitude towards atypical employment models. The full range (1-6) was used (the range had a possibility to not participate, "No answer"). R4P received 18 responses with 72% in favor of a typical contract when it comes to enhanced flight safety, likewise the R4T received 320 responses and with 75% favoring a typical contract. $N_{missing}$ =1. The question was not further analyzed.

In the table below Mean and Standard Deviation is given, graphical illustrations are found below the table.

R4T/R4P: Flight Safety vs Employment models Descriptive Statistics						
	N	Range	Min.	Max.	Mean	SD
R4T: Employment models versus flight safety in Europe.: Temporary Employment models	338 (18)	5	1	6	1,43	,670
R4P: Employment models versus flight safety in Europe.: Permanent Employment model (unlimited)	339 (320)	5	1	6	4,63	,647
Valid N (listwise)	338					

Table 35, Flight safety versus employment models

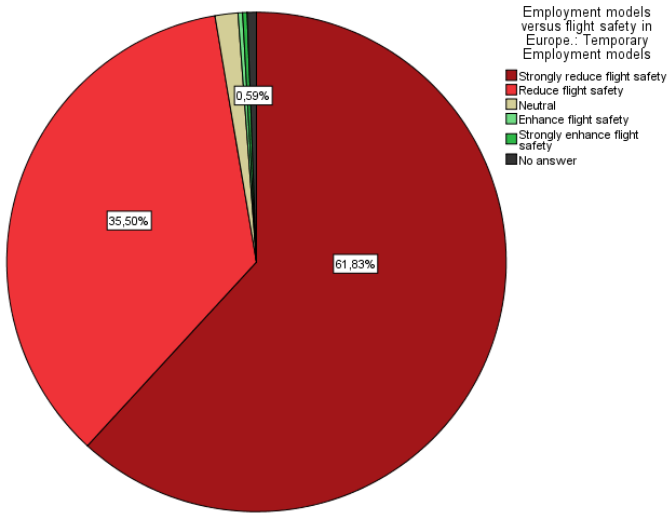


Figure 53, Temporary employment versus flight safety, red negative effect

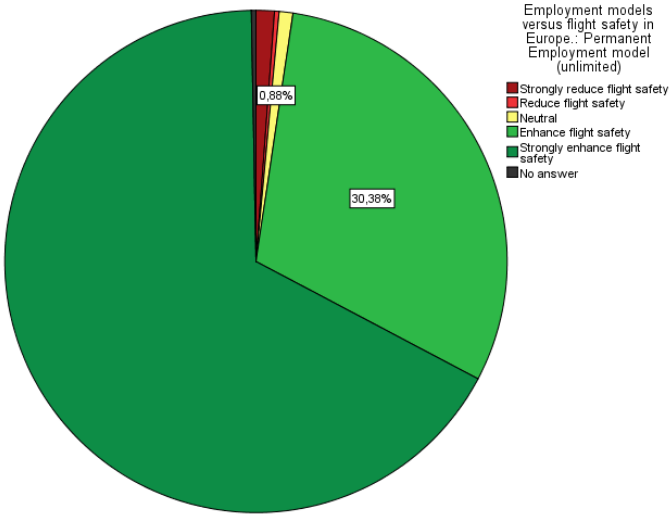


Figure 54, Typical employment versus flight safety, green positive effect

Self-reporting vs previous contract evaluation

To get a better picture of the self-reporting willingness versus employment models, those with less than 5 years at current employer were asked additional questions about their views on self-reporting, among other issues. 70 respondents were asked the question and $N_{missing}$=3. Pilots with a previous typical employment contract ($N_{prevTyp}$=28) were more neutral, i.e. reported no change from previous employer. Pilots with a previous atypical employment model ($N_{prevAtyp}$=34) were much more negative to self-reporting when on an atypical contract. The table below shows the cross tabulation and frequency. The figures are graphically illustrated below the table. No further analysis was performed on this question.

You have changed employer the last 5 years; With your PREVIOUS employer, how would you rate the following criteria?					
	Self-reporting				
	Much harder / Much less Count	Harder / Less Count	No change Count	Easier / more Count	Much easier / much more Count
Previous Typical	1	7	14	3	3
Previous Atypical	11	14	7	2	0
Other (no previous etc.)	0	1	1	1	1

Table 36, Previous employer contract versus Self-Reporting.

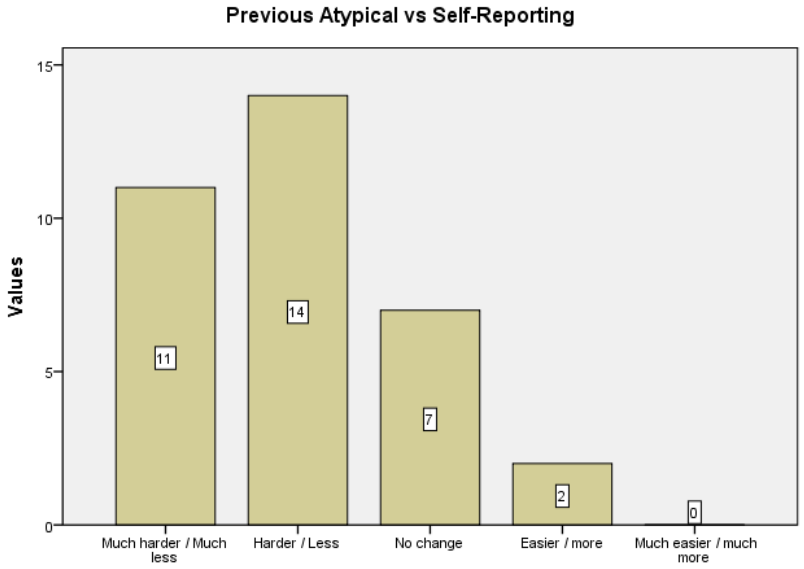


Figure 55, "Atypical" previous employer contract versus Self-reporting

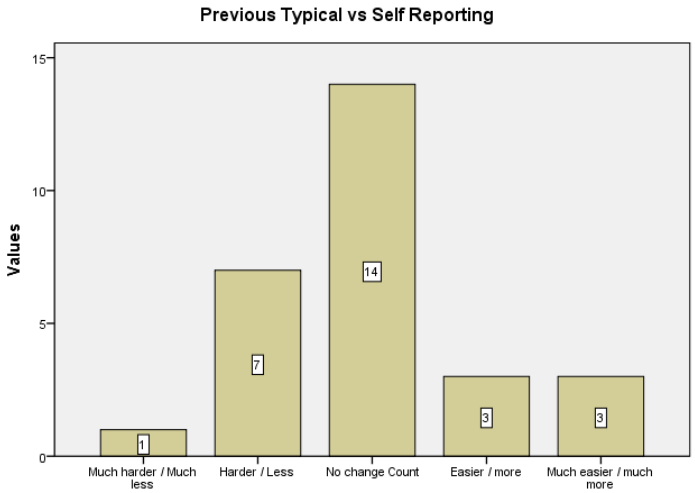


Figure 56, "Typical" previous contract versus Self-Reporting

Stepping down from duty due to fatigue vs Employment models

Pilots were asked different questions depending on their current employment contract (typical or atypical) versus their willingness to step down from duty due to fatigue. (The pilots have a right and obligation to step down from duty when fatigued). The pilots were asked different questions depending on their contract type, unfortunately the wording is not equal, one group were asked a negatively worded question while the other were asked a positively worded question. This might cause bias towards one employment contract type. However the results are unambiguous when looking at the mean scores. Those on Atypical contracts believe it is easier to step down from fatigue when on a typical contract M=3.89 & SD .875, vice versa those on typical contract believe it is harder to step down from duty due to fatigue when on an atypical contract (M=4,57 & SD=.735). To have a consistent look versus flight safety the latter group was reversed and the comparable mean value is very low (M=1.43).

Independent-samples T-Tests were performed on age, position, management role and previous contract type groups. The previous contract type was so small that the test contained only N=9 (the question was already divided in contract type groups) and hence discarded. The position group and management role group showed small or no significant differences.

The age group (below/above 40) showed significant differences even though the means were extremely low for both. The pilots with a age below 40 (N=95, M=1.6, SD=.892) showed a difference to those with age above 40 (N=225, M=1.36, SD=0.647); t(11.6)=2.372, p=.019, two-tailed) versus the willingness to step down from fatigue versus the contract type. The magnitude of difference in the means (MD=.240, 99% CI: .04 to -.44) is medium with Cohen's d at 0,312. In short older pilots were more skeptical towards atypical contracts and the willingness to step down from duty.

Employment models vs Stepping down from duty due to fatigue.	N	Range	Min.	Max.	Mean	SD
F6P: If I had a permanent (unlimited) employment contract it would be easier to step down from duty, when fatigued.	19	3	2	5	3,89	,875
F6T: If I was employed through a temporary contract it would be harder to step down from duty, when fatigued.	320	4	1	5	4,57	,735
Valid N (listwise)	339					
Question F6T reversed for consistency vs flight safety, (due negative wording)	320	4	1	5	1,43	,735

Table 37, Employment models versus stepping down from duty due to fatigue

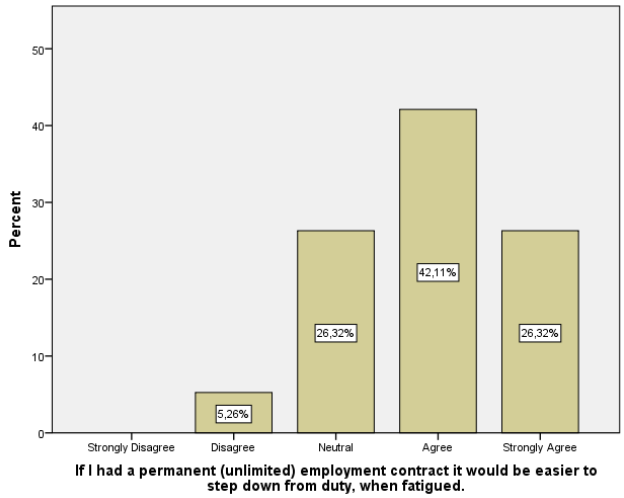


Figure 57, F6P graphically illustrated, 68.5% in favor of typically employment

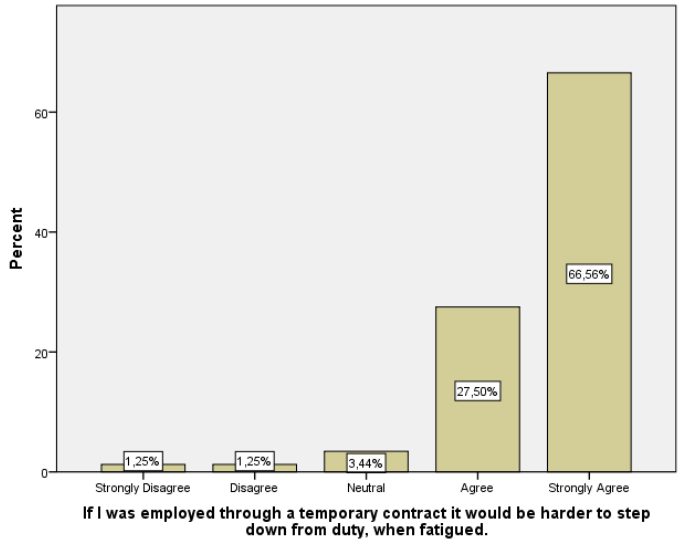


Figure 58, F6T graphically illustrated, 94% negatively biased if atypically employed

4.5.3 Miscellaneous

The questionnaire had two open ended questions one specific and one open to comment on the questionnaire and other issues, the latter is deleted from this paper. The first question asked what the respondents viewed as the "Greatest threat to European aviation". The response text is compromising for some, revealing company names etc. therefore the full text is not shown in this report. The answers were evaluated one by one and categorized as greatest threat (N=309) and second greatest threat (N=119) to European Aviation; -two new variables were established for this purpose. A few participants contributed with a third threat, but this is not reflected in this report.

Top three threats listed by the respondents as greatest or second greatest are identical; the frequency tables below show the ranked lists of threats. Employment models, fatigue and

political governing of CAA are ranked as top three threats and in that order. Remarkably, only two respondents mention terrorist acts as the greatest threat to European Aviation. Political governing have a frequency 20 times higher, and fatigue 45 times higher and employment models rise to 50 times greater threat to aviation than terrorist acts. None mentioned terrorist acts as a secondary threat to aviation.

Greatest threat to European Aviation, ranked high-low.					
		Frequency	Percent	Valid %	Cumulative %
Valid	Employment models	99	29,2	32,0	32,0
	Fatigue	90	26,5	29,1	61,2
	Political governing of CAA/deregulation/responsibility fragmentation	41	12,1	13,3	74,4
	Low Cost Carrier Regime/Race to the bottom	32	9,4	10,4	84,8
	Economical pressure	20	5,9	6,5	91,3
	Operator Management pressure	7	2,1	2,3	93,5
	Training standards/Manual flying skills	6	1,8	1,9	95,5
	Other	6	1,8	1,9	97,4
	Low Pilot Experience	4	1,2	1,3	98,7
	Lack of social security	2	,6	,6	99,4
	Terror/Criminal act	2	,6	,6	100,0
	Total	309	91,2	100,0	
Missing	System	30	8,8		
Total		339	100,0		

Table 38, Threat to European Aviation ranked high to low, extracted from open ended text.

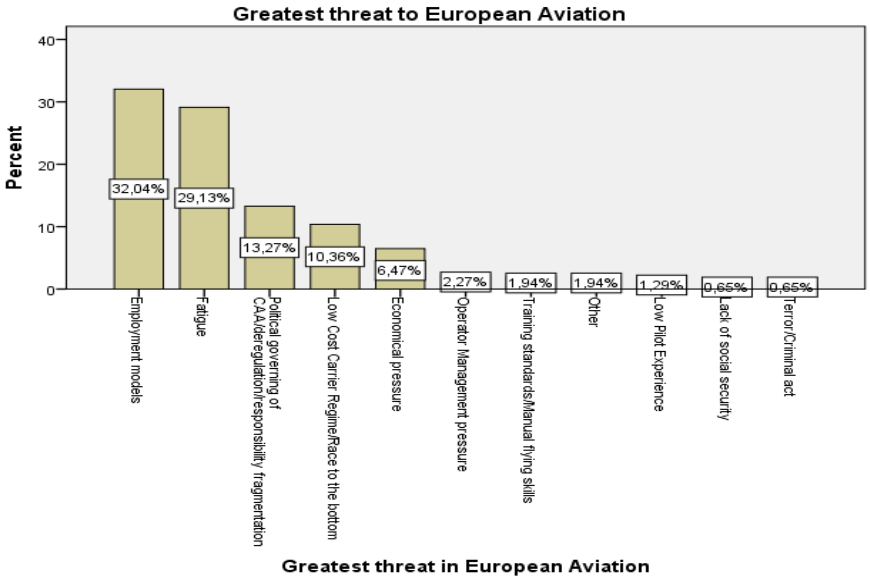


Figure 59, Threats to European aviation ranked, extracted from open ended text

"Secondary" threats to European aviation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employment models	40	11,8	33,6	33,6
	Fatigue	27	8,0	22,7	56,3
	Political governing of CAA/deregulation/responsibility fragmentation	14	4,1	11,8	68,1
	Training standards/Manual flying skills	10	2,9	8,4	76,5
	Economical pressure	7	2,1	5,9	82,4
	Other	7	2,1	5,9	88,2
	Low Cost Carrier Regime/Race to the bottom	5	1,5	4,2	92,4
	Operator Management pressure	4	1,2	3,4	95,8
	Low Pilot Experience	3	,9	2,5	98,3
	Lack of social security	2	,6	1,7	100,0
	Total	119	35,1	100,0	
Missing	System	220	64,9		
Total		339	100,0		

Table 39, "Secondary/additional" listed threat (ranked high to low)

The "Other" category above hide to a large extent a Norwegian helicopter issue called HOFO, see abbreviations.

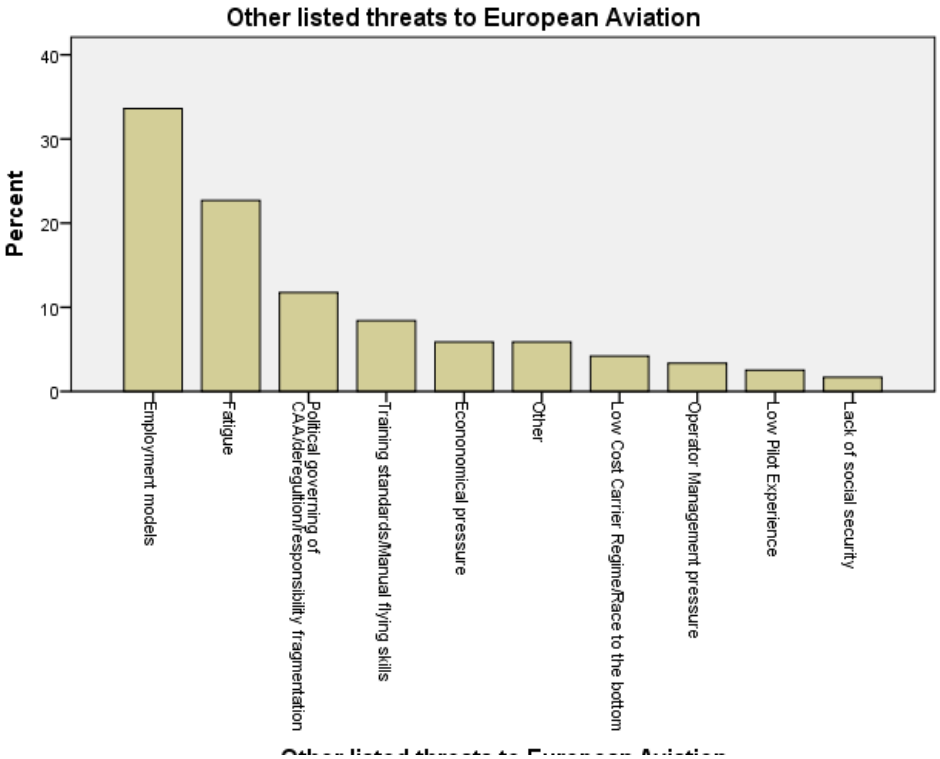


Figure 60, "Secondary/additional" listed threat (ranked high to low), terror not mentioned

Luck vs flight safety

A report from New Zeeland (Gill and Shergill, 2004, Abstract and section 4.1) reported a high number of pilots to consider luck a major part of flight safety, to evaluate this among Nordic pilots a question confronting the matter were issued. The result was positive and "only" 9% considered luck a main factor towards flight safety.

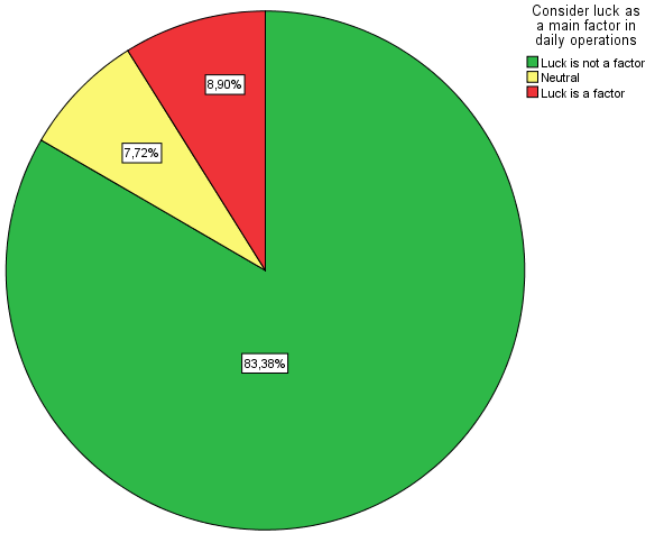


Figure 61, Percentage of pilots considering luck a main safety factor in their company

Independent-samples T-Tests were conducted on the age, contract type, position, previous contract and management groups to check for differences. Age and Contract type showed differences, both groups not satisfying the equal variance assumption.

The pilots with an age below 40 (N=103, M=3.98, SD=1.24) showed a difference to those with age above 40 (N=243, M=4.40, SD=0.913); t(12.5)=-3.088, p=.002, two-tailed) versus luck as a safety factor (high M value is positive regarding flight safety). The magnitude of difference in the means (MD=.421, 99% CI: -.691 to -.152) is medium with Cohen's d at 0.389. Young pilots considered luck to be a greater factor.

The pilots with a typical contract (M=4.32, SD=.994) showed a difference to those on an atypical contract (M=3.20, SD=1.5521); t(9)=2.817, p=.013, two-tailed) versus luck as a safety factor (high M value is positive regarding flight safety). The magnitude of difference in the means (MD=1.118, 99% CI: .270 to 1.985) is high with Cohen's d at 0.891. Atypically employed pilots considered luck a greater factor towards flight safety.

ANOVA, Analysis of variance, where performed on the question of luck and the type of company, the number of types was reduced to four groups, Network, Low Cost Carriers (LCC), Helicopter and other (General aviation, Business etc.). Only the three first are commented on in this paper.

Levene's test of homogeneity of variance showed no violation occurred and a Scheffe post hoc test was performed on all groups.

One way between-groups analysis on the total Reporting cluster:

There were significantly differences ($p<0.05$) in the three company types, $F(3,333)=15.15$ at $p=0.000$ for the question of luck and flight safety. A Scheffe post hoc showed significant differences between LCC (M=3.23 & SD=1.285) and Network (M=4.37 & SD=0.946), and between LCC and Helicopter (M=4.58 & SD=.83), the Mean differences where high (MD LCC/Network=1.142 and LCC/Helicopter=1.347).

Cohen's d for Network/LCC = 1.02 and Cohen's d for LCC/Helicopter= 1.27. Both figures are considered a large effect size (larger than SD). Luck was considered a greater factor in LCC operations than for network and helicopter operations.

Only the Multiple Comparisons table from the ANOVA is shown below.

Multiple Comparisons

Dependent Variable: Luck

Scheffe

(I) Type of company reduced	(J) Type of company reduced	MD (I-J)	Std. Error	Sig.	99,9% CI Lower Bound	99,9% CI Upper Bound
Network	Low Cost	1,142*	,178	,000	,42	1,87
	Helicopter	-,205	,182	,738	-,95	,54
	Other	-,008	,193	1,000	-,80	,78
LCC	Network	-1,142*	,178	,000	-1,87	-,42
	Helicopter	-1,347*	,238	,000	-2,32	-,38
	Other	-1,151*	,247	,000	-2,16	-,14
Helicopter	Network	,205	,182	,738	-,54	,95
	Low Cost	1,347*	,238	,000	,38	2,32
	Other	,196	,250	,892	-,82	1,22
Other	Network	,008	,193	1,000	-,78	,80
	Low Cost	1,151*	,247	,000	,14	2,16
	Helicopter	-,196	,250	,892	-1,22	,82

*. The mean difference is significant at the 0.001 level.

Table 40, Luck and flight safety versus company type comparison

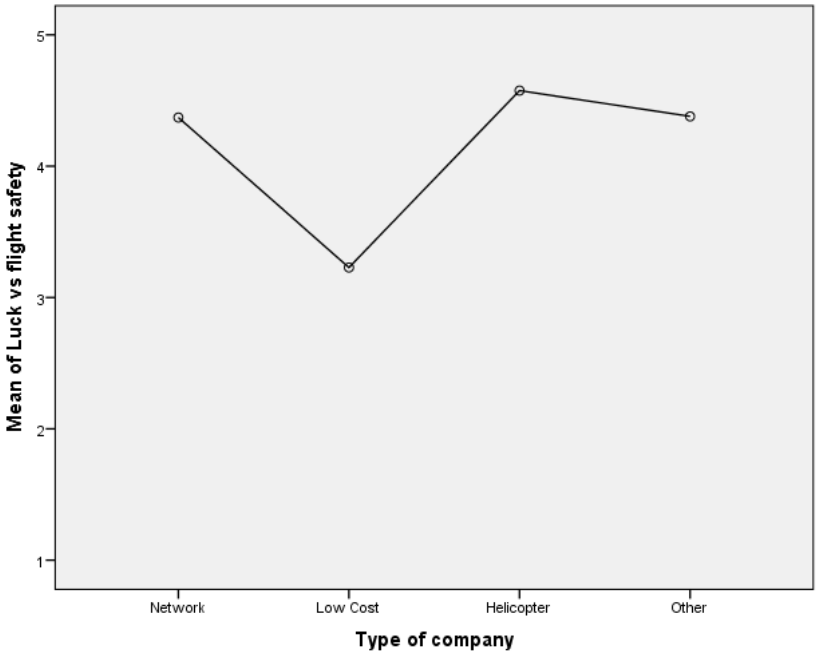


Figure 62, Luck and flight safety versus company type, lower number is more negative towards safety

5 Discussion; Essences and Analysis

The theoretical background of SMS effectiveness and possible in-group differences where summed up in two hypotheses, referred below. This discussion will focus on both positive and negative effects on SMS effectiveness and the ability to retain effectiveness. Please refer to the theoretical background of SMS, Employment models and the research question described in chapter 1 and 2. Headlines in each section below refer the objectives listed in sections 1.2.

- ***Hypothesis 1:*** *The SMS system need to have the characters of mutual "just culture", openness, trust and support to receive reports, in addition the systems need channels and flexibility to promote the information to the sharp-end in a trustworthy manner. If any of these factors are violated from the management the pilots will not self-report and the safety management system will lose effectiveness.*
- ***Hypothesis 2:*** *Differences within contract types, age groups, experience level, position and roles and the type of company will show differences towards self-reporting willingness, perceived safety support, fatigue issues and just culture, and hence indicate differences towards the possibility to retain SMS effectiveness.*

A key point is the five forces of an effective safety reporting environment and to recapitulate these are given below:

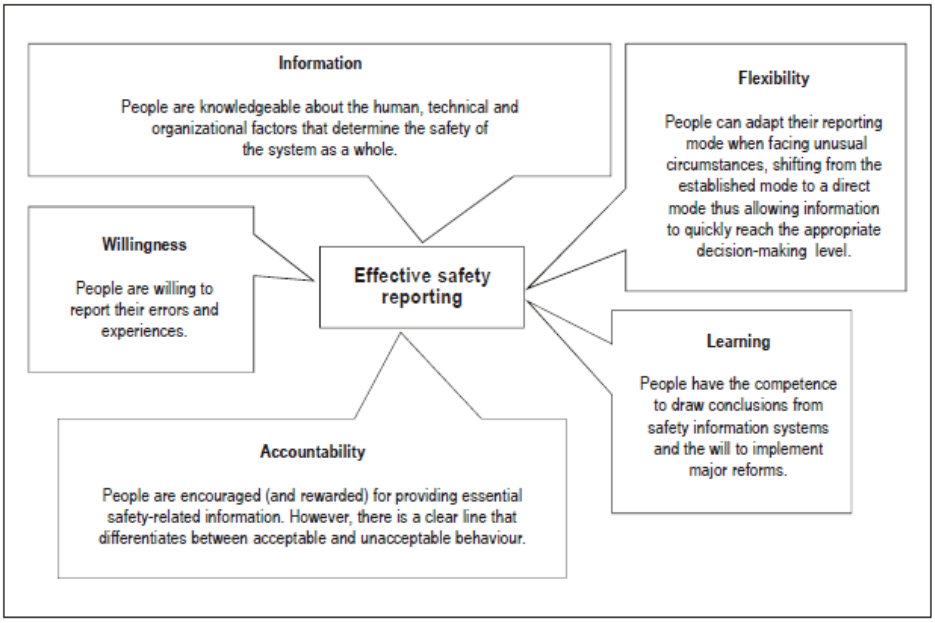


Figure 2-7. Effective safety reporting — five basic characteristics

Figure 63, Recap of the five basic characteristics of "effective safety reporting" (ICAO, 2013, p. 2-17)

5.1 Empirical findings versus the four safety dimensions

One of the main objectives was to check if the LSE safety culture survey dimension of perceived safety support, fatigue, reporting and just culture could be verified among Nordic pilots. The cultural characteristics (low hieratical gradient, culture of speaking up and strong labor regulations(Tear et al., 2016)) and strong union employer cooperation made it plausible to expect an equal or better score in this survey, especially on just culture and perceived safety support. The number of questions in each dimension is far less and hence not directly comparable but a good indication.

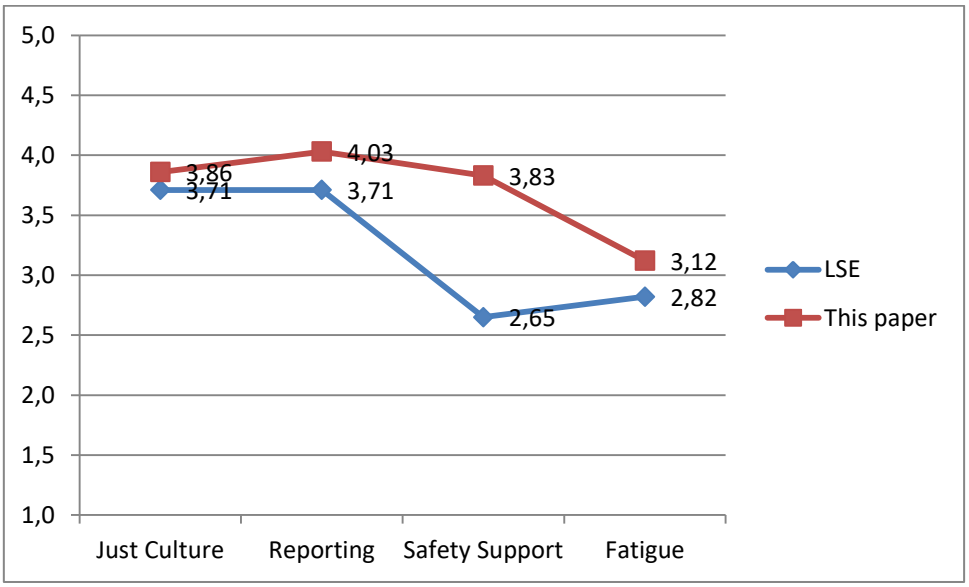


Figure 64, LSE versus this survey, safety clusters (Reader et al., 2016)

As shown above this survey have higher mean values than in the LSE survey. The remarkable difference is perceived safety support which scores considerably higher, this cluster contained considerable less and less diverse questions than in the LSE survey, this might be a reason, but equally so the Nordic cultural traditions (Tear et al., 2016) mentioned might be another reason for this gap. Moving away from these traditions might alter the picture in the future. All scores in this survey are above the cutoff value of 3.5, except for the fatigue cluster (3.12), which gives room for interpretation, -more about fatigue later.

Overall the mean values in this survey are considered good and positive towards hypothesis 1. This indicates a good safety culture environment among Nordic operators and their pilots and should be regarded as a validation of the conclusion in the LSE survey:

> *The results show that the overall pilots' perception of safety culture is generally positive. (Reader et al., 2016, p. 148)*

Another main objective was to evaluate if the Safety Management System can retain effectiveness in the changing pilot environment. Based on the overall scores there are only one concern, or crack in the SMS fundament, -fatigue. Ref. Hypothesis 1, i.e. reporting willingness of fatigue matters are lacking as an input to the SMS, and hence indirectly lack of perceived safety support since it is not handled by the authorities and in this respect render the Safety Management System less efficient than needed.

5.1.1 Nordic pilot groups vs the safety culture, -a more diverged picture

The Nordic pilot group were categorized in these groups to show differences and to detect possible pitfalls toward SMS effectiveness:

- Title; Captains & Flight Officers
- Contract type; Typical & Atypical
- Management role; Management & Non-Management
- Experience level; Above 40 years & Below 40 years of age
- Company type; Network, Low Cost & Helicopter

Title, Contract type, Management role and Experience

The first group, title, shows difference between captains and first officers only when comparing scores in the fatigue cluster, but with a small effect size (0.268). The next categorization, contract type, was skewed but showed differences in all clusters and with high effect size (0.562 to 0.760). Managers showed no differences towards the clusters. The age division showed medium differences, effect size 0.342 to 0.393 in all clusters. This indicates, in line with the LSE survey, that younger, less experienced copilots are more negative towards the safety culture clusters. In addition this survey and the LSE survey found a higher percentage of these pilots holding an atypical contract (Reader et al., 2016, p. 117). Contract type differences indicate a shift in aviation safety thinking and support hypothesis 2 in the suggestion of a possible shift in SMS effectiveness, but require supplementary studies, see recommendations.

Company type

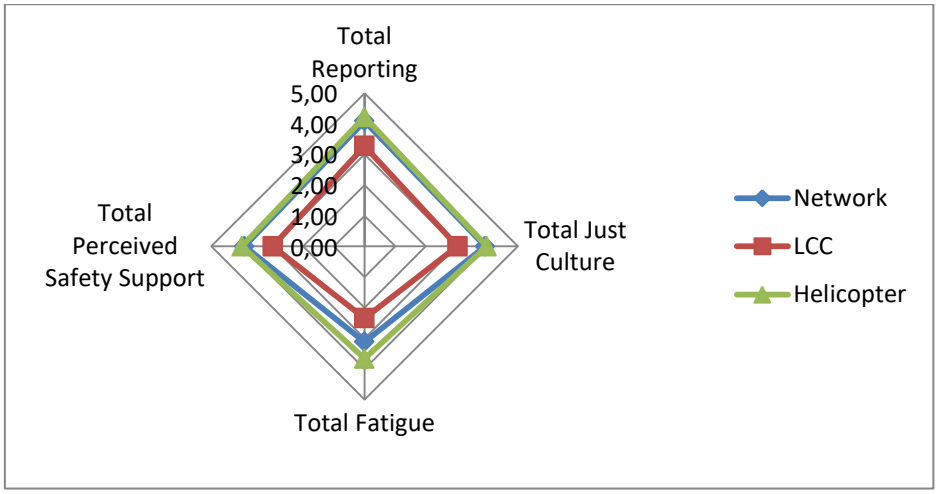


Figure 65, Differences illustrated by mean scores vs company type, discussed below.

More interesting and distinct were the findings between company types, Network, Low Cost Carriers (LCC) and the Helicopter segment. Overall the Helicopter segment is by far the most positive, even the fatigue cluster are in the "good" range (M=3.66). (Please note almost all of the helicopter pilots were based in Norway and hence generalization outside this segment is doubtful).

The LCC segment scores in the caution range or below in all clusters, while the network segment falls in the caution range in the concerning fatigue cluster only. The difference between the groups, LCC/Network, is high, actually the effect size is larger than the standard deviation in all clusters (1.3 to 1.7), and fatigue is again the most concerning.

Noteworthy is the mean value for LCC and the fatigue cluster at 2.34 calling for immediate attention. The Network value is in the middle of the caution range (3.12 versus 2.5 to 3.5).

This and the Ghent university survey found Low Cost Carriers to have the far more pilots on atypical contracts than network companies (Jorens et al., 2015, p. 160-161).

The indications that younger, less experienced have a higher degree of atypical contracts together with the shift towards LCC in Europe, and their higher use of atypical contracts, and concerning safety culture scores show a concerning picture towards hypothesis 2. It is safe to assume the shift described will affect the effectiveness of the Safety Management System negatively.

5.2 SMS effectiveness; -Respondent's knowledge of own company SMS

The effectiveness of a Safety Management System is dependent on the knowledge of the SMS and the potential for learning and the perceived information flow. To check this knowledge

additional question were asked and a positive high percentage (high 80's) had knowledge of the company's safety management system. Equal numbers were found versus reporting systems (mandatory, voluntary, confidential) in their company.
Pilots prioritizing of the main focus areas, in their safety organization, put "Human factors" and "Pilot Procedural errors" first and "Latent Errors" within the organization after the two mentioned categories. This is contradictory to one of the reasons to implement a Safety Management System; - to detect latent errors.
The respondents were also asked to prioritize the objectives of their reporting system, (Learning, Put blame, Trend analysis, Fulfil obligations towards regulators). A clear positive result towards SMS effectiveness were received, learning, trend analysis, fulfil obligations, other and then to put blame.
Only small in-group differences were noted in both questions.
To remain effective the SMS must have a clear policy of just culture and willingness to learn, this was verified by the response and hence a positive response versus hypothesis 1. There is no reason, based on these items, to believe that SMS efficiency is reduced, even though latent errors were prioritized lower than desired, but the differences were very small.

5.3 Other findings relevant to assess the effectiveness of the SMS,

5.3.1 The Nordic pilot group versus employment models

Pilot employment models versus flight safety were tested, and the disturbing mean value of 1.6, shows an unambiguous response in favor of typical employment models. It should be noted that the pilot group is skewed and probably biased towards own contract type. A less skewed category (previous employment contract) showed the pilots preferred a typical employment model towards the willingness to self-report. In addition the question of willingness to step down from duty due to fatigue favored typical contracts.
The above might indicate a reason to dig into this matter in further studies, and it is negative in respect to hypothesis 2, and hence SMS efficiency of just culture and reporting willingness is reduced.

5.3.2 The Nordic pilot group versus safety/fatigue reports

The mandatory issue of Fatigue reporting shows disappointing results. Approximately 65% of the total pilot group had skipped one or more fatigue reports the last 12 months, even those in management skip these reports at the same level. There might be reasons to do so, ease of reporting, fatigue itself and of course if there is lack of support or action on such reports from

the companies. This render the Safety Management System less effective (both hypothesis 1 & 2 is negative) than necessary versus fatigue issues and hence flight safety.

Pilot quote open ended question number 54:

"My company officially claims to practice non punitive reporting. I was ordered to my chief pilot because they said I filed too many fatigue reports according to our head of flight crew and head of flight operations. They threatened to take me off (xxxxx deleted text) *operations. Officially our head of flight operations ask us to file reports and says that* (XXXX company deleted) *should be a learning organization. The reality however show that they punish and threatened those who does, me included.*

As I'm not want to jeopardize my employment I stopped filing reports after this clear management message they send me!"

5.3.3 The Nordic pilot group versus threats in aviation

Another possible biased question, due to the fact respondents have a high degree of typical employment, is; -What is the greatest threat to European aviation?

1. Employment models
2. Fatigue
3. Political governance of CAA/regulations etc.

   ……

11. Terrorist act (only 2 listed this at all)

This order (first three listed) was repeated when listing the second greatest threat to aviation in Europe. Even if biased when it comes to employment models, the disturbing fact remains; - the three greatest threats are not considered criminal act, but regulations itself and problems regulating the issues of employment and fatigue. Only the regulators may alter all of the first three listed threats, this aggregates the negative picture. If we sum up the three first into one "regulator as a threat group" a depressing 74.4 percent list this as the greatest threat to European aviation. 91 percent of the respondents answered this question. This question raises considerable concern towards the regulating authorities and their "SMS effectiveness". The companies on the other hand are believed to follow the path laid by the regulators to stay competitive and have little choice in that respect, i.e. stricter internal company rules than required by the authorities will increase costs and reduce competiveness.

No in-group differences were tested and the question is not evaluated towards the main hypothesizes.

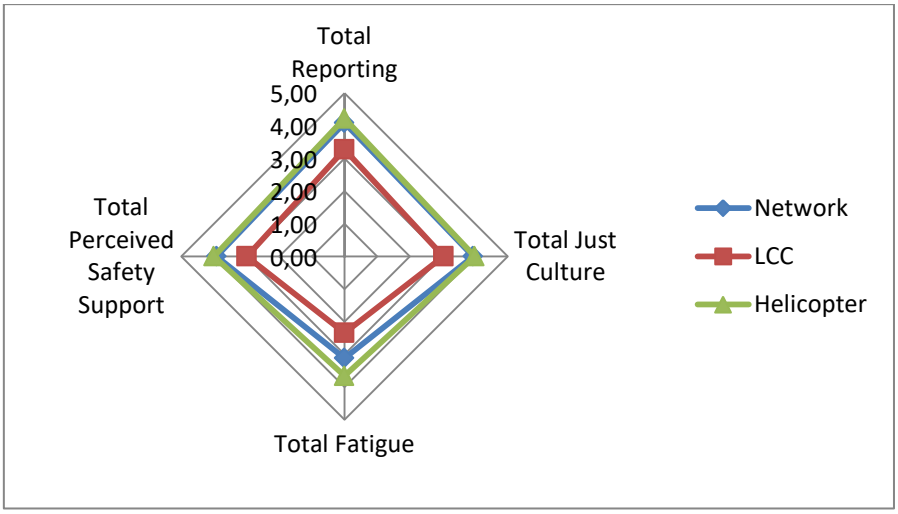
5.4 Does the Nordic pilot group have information and knowledge of national CAA reporting systems and confidence in CAA?

54% have knowledge of CAA reporting systems and 46% of the pilots don't know if such systems exist. This shows an information problem within national CAA and hence a reduced learning potential and possibility to evaluate what is going on effectively at a state level. If we in addition recall the fact that the mean value of 1.94 was registered for the question of political governance of national CAA to a degree were safety is jeopardized, then this add up to a huge mistrust towards the CAA/EASA possibility to rule in a safe manner. This result was not evaluated towards the main hypothesizes.

6 Conclusion, Recommendations and words of caution

6.1 How does the pilot employment environment affect SMS effectiveness?

The overall picture when looking at mean scores for all safety clusters is good, except the fatigue cluster. Fatigue calls for attention with a mean score of 3.12. Individual scores within the cluster and the fact that a vast majority think safety is at risk (M = 2.43) because of fatigue, together with high a mandatory fatigue report skip rate it is safe to assume that the SMS lack effectiveness in the fatigue area and indirectly reporting willingness in this respect. There are clear indications of differences among pilots employed in different company types (Network versus Low Cost Carriers versus Helicopter) within all safety dimensions analyzed:



There are indications that LCC have a greater SMS effectiveness problem than Network carriers and especially Helicopter operators. LCC have less perceived safety support, less perceived feeling of just culture, less reporting willingness and a higher fatigue issue. This picture is aggregated by the fact that LCC use a higher degree of atypical employment models

and younger (less experienced) pilots to a higher degree (Jorens et al., 2015), both these groups are more negative towards the safety dimensions analyzed. The legacy carriers are shifting towards LCC operations and moving towards the LCC employment regime (Ibid), i.e. lowering cost by outsourcing operations to LCC, and this shifting pilot environment makes it plausible to assume a shift in the efficiency of the SMS among network carriers too.
Overall the survey validated the LSE findings (Reader et al., 2016, p. 148), hence fulfilled one of the main goals of research; replication and hence validation of results (Marczyk et al., 2005, Loc. 417), making the findings more plausible.
The cumulonimbus clouds in European aviation might be embedded or obscured, but partly disclosed by this and other surveys, like the LSE and Ghent surveys (Reader et al., 2016, Jorens et al., 2015). All pointing to fatigue, employment models and regulation as areas of great concern, this will if unaddressed probably render the companies and national Safety Management Systems less efficient in the long run, because of widespread mistrust, fear of retaliations and failure to give safety support.
SMS safety pillars, reporting, just culture, perceived safety support and the interwoven fatigue issue are under pressure, due to the shifting pilot environment towards unsecure job contracts and legislation uncertainty it might even crack. Countermeasures to rebuild a cracked, but not collapsed, SMS fundament seem appropriate.
The mistrust among pilots towards political governance of EASA/CAA is so pronounced that it is almost unbelievable (M = 1.94, 74.5% of commercial pilots states safety is jeopardized by political governance of CAA/EASA), and should be of great concern both for companies and governing regulators. Based on ICAO's words of an effective safety organization (safety information, learning and willingness to report etc. see citation below (ICAO, 2013)) the conclusion must be; a failure by EASA/National CAA to embed a safety culture at all levels.
This study found a clear favor of typical employment contracts and favor of legacy carrier models, additionally it seems younger and less experienced pilots are more negative, or if you like; -the future of European aviation, the last line of defense, is less positive towards the safety culture evolution seen in Europe.

6.2 Recommendations

- In future surveys adjust the pilot demographics of contract types to clarify if pilots are employed directly by the AOC holder (i.e. employed directly where the SMS organization is responsible/accountable) or through work agencies, third, fourth, fifth

parties etc., this will give a better understanding of the real differences between pilot groups, reduce skewness and probably enhanced validity.

- The huge mistrust towards political governance of regulators and the regulators themselves, as disclosed in this survey, needs to be studied.
- Urgent action is needed to validate the findings in this survey towards fatigue. This survey discloses the area of fatigue among pilots to be of great concern towards flight safety in Europe. Fatigue must be addressed and action taken in Europe; US FAA did take actions after numerous catastrophic accidents related to fatigue (Sumwalt, 2008), the evidence of the fatigue problem is widely documented (Roach et al., 2012, Goode, 2003, Honn et al., 2016, Caldwell, 2005, Caldwell, 2001, Hartzler, 2014, Maruff et al., 2005) and lives do not need to be wasted before this issue is addressed in Europe. This and other surveys together with ICAO's words, do put a huge responsibility on politicians, regulators and operators in this respect (please substitute the word management below with the three listed if the "chain of command" is hard to grasp).

  > *"The ultimate responsibility for the establishment and adherence to sound safety practices rests with the management of the organization. A safety culture cannot be effective unless it is embedded within an organization's own culture."*

  (ICAO, 2013, p 2-10)
- EASA is recommended to conduct pilot safety culture surveys regularly;
  - To improve trust and perceived cooperation between the blunt and sharp end of European aviation.
  - To get a better picture of embedded safety issues in the ever changing environment of aviation.
  - To enable direct information channels with the sharp end.
  - To improve the SMS efficiency at the regulator level.
  - Pilots should be a part of the design group to pin-point problem areas at a larger degree.

6.3 Words of caution and contemplation:

> *"It is unknown whether 'fear' of reporting is widespread. There is anecdotal evidence that in companies and organisations that have an authoritarian approach to health and safety widespread fear exists. There is a need to:*
>
> - *Measure fear across a range of industries.*

- *Measure the impact of fear.*
- *Gather data in a way that is not threatening to the people and organisations involved.*

It is a gloomy prediction that fear may be endemic or will become endemic in occupational safety. To make the case that fear exists, risks erroneously undermining the credibility of H& S management. To make the case that fear does not exist risks leaving a potential threat to the effectiveness of H& S unaddressed" (Townsend, 2013, Loc 1346 (Kindle version)).

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APPENDICES

1. Survey questions with alternatives and logic

* Equal to the LSE Pilot Safety Culture Survey

** Almost equal to LSE Safety Culture Survey, small clarification.

"xx_other" SPSS ID for questions having an "Other" option.

N, O, S Nominal, Ordinal, Scale, SPSS measurement level

Q. No.	SPSS ID	SPSS level	Question text	Response Alternatives
1	DP1* DP1_other*	N N	What country are you based in?	Drop down menu of participating countri UK, Germany..etc
2	DP2* DP2_other*	N N	What is your nationality?	Drop down menu of nationalities: British, German, French, etc.
3	DP3*	N	What is your age?	Drop down (DD): 18-30, 31-40, 41-50, 51-60, 60+
4	DP4*	N	What company do you mainly fly for (Nordic Airlines listed first)?	Drop down list of Airlines in Europe + Other. **Question deleted in report**
5	DP5* DP5_other*	N N	What type of company do you work for?	DD: Network, low cost, charter/leisure, cargo, aereal work/ambulance/surveillance, helicopter, business/General Aviation, Other (pls state)
6	DP6* DP6_Other*	N N	What type of contract do you have?	DD: Pay to fly (Pilot pays to accumulate hours) Permanent contract (Contract length is unlimited); Zero hours contract (No or very little fixed income, pilot is paid per hour or sector flown, and typically engaged through an agency) Fixed term contract (Same terms and conditions as a permanent contract, but contract duration is limited); Self-employed (Pilot is paid through a company established by them) ; Other
7	DP7*	N	Do you work part-time or part-year in your current company?	YES/NO

8	DP8*	N	(If yes to A08) What percentage of time do you work, on average?	Only if Yes in Q7 <25%, 25-50%, 51-75%, 76-90%, 91-100%.
9	DP9*	N	What is your job title?	Captain, First Officer, Second Officer
10	DP10*	N	Do you have a management role in the company you fly for?	Yes (flight operations); Yes (training manager); Yes (other) [text box]; No
11	DP11*	N	How long have you been working in your company?	<1yr, 1-4yrs, 5-10yrs, 11yrs+
12	DP12 DP12_other	N N	You have worked less than 5 years at your current company; -What kind of contract did you hold at your PREVIOUS employer?	DD only to Pilots employed<5 yrs: Pay to fly (Pilot pays to accumulate hours) Permanent contract (Contract length is unlimited); Zero hours contract (No or very little fixed income, pilot is paid per hour or sector flown, and typically engaged through an agency) Fixed term contract (Same terms and conditions as a permanent contract, but contract duration is limited); Self-employed (Pilot is paid through a company established by them) ; Other (Please state)
13	DP13	N	Estimate your total block hours.	DD: <300, 301-1000, 1001-3000, 3001-5000, 5001-10000, 10000+
14	DP14	N	Estimate your yearly income from your current employer (Airline) in Euro.	DD: Negative (pay to fly), 0-10000, 10001-30000, 30001-50000, 50001-80000, 80001-110000, 110001-140000, 140000+
15	DC1	N	Have your company been wet/damp/dry leased to x1, x2, x3 or x4? (Names removed in this report)	DD: Yes (unspecified), Yes (x1),Yes (x2), Yes (x3), Yes (4), No, Don't know **Question deleted in report**
16	DC2	N	Has your company implemented a Safety Management System (SMS)?	Yes/No/Don't know
17	DC3	N	Do you consider the company's Safety	Proactive, Reactive, Both Proactive and Reactive, equally so, Don't know

			Management System mainly proactive or reactive?	
18	DC4M DC4V DC4C	N N N	What kind of reporting system does your company have?	Matrix: Yes/No/Don't Know Mandatory? Voluntary? Confidential?
19	CAA1	N	Is there a voluntary pilot reporting system in the country (CAA) where your company's AOC is registered?	Yes/No/Don't know
20	DC5	N	Does the company have an agreement with the pilots (unions, collective agreements etc.) that safeguard an anonymous reporting environment?	Yes (Union/collective agreement), Yes(no Union), No, Don't know
21	R1L R1B R1O R1T R1_other	O O O O O	In my opinion; -The main objectives of my company's reporting system is (pls prioritize):	Prioritize: Learning, Put Blame, Fulfil obligation towards regulators, Trend Analysis, Other
22	Misc1SD Misc1CP Misc1CS Misc1M Misc1CAA Misc1NCP Misc1F	O O O O O O O	How easy do you consider it to raise/discuss FLIGHT SAFETY concerns in public (Company, media, CAA, Friends):	Single select matrix: Impossible, Difficult, Neutral, Easy, Very Easy Company Flight Safety department: Company Pilots: Company Staff (other than above): Media: CAA: Non-Company Pilots: Friends (Non-pilots):
23	R2M R2V R2C	O O O	My company encourages me to file reports?	Single select matrix: Never, Rather not, I don't know, Please do, Always Mandatory reports: Voluntary reports: Company related reports:

24	R3	O	My company always submits pilot reports, with a required authority reporting issue, to the authorities?	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
25	JC1	O	The company's report investigation makes a clear distinction between a deliberate/gross violation and an unintentional error/mistake.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
26	Misc2	O	I consider luck as a main safety factor in my company's daily operations?	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
27	JC2	O	If there is NO reckless conduct, gross negligence or willful misconduct performed the organization and the pilots always have a sheared responsibility when a mishap occurs.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
28	DC6L DC6PP DCHF DC_other	O O O O	In my company's safety organization I consider the main focus area towards flight safety performance to be: (pls prioritize)	Prioritize: Latent/organizational errors Pilot Procedural Errors Human Factor Errors Other
29	Misc3	O	Pilot employment models do not affect flight safety.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
30	R4P	O	I would report more safety related issues if I had a permanent (unlimited) contract with my company?	Only if not "Permanent Contract": Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
31	R4T	O	I would report more safety related issues if I had a	Only if "Permanent Contract": Strongly disagree - Disagree - Neutral - Agree - Strongly Agree

			temporary contract with my company?	
32	Misc4SR Misc4FS Misc4MS Misc4SS	O O O O	You have changed employer the last 5 years; With your PREVIOUS employer, how would you rate the following criteria?	Only for pilots with less than 5 years in company: Much Harder/less, Harder/less, No Change, Easier/more, Much easier/less Self-reporting Company flight safety focus Management support Social security situation
33	Misc5T Misc5P	O O	Employment models versus flight safety in Europe.	Single select Matrix: Strongly reduce flight safety, Reduce flight safety, Neutral, Enhance Flight safety, Strongly enhance flight safety, No answer Temporary employment models: Permanent employment model:
34	JC3*	O	Pilots who report safety-related occurrences are treated in a just and fair manner.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
35	S1**	O	In my Company: Voicing concerns about safety is encouraged.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
36	S2**	O	In my Company: We get timely feedback on the safety issues we raise.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
37	S3*	O	I am prepared to speak to my direct manager when unsafe situations are developing.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
38	JC4	O	If there is NO reckless conduct, gross negligence or willful misconduct performed, self-reporting would have NO consequences to my carrier.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree

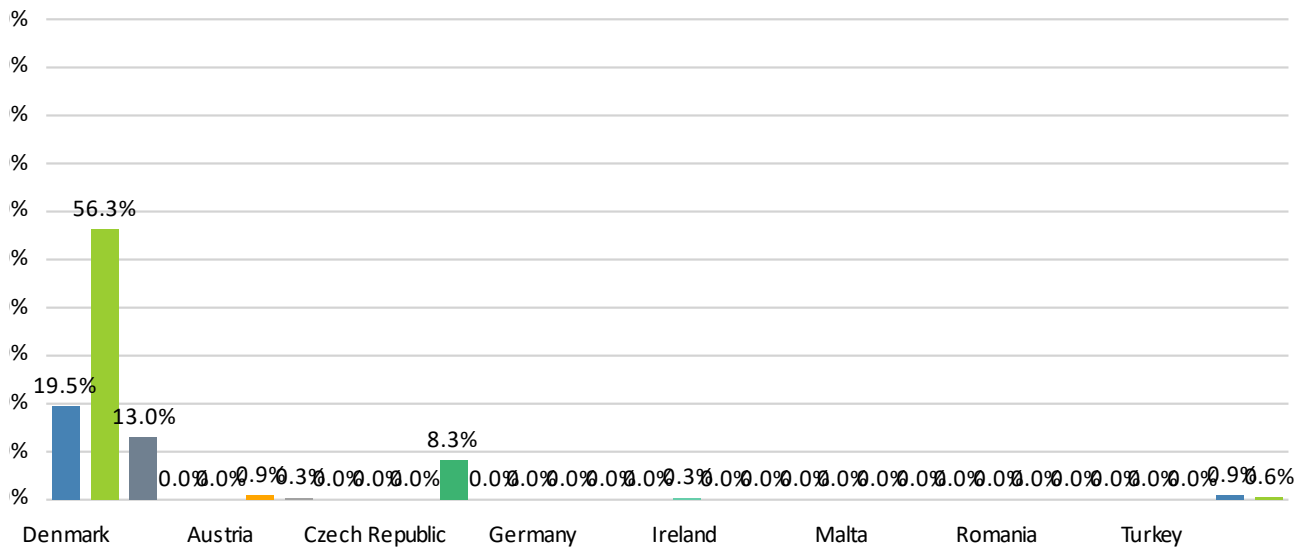
39	S4*	O	Information about safety-related changes within this company is clearly communicated to staff.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
40	S5*	O	We learn lessons from safety related incident or occurrence investigations.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
41	S6*	O	People in this company share safety related information.	
42	F1	O	My company fully supports my decision if I step down from duty because of fatigue	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
43	JC5	O	If I reported an error I am confident my company would treat me according to "just culture" principals, i.e. make a clear distinctions between human errors and "reckless conduct/ gross negligence/willful misconduct".	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
44	F2*	O	Pilots in this company are often tired at work.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
45	F3*	O	I would feel comfortable to complete a fatigue report.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
46	F4*	O	The issue of fatigue is taken seriously by this company.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
47	R5	O	I always file a fatigue report when it is required by the authorities.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
48	R6	O	Your previous answer indicates you don't always file fatigue reports when	Drop down: 0, 1-3, 4-6, 7-10, 10+, No answer

			required, approximately how often have you skipped a fatigue report the last 12 months?	
49	F5	O	Colleagues are sometimes fatigued to a level where flight safety is at risk.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
50	F6P	O	If I had a permanent (unlimited) employment contract it would be easier to step down from duty, when fatigued.	Only if NOT "Permanent contract": Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
51	F6T	O	If I was employed through a temporary contract it would be harder to step down from duty, when fatigued.	Only if "Permanent contract": Strongly disagree - Disagree - Neutral- Agree - Strongly Agree
52	CAA2	O	The national aviation safety authorities are politically governed to a degree that flight safety is jeopardized.	Strongly disagree - Disagree - Neutral - Agree - Strongly Agree
53	CAA3	N	Please specify the country, or Europe (EASA), you was thinking of in the previous question.	Drop down country + EASA
54	Misc6	N	What is the greatest threat to aviation safety in Europe?	Text box **Text deleted in report, but categorized into Misc6_FirstThreat & Misc6_SecThreat**
55	Misc7	N	Please feel free to comment on the issues of Flight Safety, Employment models, Just Culture, Reporting and Safety support:	Text box **Text deleted in report**

2. Questback graphs, Mean, Standard deviation and results exported to SPSS

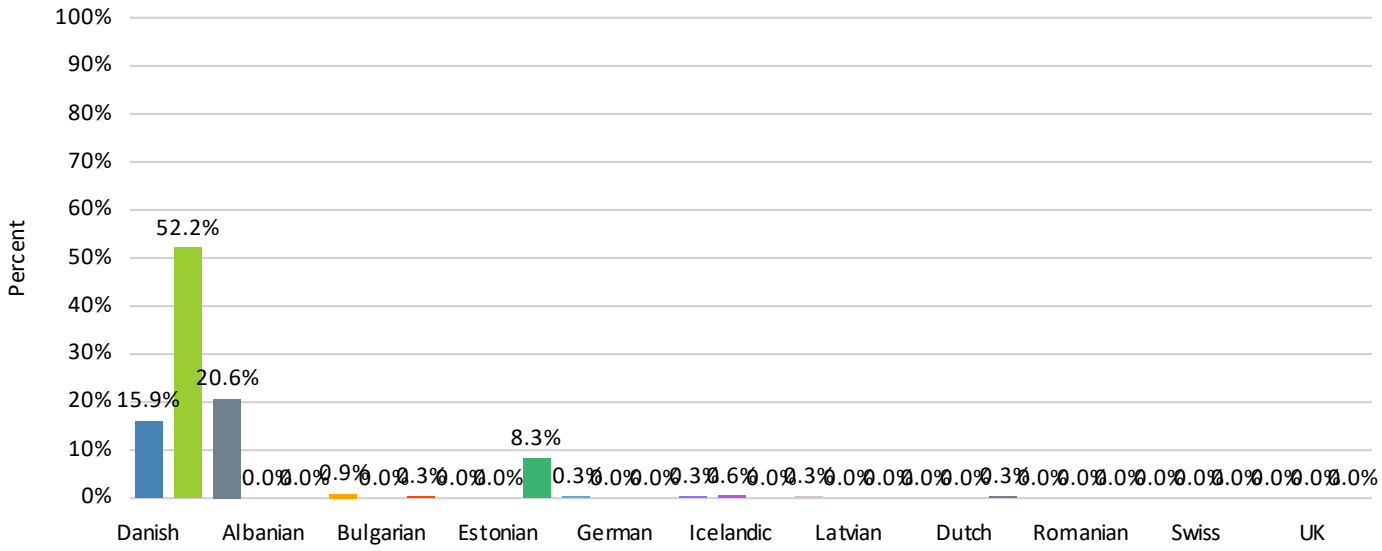
The question containing company names and open ended questions were exported to SPSS, but they are deleted in the list below, because they infringed the clause of anonymity.

1. What country are you based in?



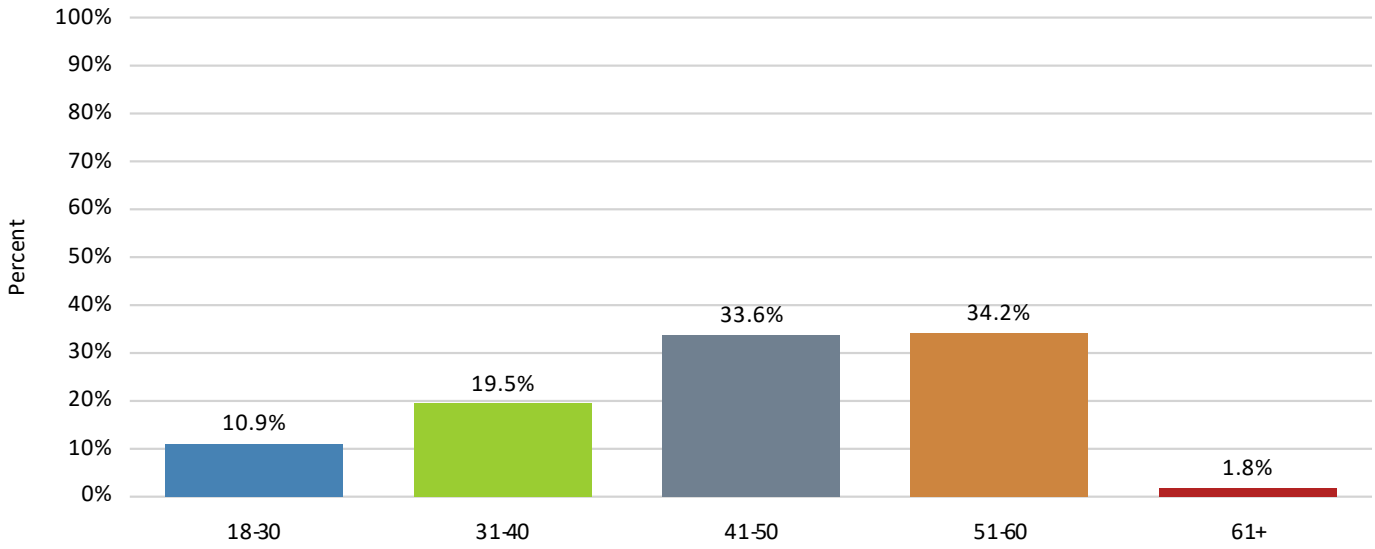
Question	N	Mean	Standard deviation	Median
What country are you based in?	339	3.04	3.79	2.00

2. What is your nationality?



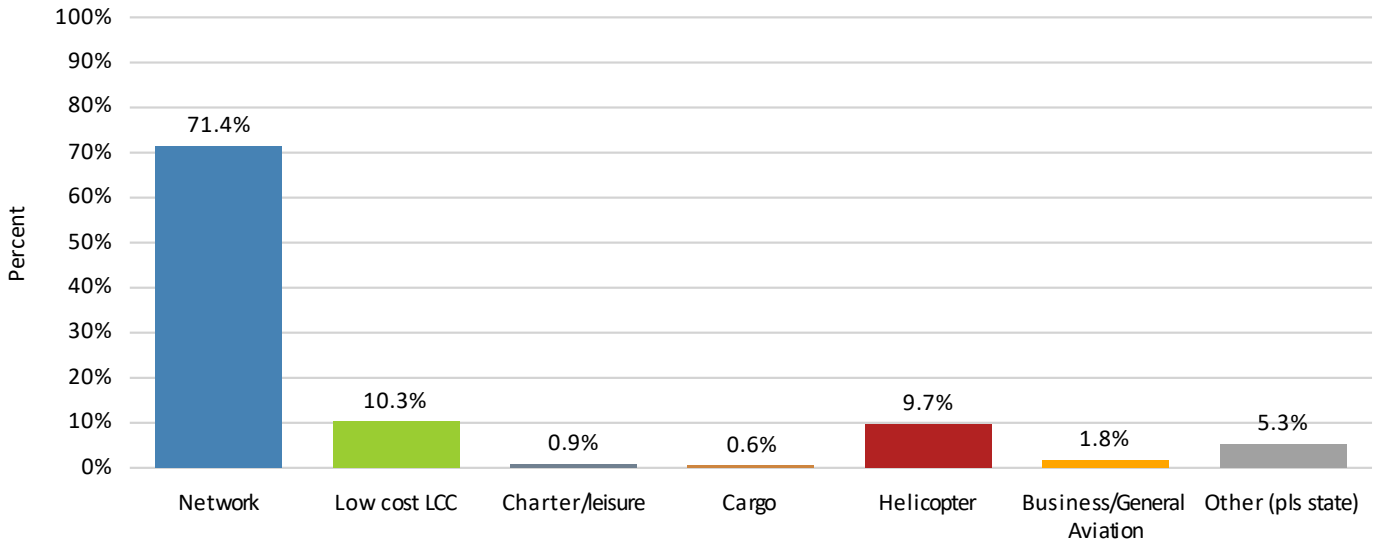
Question	N	Mean	Standard deviation	Median
What is your nationality?	339	3.10	3.18	2.00

3. What is your age?



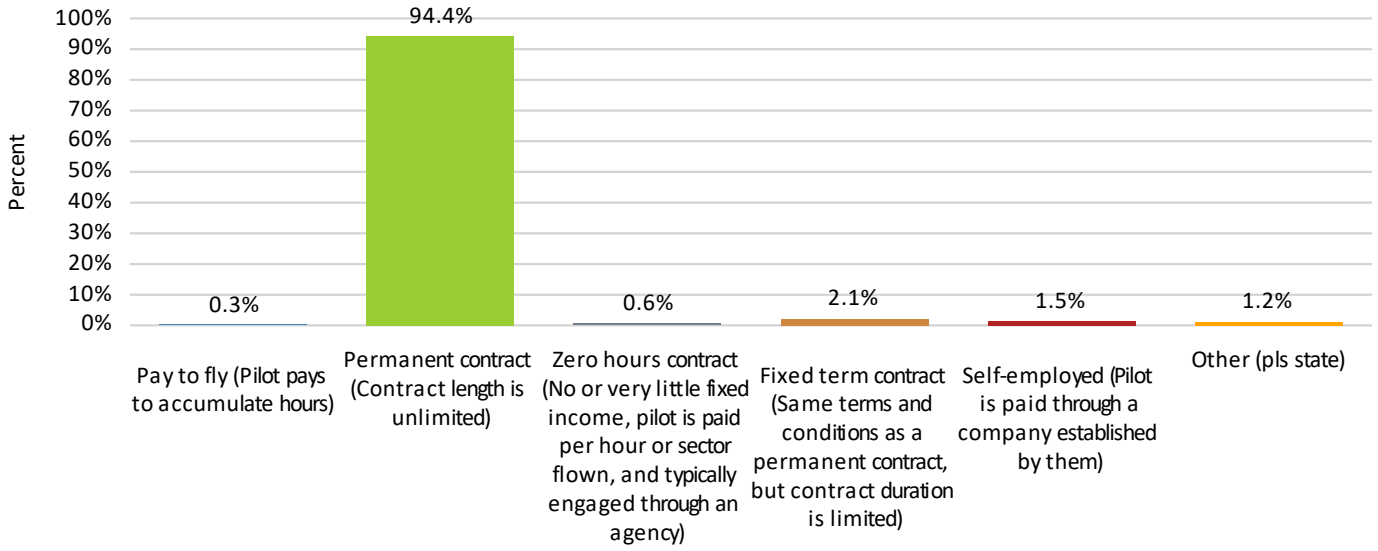
Question	N	Mean	Standard deviation	Median
What is your age?	339	2.96	1.02	3.00

4. What type of company do you work for?



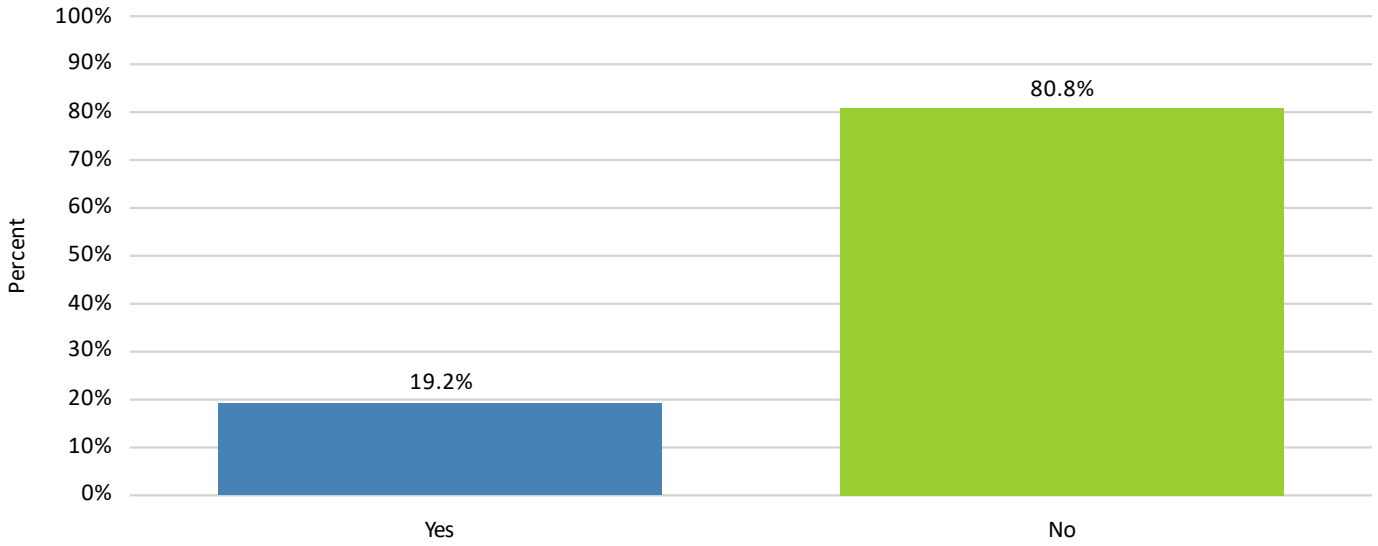
Question	N	Mean	Standard deviation	Median
What type of company do you work for?	339	1.65	1.38	1.00

5. What type of contract do you have?



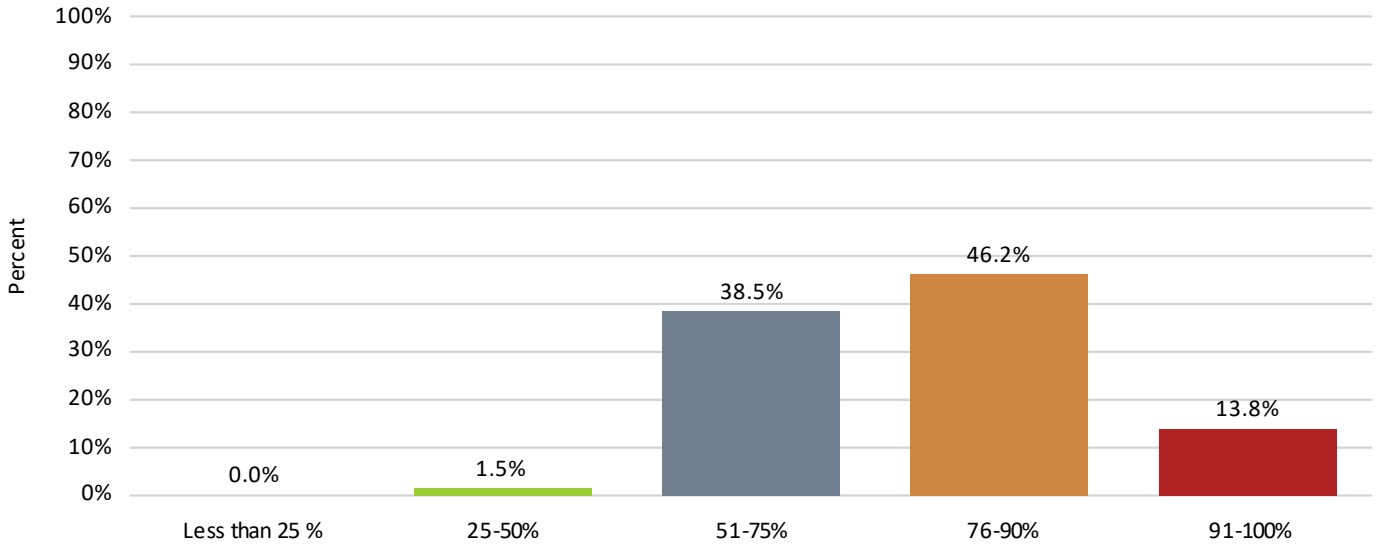
Question	N	Mean	Standard deviation	Median
What type of contract do you have?	339	2.09	0.47	2.00

6. Do you work part-time or part-year in your current company?



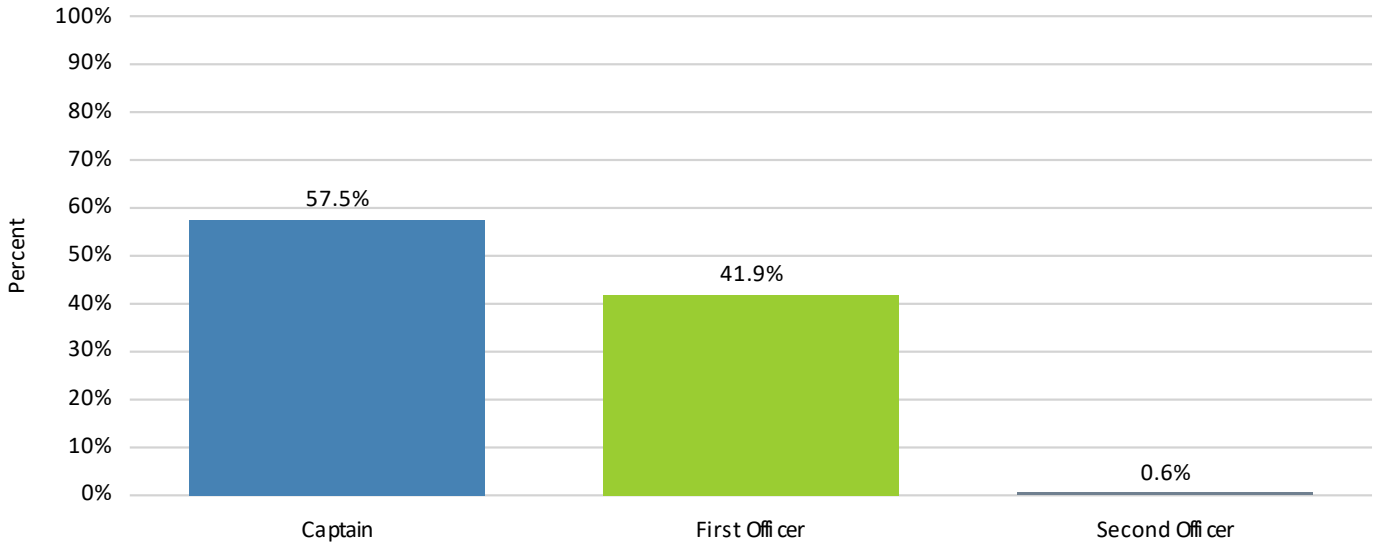
Question	N	Mean	Standard deviation	Median
Do you work part-time or part-year in your current company?	339	1.81	0.39	2.00

7. What percentage of time do you work, on average?



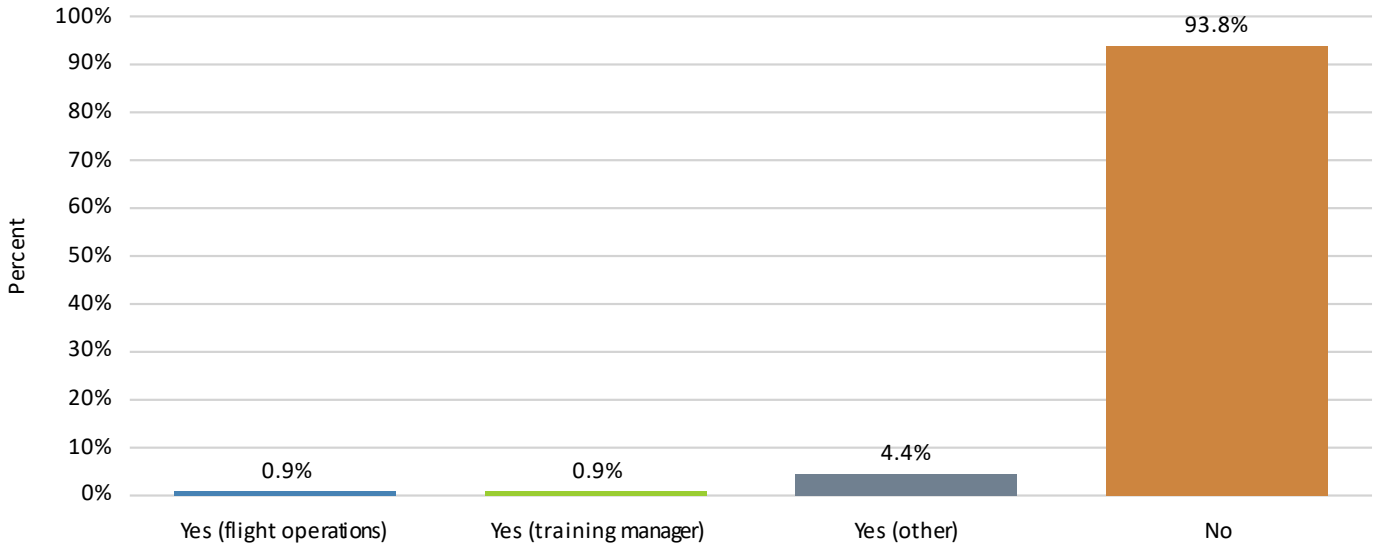
Question	N	Mean	Standard deviation	Median
What percentage of time do you work, on average?	65	3.72	0.71	4.00

8. What is your job title?



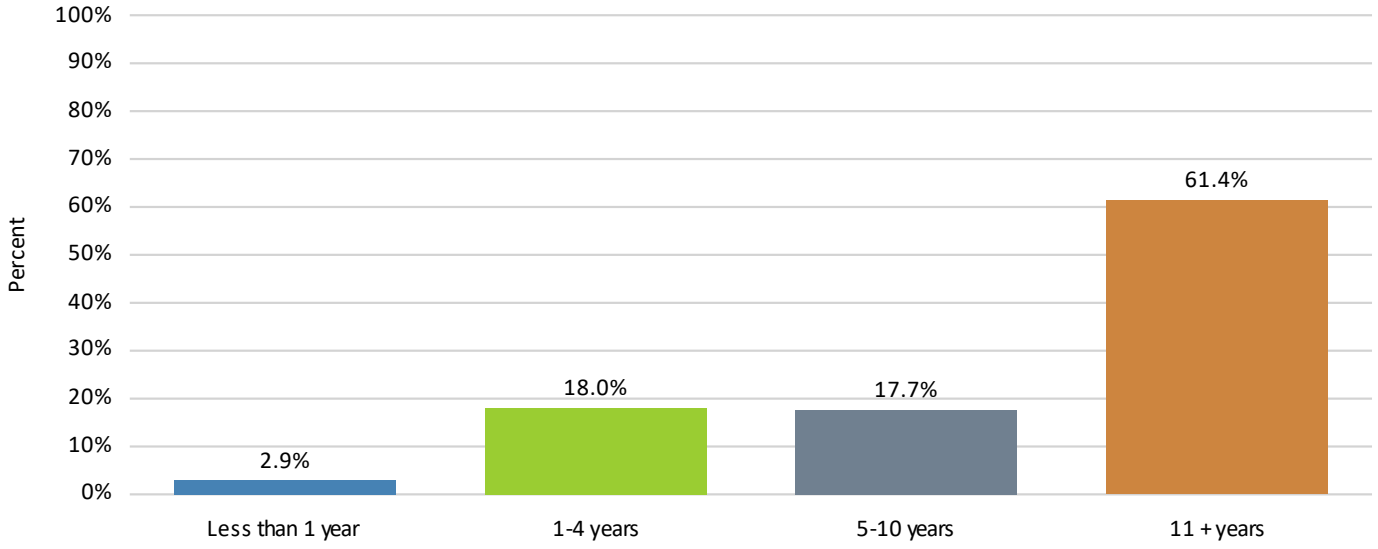
Question	N	Mean	Standard deviation	Median
What is your job title?	339	1.43	0.51	1.00

9. Do you have a management role in the company (as specified in question 3) you fly for?



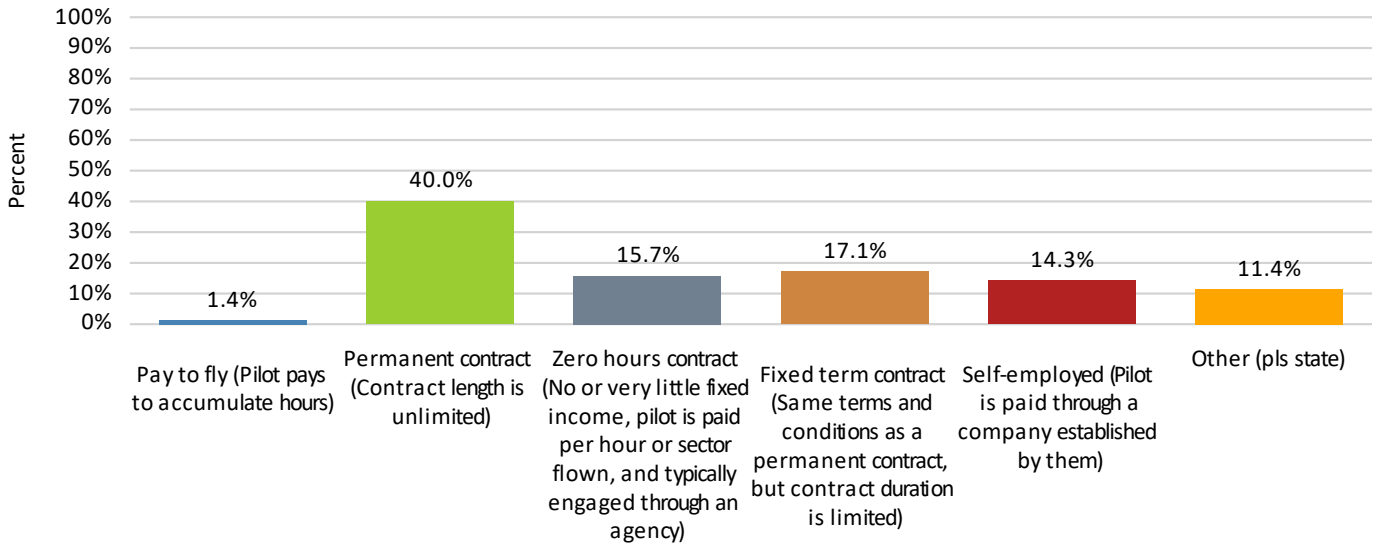
Question	N	Mean	Standard deviation	Median
Do you have a management role in the company (as specified in question 3) you fly for?	339	3.91	0.39	4.00

10. How long have you been working in your current company?



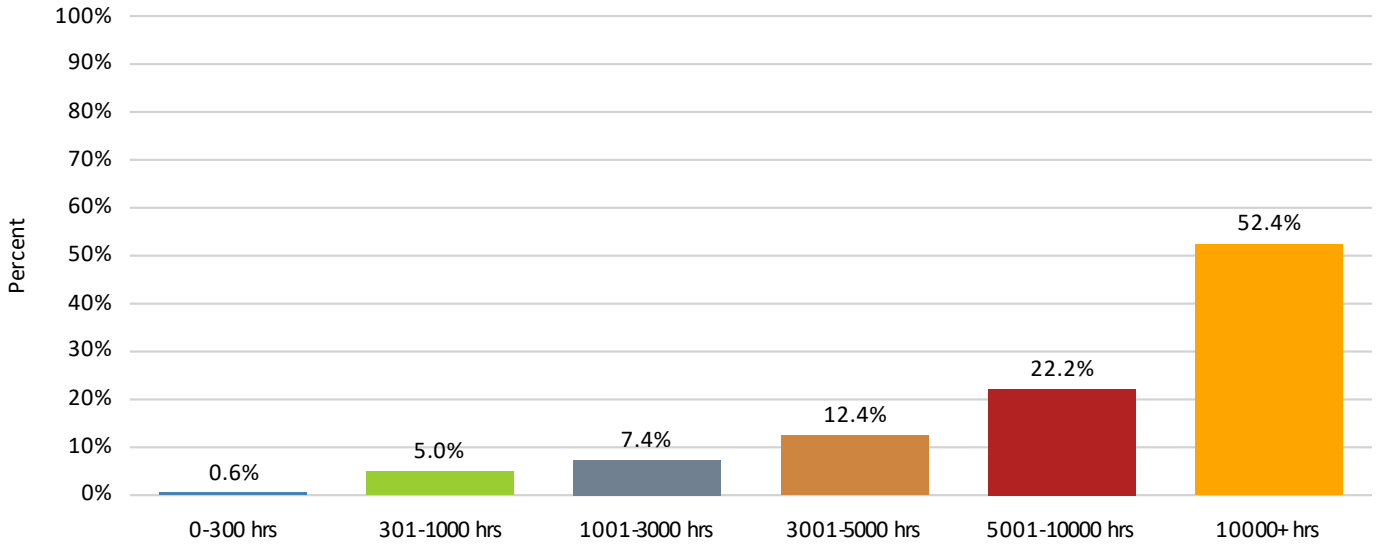
Question	N	Mean	Standard deviation	Median
How long have you been working in your current company?	339	3.37	0.88	4.00

11. You have worked less than 5 years at your current company; -What kind of contract did you hold at your PREVIOUS employer?



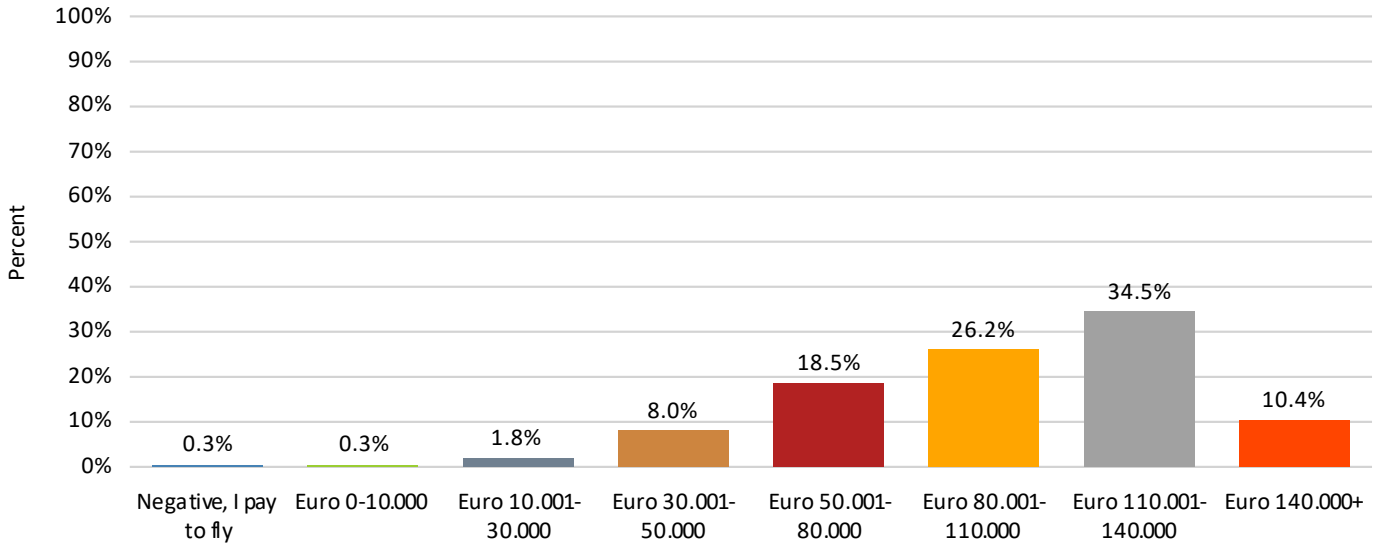
Question	N	Mean	Standard deviation	Median
You have worked less than 5 years at your current company; -What kind of contract did you hold at your PREVIOUS employer?	70	3.03	1.16	3.00

12. Estimate your total block hours.



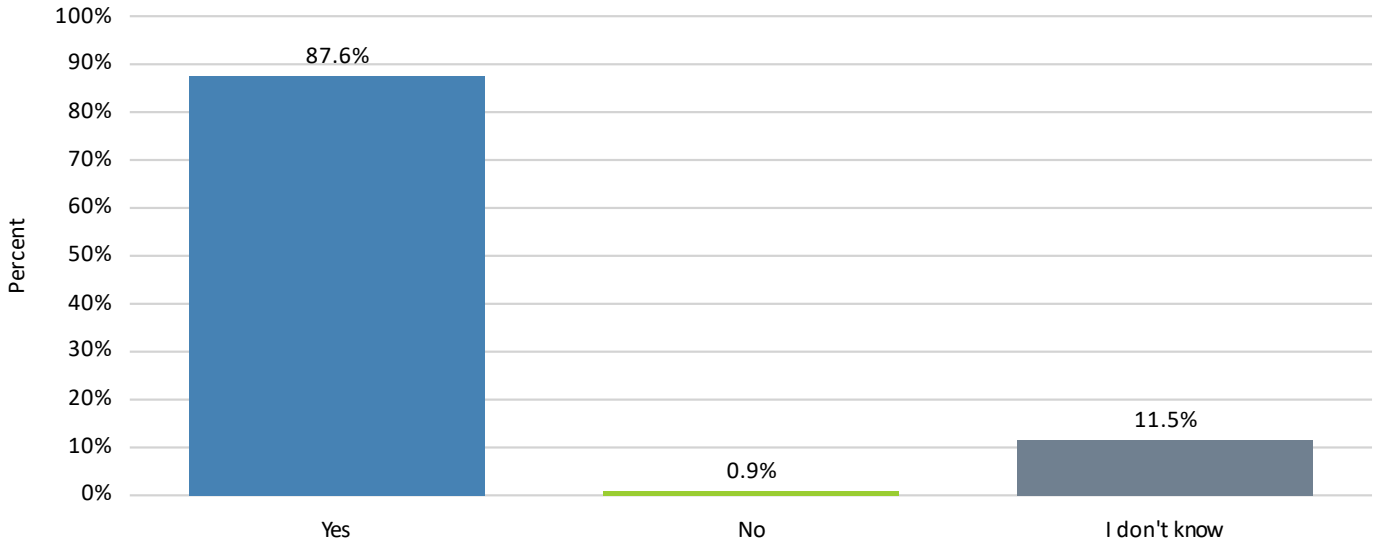
Question	N	Mean	Standard deviation	Median
Estimate your total block hours.	338	5.08	1.22	6.00

13. Estimate your yearly income from your current employer (Airline) in Euro.



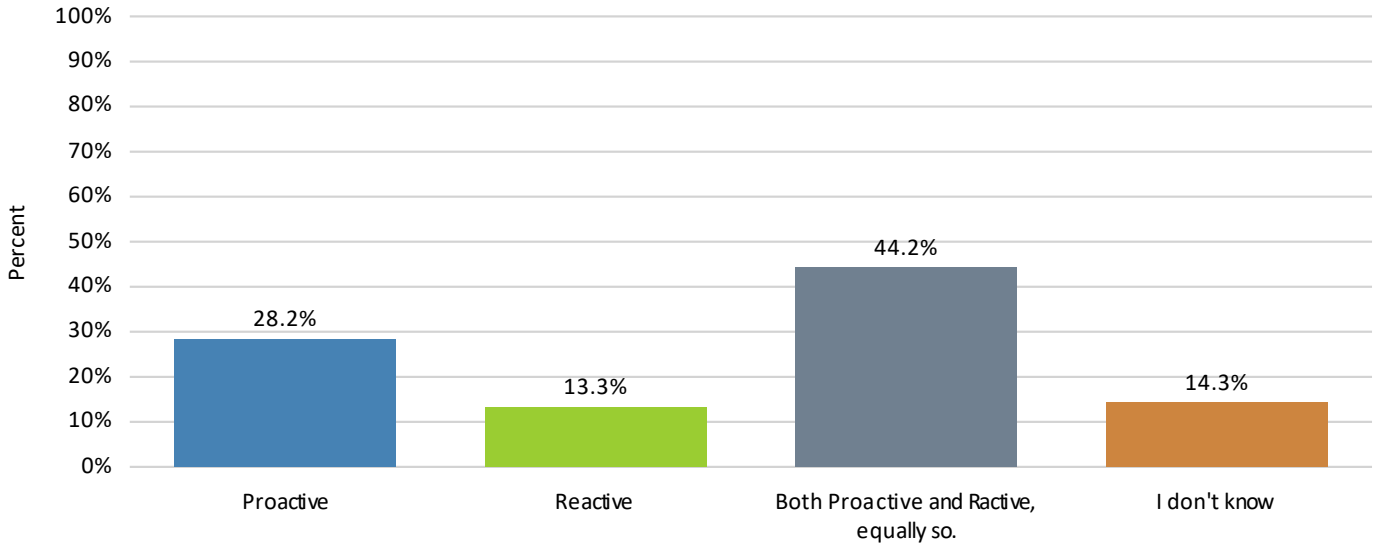
Question	N	Mean	Standard deviation	Median
Estimate your yearly income from your current employer (Airline) in Euro.	336	6.13	1.24	6.00

14. Has your company implemented a Safety Management System (SMS)?



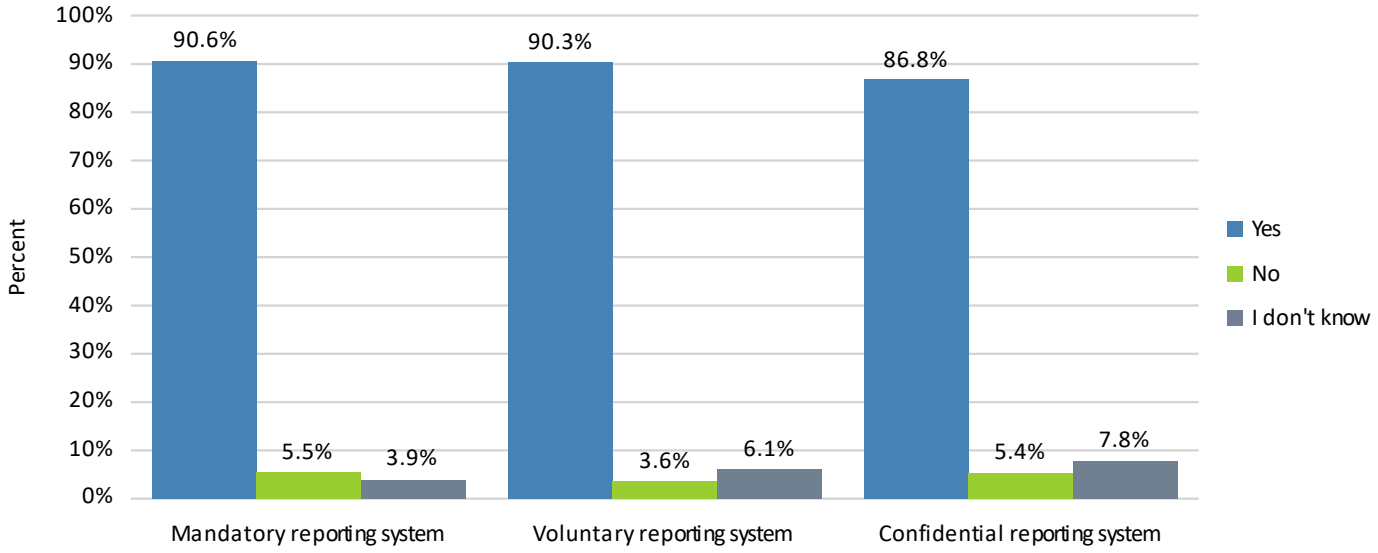
Question	N	Mean	Standard deviation	Median
Has your company implemented a Safety Management System (SMS)?	338	1.01	0.10	1.00

15. Do you consider the company's Safety Management System to be mainly proactive or reactive?



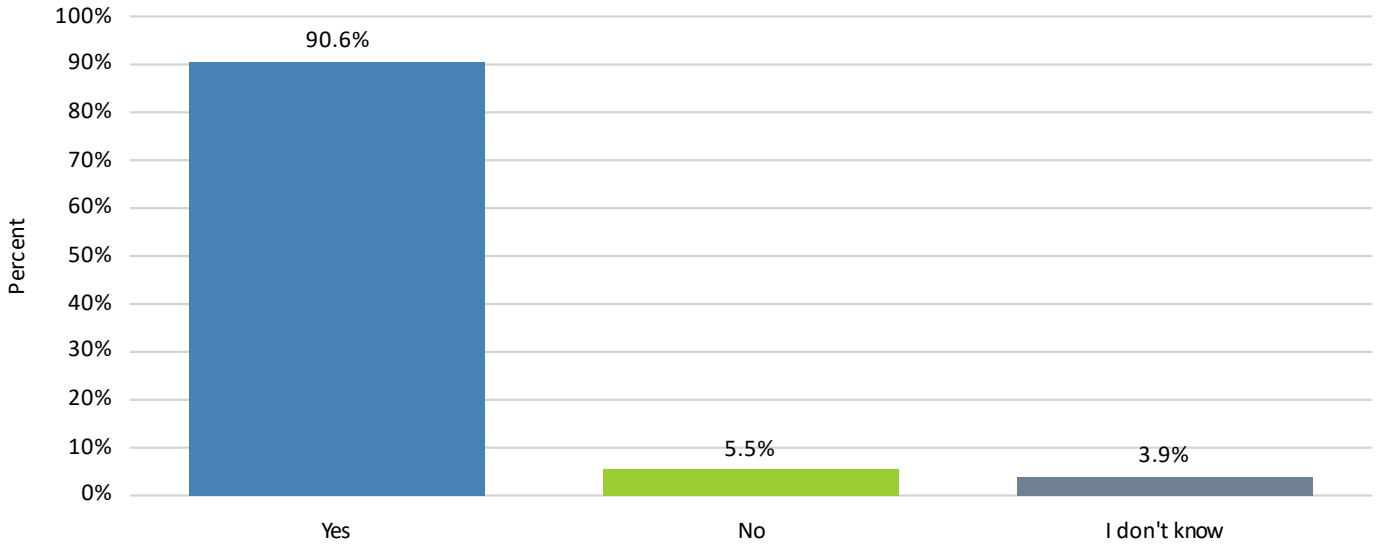
Question	N	Mean	Standard deviation	Median
Do you consider the company's Safety Management System to be mainly proactive or reactive?	294	2.19	0.90	3.00

16. What kind of reporting system does your company have?



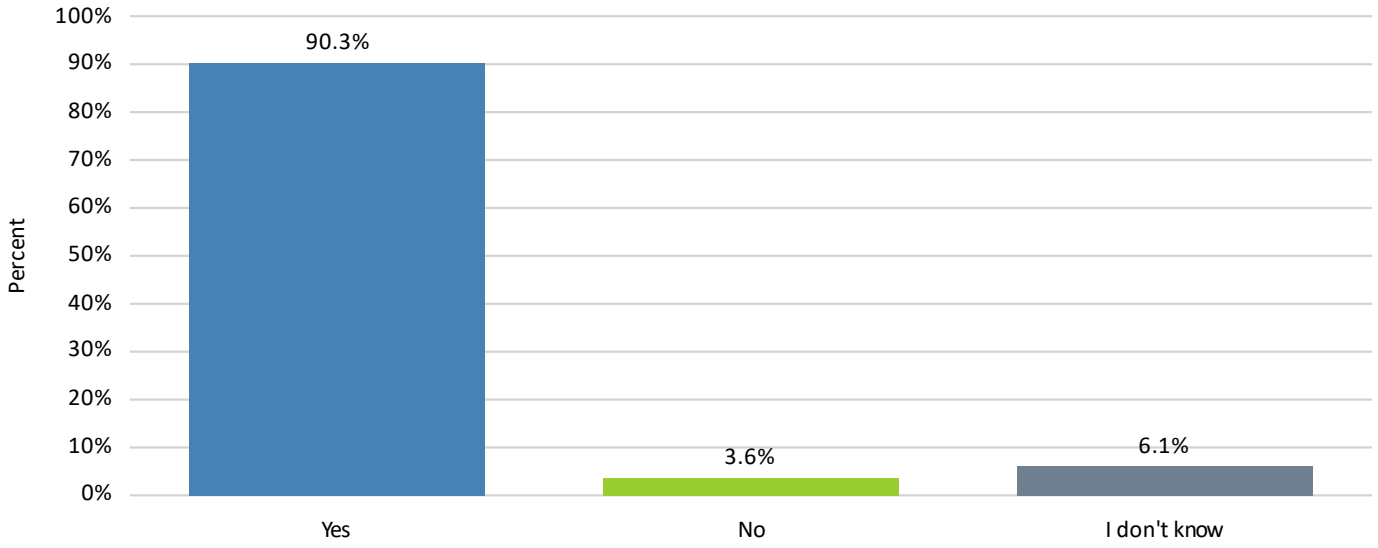
Question	N	Mean	Standard deviation	Median
Mandatory reporting system	330	1.06	0.23	1.00
Voluntary reporting system	329	1.04	0.19	1.00
Confidential reporting system	333	1.06	0.23	1.00

17. Mandatory reporting system



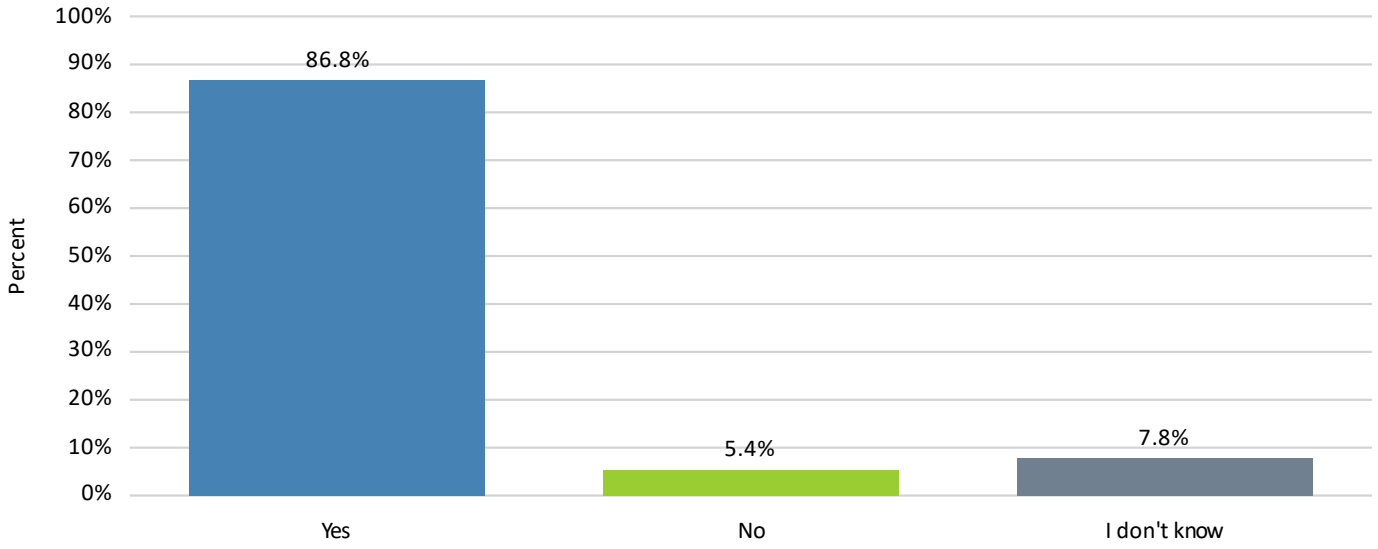
Question	N	Mean	Standard deviation	Median
Mandatory reporting system	330	1.06	0.23	1.00

18. Voluntary reporting system



Question	N	Mean	Standard deviation	Median
Voluntary reporting system	329	1.04	0.19	1.00

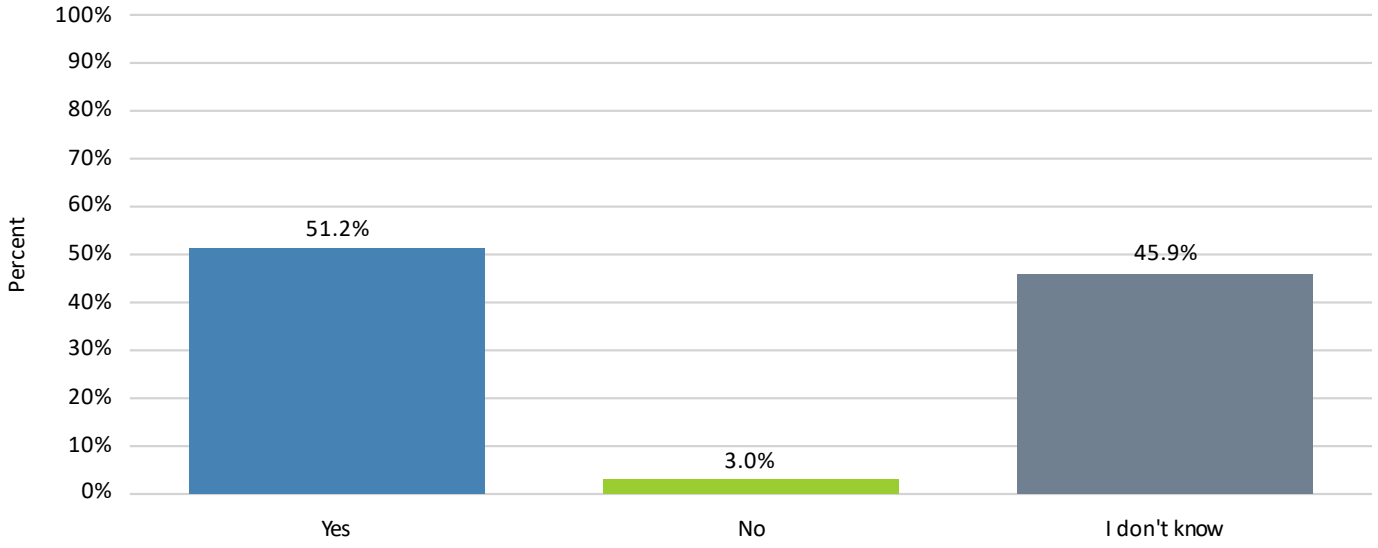
19. Confidential reporting system



Question	N	Mean	Standard deviation	Median
Confidential reporting system	333	1.06	0.23	1.00

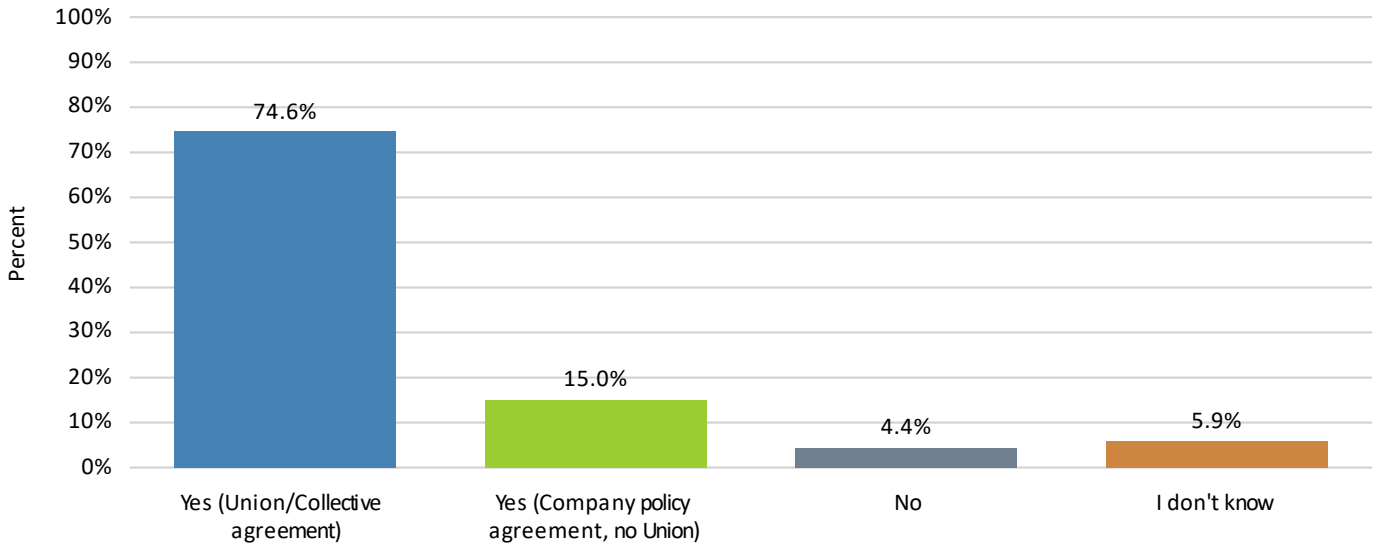
20. Is there a voluntary pilot reporting system in the country (CAA) where your company's AOC is registered?

AOC = Airline Operators Certificate
CAA = Civil Aviation Authorities



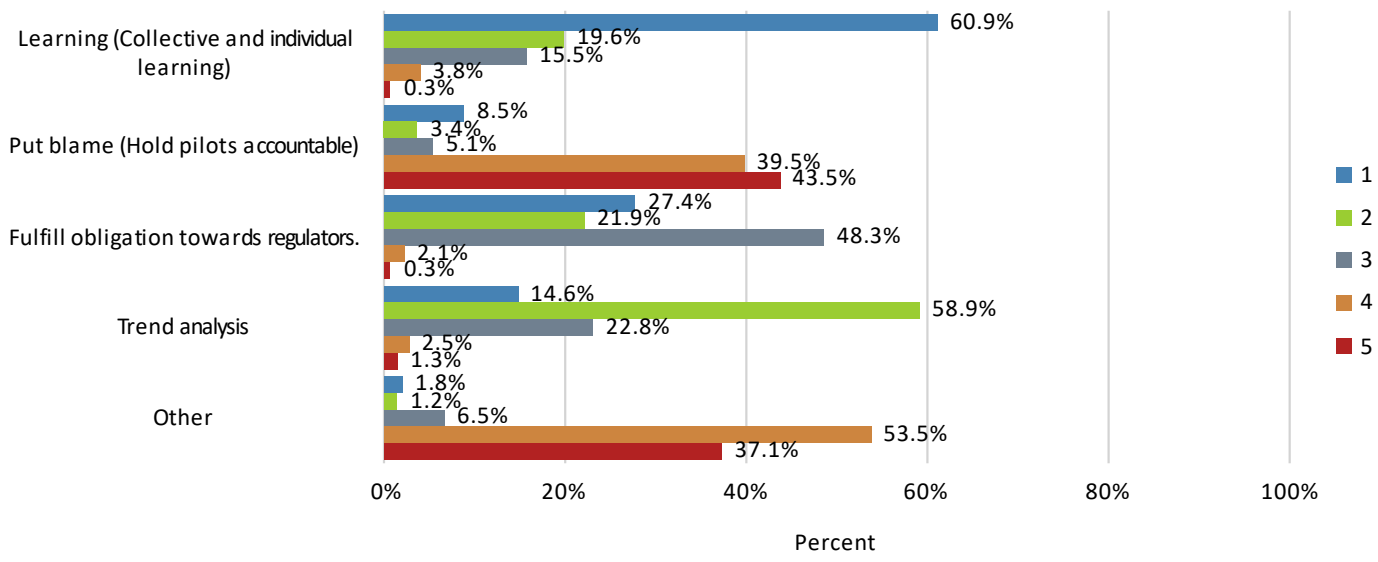
Question	N	Mean	Standard deviation	Median
Is there a voluntary pilot reporting system in the country (CAA) where your company's AOC is registered?	338	1.05	0.23	1.00

21. Does the company have an agreement with the pilots (unions, collective agreements etc.) that safeguard a "just" reporting environment?



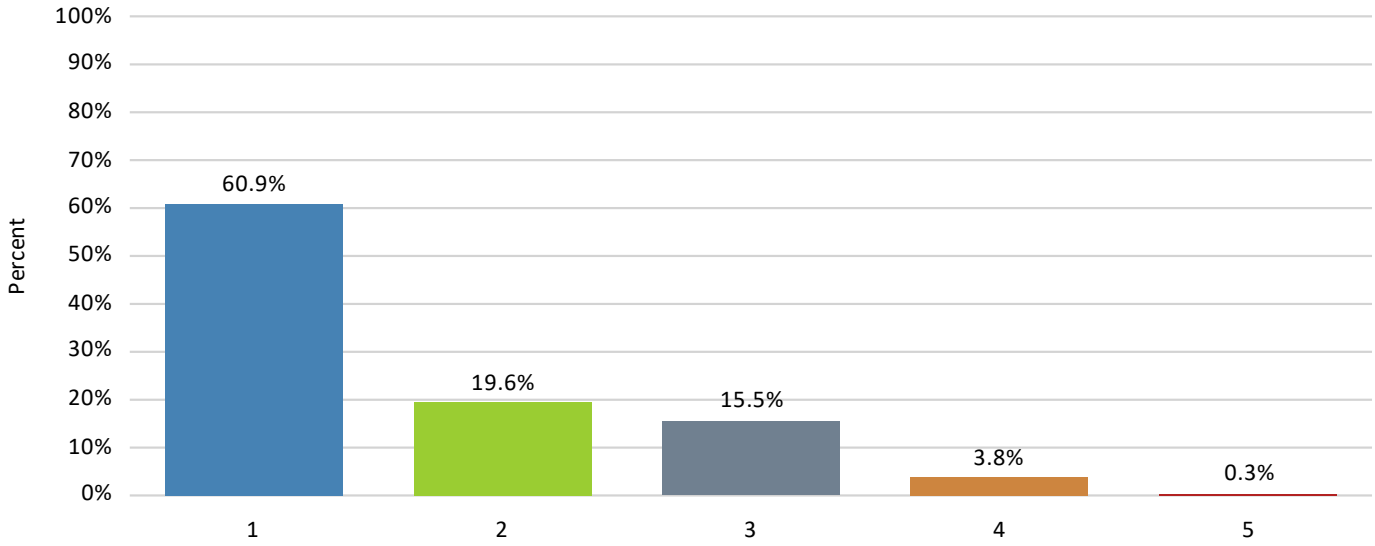
Question	N	Mean	Standard deviation	Median
Does the company have an agreement with the pilots (unions, collective agreements etc.) that safeguard a "just" reporting environment?	339	1.25	0.53	1.00

22. In my opinion; -The main objectives of my company's reporting system is (pls prioritize):



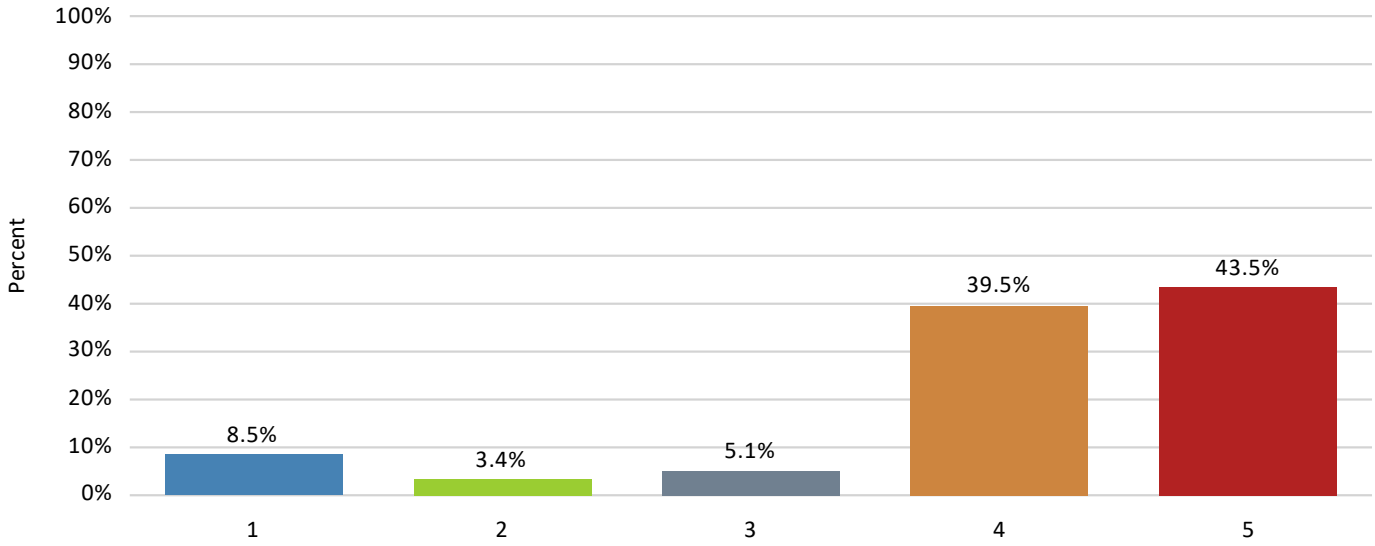
Question	N	Mean	Standard deviation	Median
Learning (Collective and individual learning)	317	1.63	0.90	1.00
Put blame (Hold pilots accountable)	177	4.06	1.17	4.00
Fulfill obligation towards regulators.	292	2.26	0.90	3.00
Trend analysis	316	2.17	0.75	2.00
Other	170	4.23	0.77	4.00

23. Learning (Collective and individual learning)



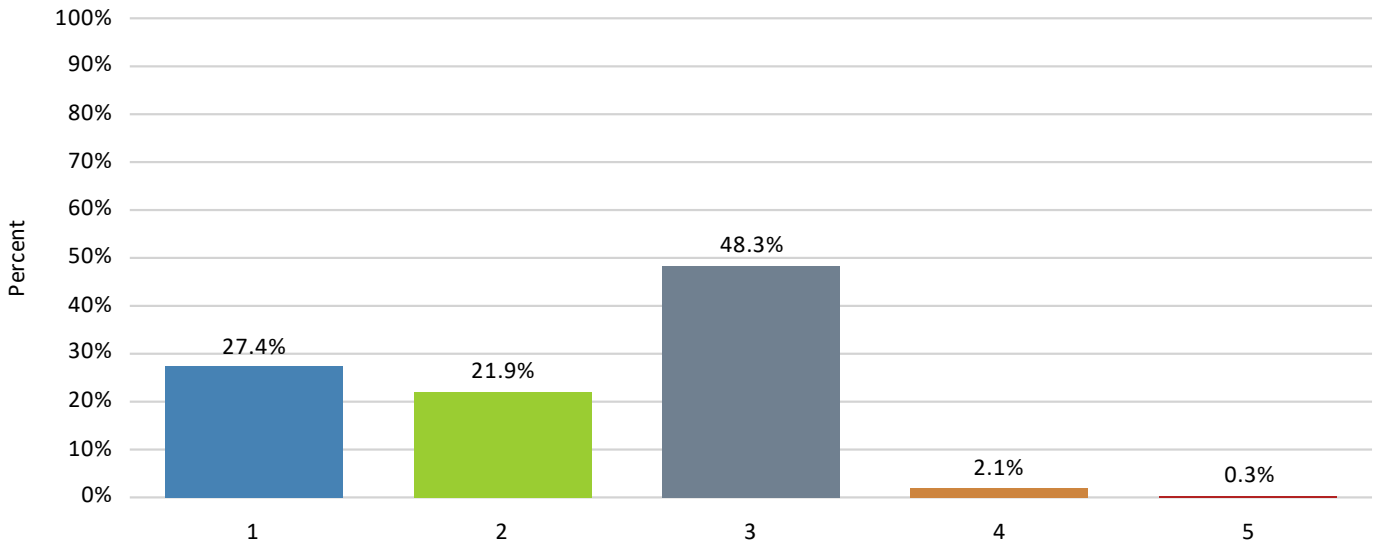
Question	N	Mean	Standard deviation	Median
Learning (Collective and individual learning)	317	1.63	0.90	1.00

24. Put blame (Hold pilots accountable)



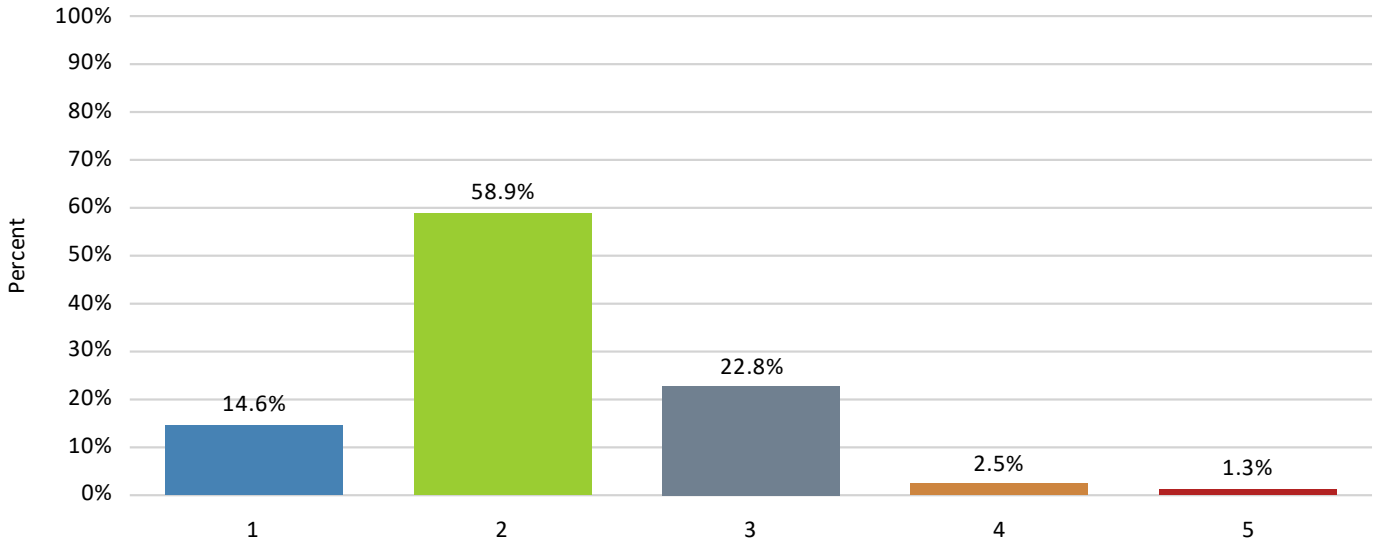
Question	N	Mean	Standard deviation	Median
Put blame (Hold pilots accountable)	177	4.06	1.17	4.00

25. Fulfill obligation towards regulators.



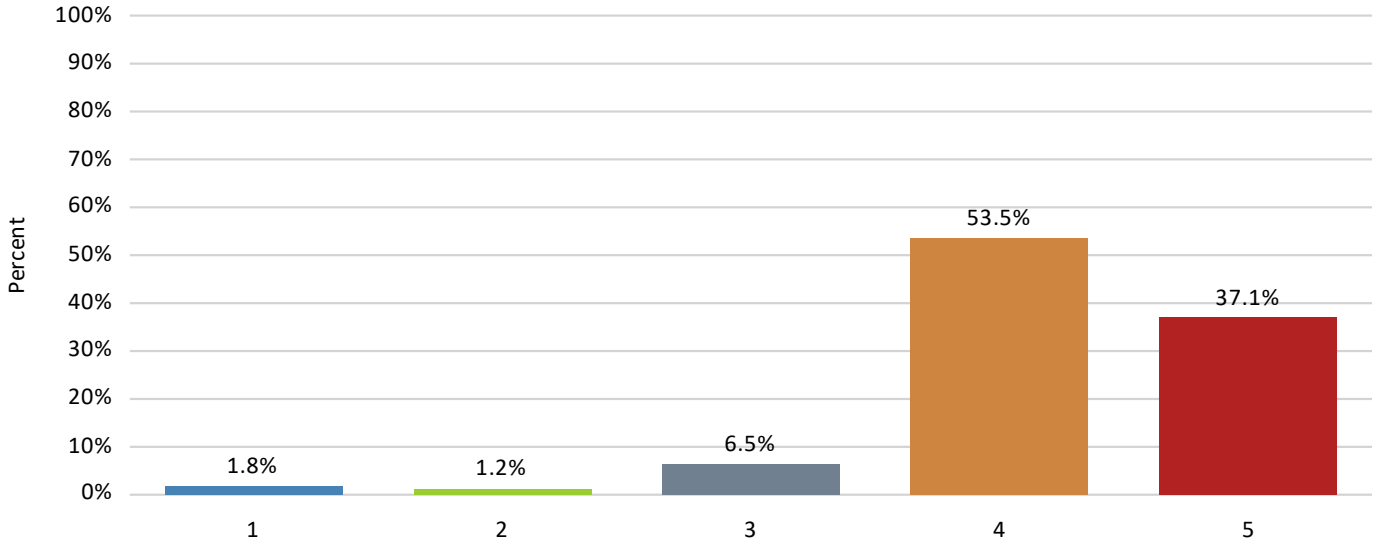
Question	N	Mean	Standard deviation	Median
Fulfill obligation towards regulators.	292	2.26	0.90	3.00

26. Trend analysis



Question	N	Mean	Standard deviation	Median
Trend analysis	316	2.17	0.75	2.00

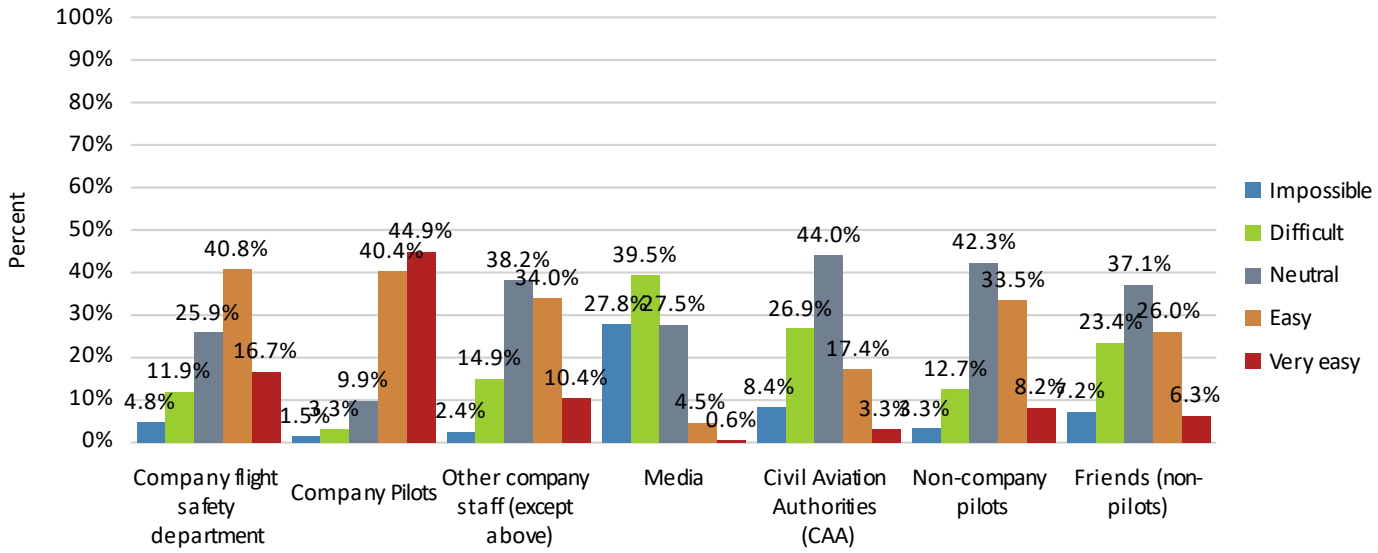
27. Other



Question	N	Mean	Standard deviation	Median
Other	170	4.23	0.77	4.00

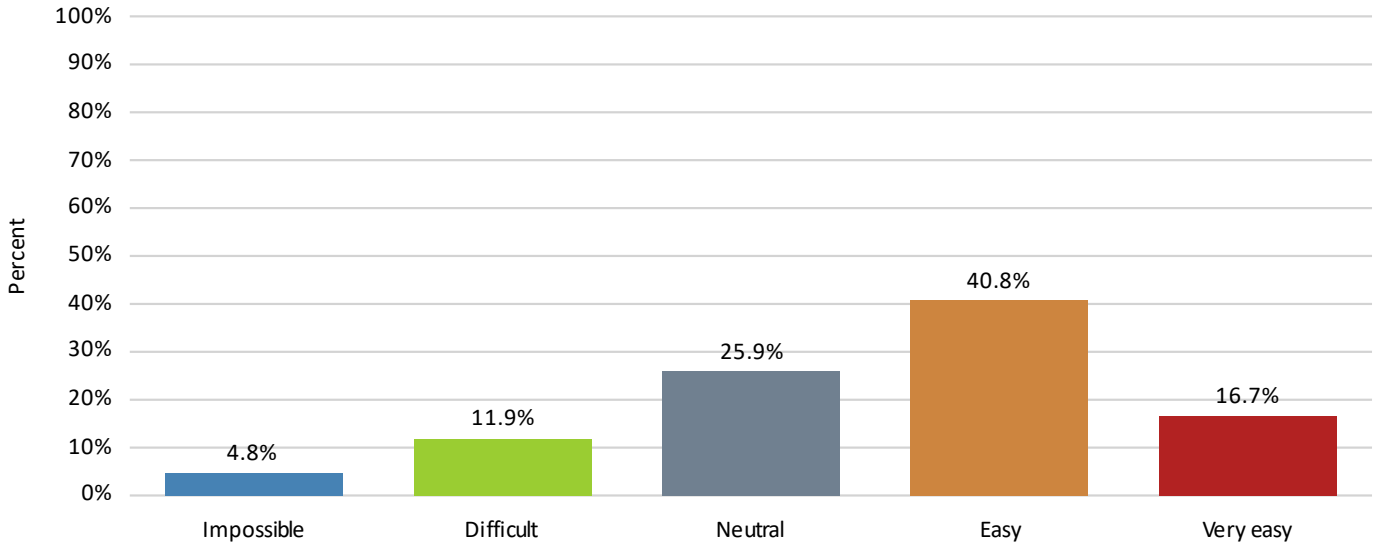
28. How easy do you consider it to raise/discuss FLIGHT SAFETY concerns in public (Company, media, CAA, Friends):

"Company" refer to the company you mainly fly for.



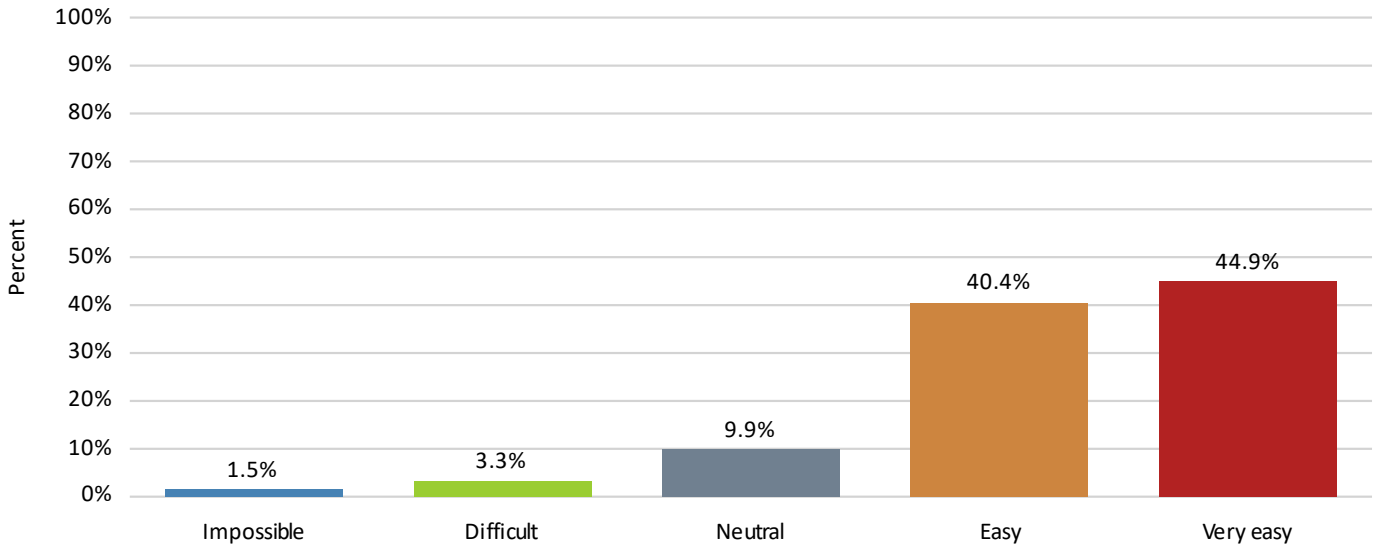
Question	N	Mean	Standard deviation	Median
Company flight safety department	336	3.53	1.05	4.00
Company Pilots	334	4.24	0.87	4.00
Other company staff (except above)	335	3.35	0.94	3.00
Media	334	2.10	0.88	2.00
Civil Aviation Authorities (CAA)	334	2.80	0.93	3.00
Non-company pilots	331	3.31	0.91	3.00
Friends (non-pilots)	334	3.01	1.02	3.00

29. Company flight safety department



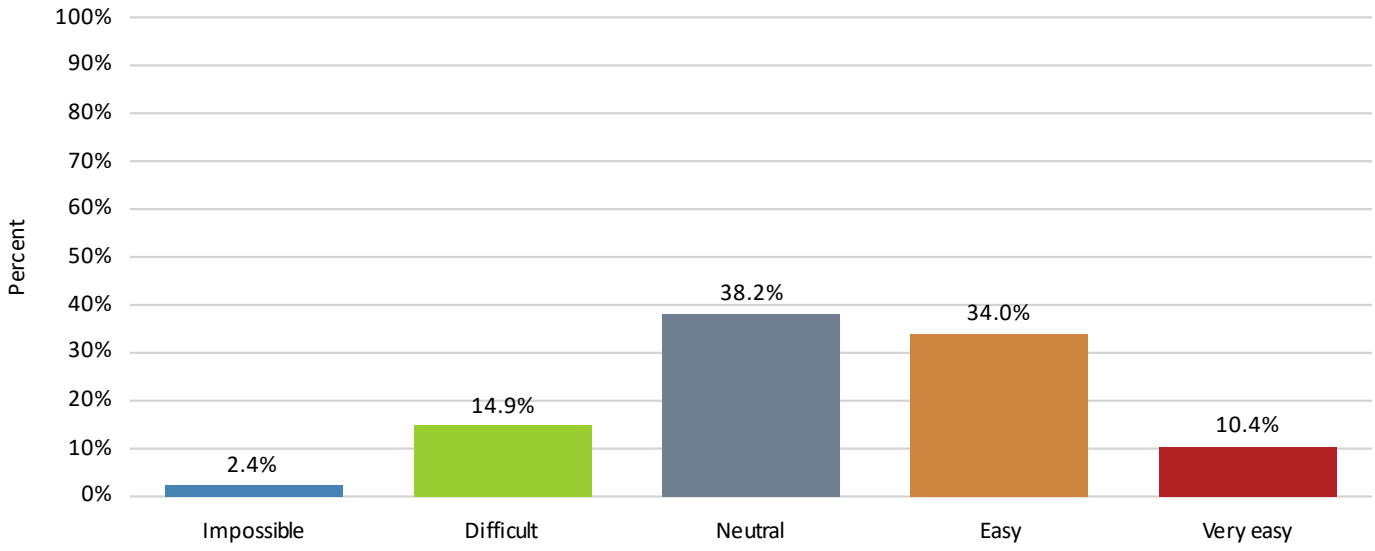
Question	N	Mean	Standard deviation	Median
Company flight safety department	336	3.53	1.05	4.00

30. Company Pilots



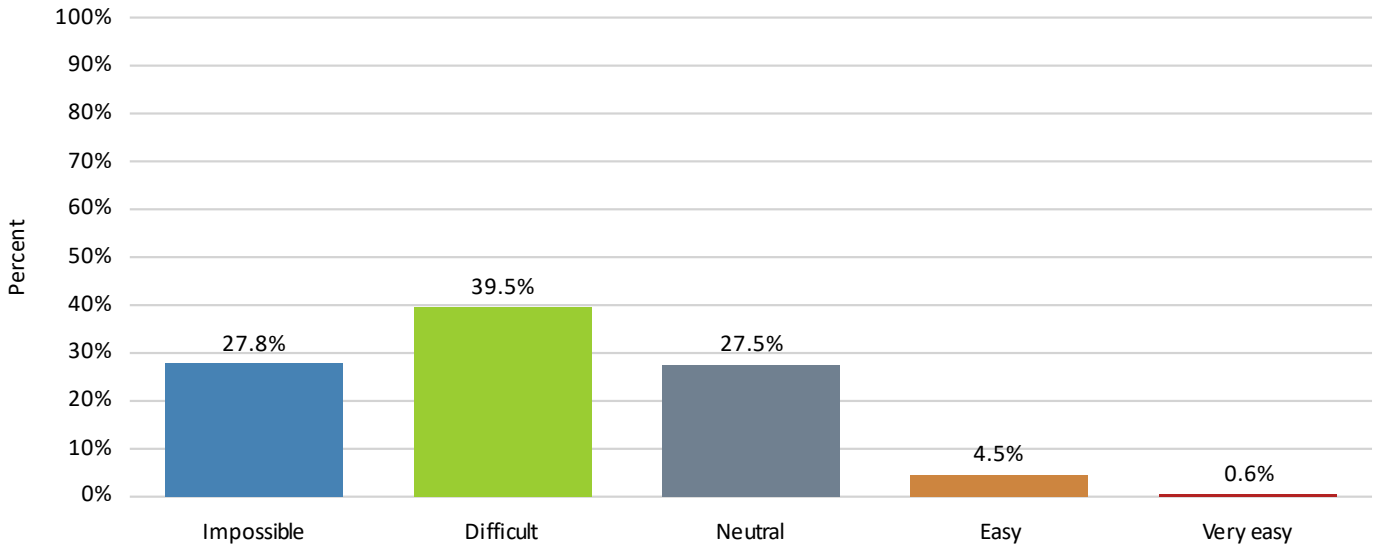
Question	N	Mean	Standard deviation	Median
Company Pilots	334	4.24	0.87	4.00

31. Other company staff (except above)



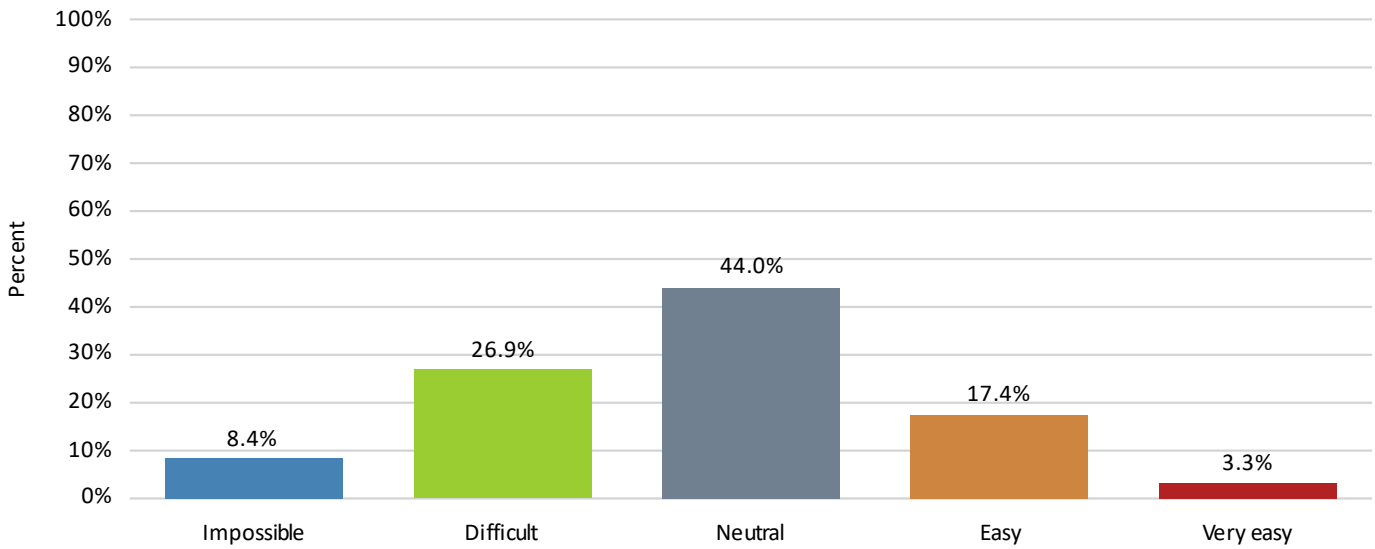
Question	N	Mean	Standard deviation	Median
Other company staff (except above)	335	3.35	0.94	3.00

32. Media



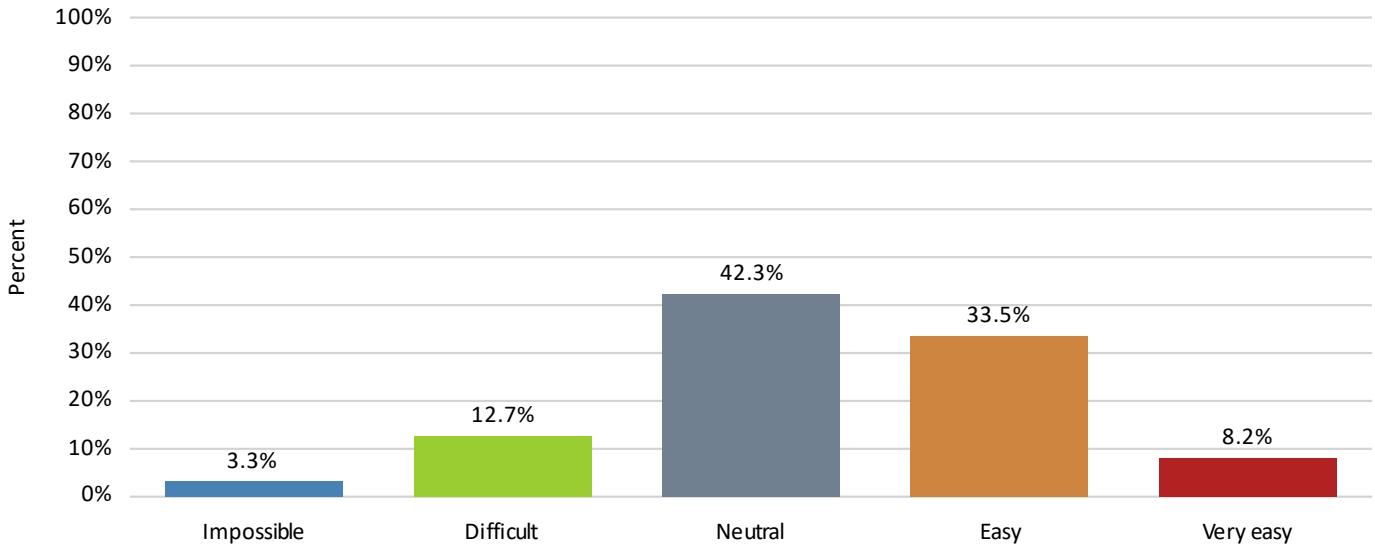
Question	N	Mean	Standard deviation	Median
Media	334	2.10	0.88	2.00

33. Civil Aviation Authorities (CAA)



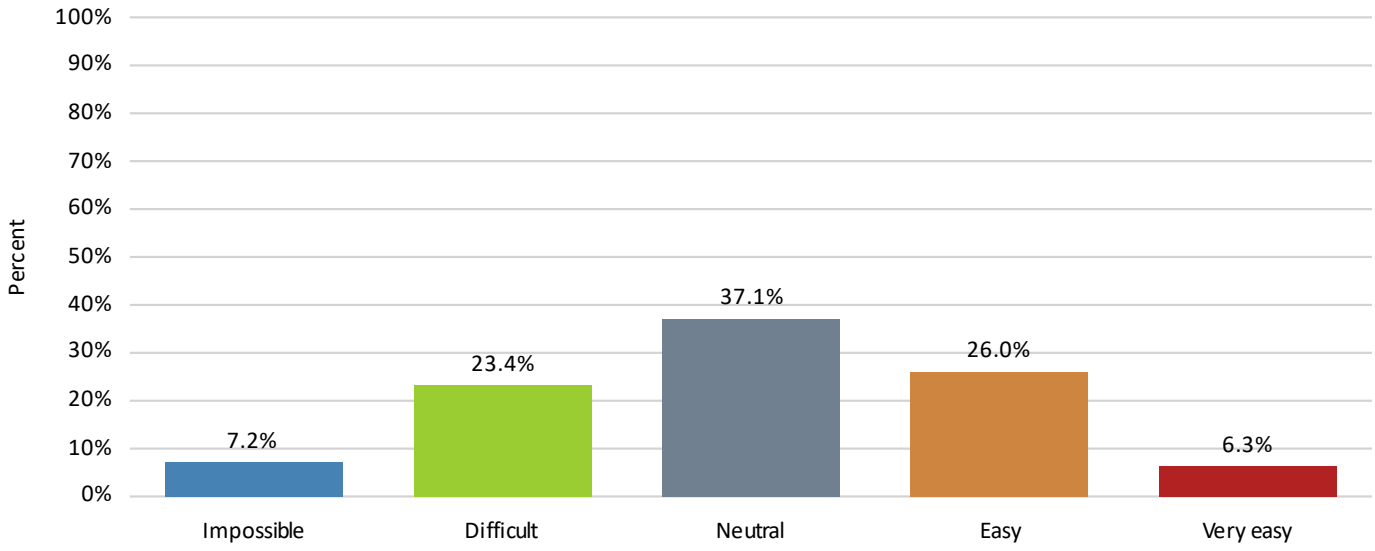
Question	N	Mean	Standard deviation	Median
Civil Aviation Authorities (CAA)	334	2.80	0.93	3.00

34. Non-company pilots



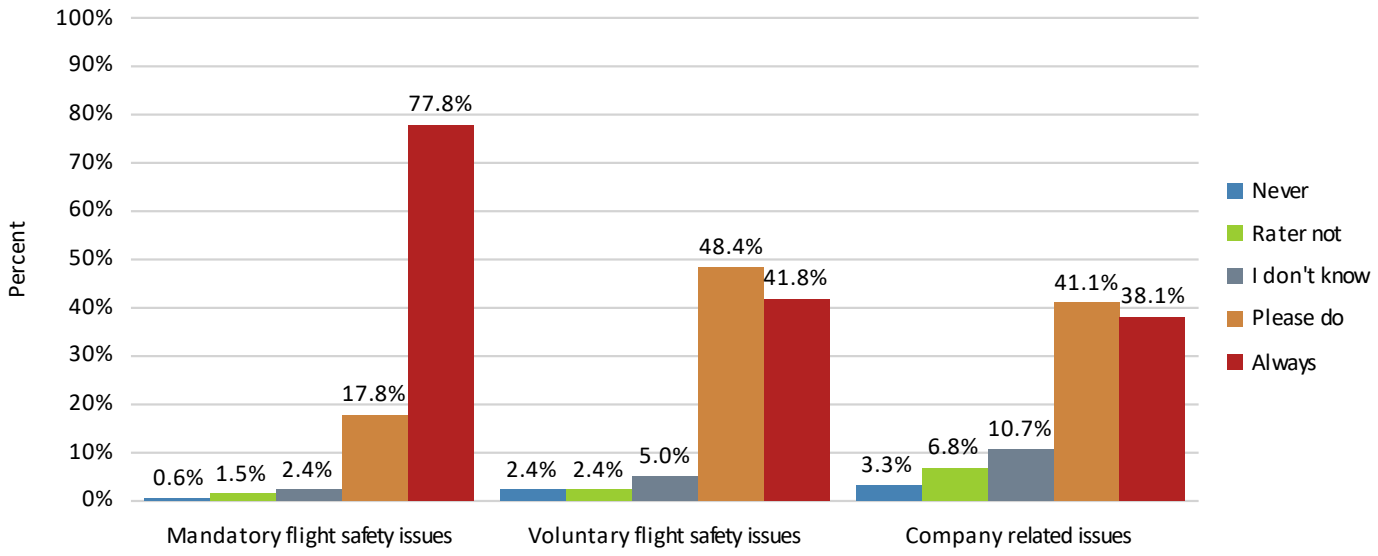
Question	N	Mean	Standard deviation	Median
Non-company pilots	331	3.31	0.91	3.00

35. Friends (non-pilots)



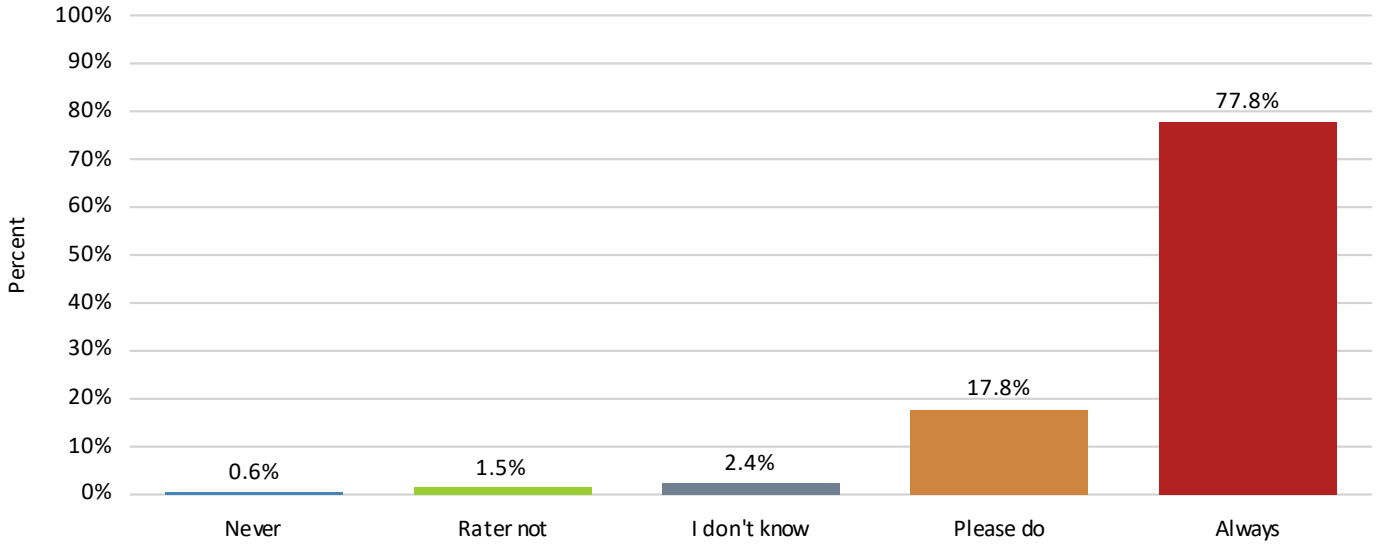
Question	N	Mean	Standard deviation	Median
Friends (non-pilots)	334	3.01	1.02	3.00

36. My company encourages me to file reports about?



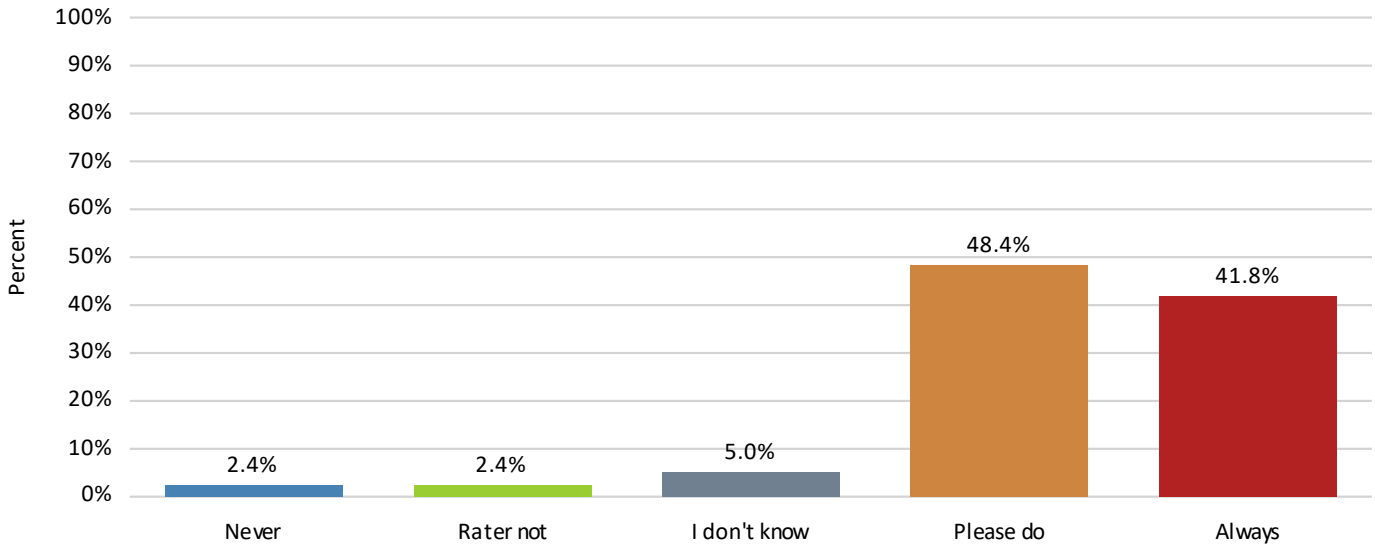
Question	N	Mean	Standard deviation	Median
Mandatory flight safety issues	338	4.71	0.64	5.00
Voluntary flight safety issues	337	4.25	0.85	4.00
Company related issues	336	4.04	1.03	4.00

37. Mandatory flight safety issues



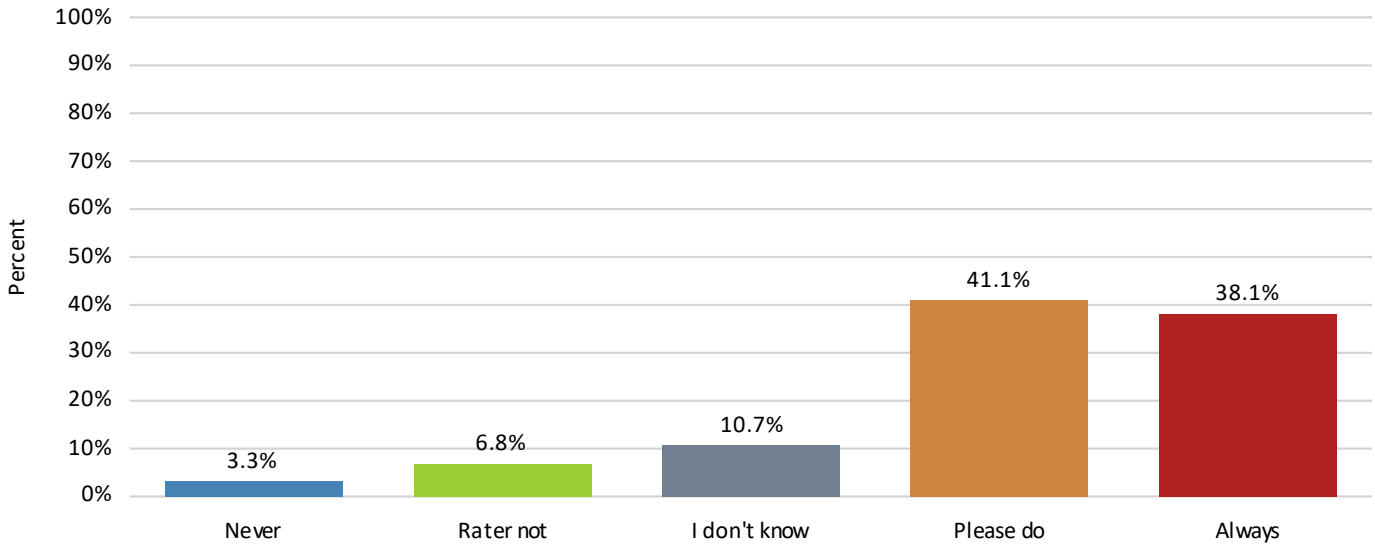
Question	N	Mean	Standard deviation	Median
Mandatory flight safety issues	338	4.71	0.64	5.00

38. Voluntary flight safety issues



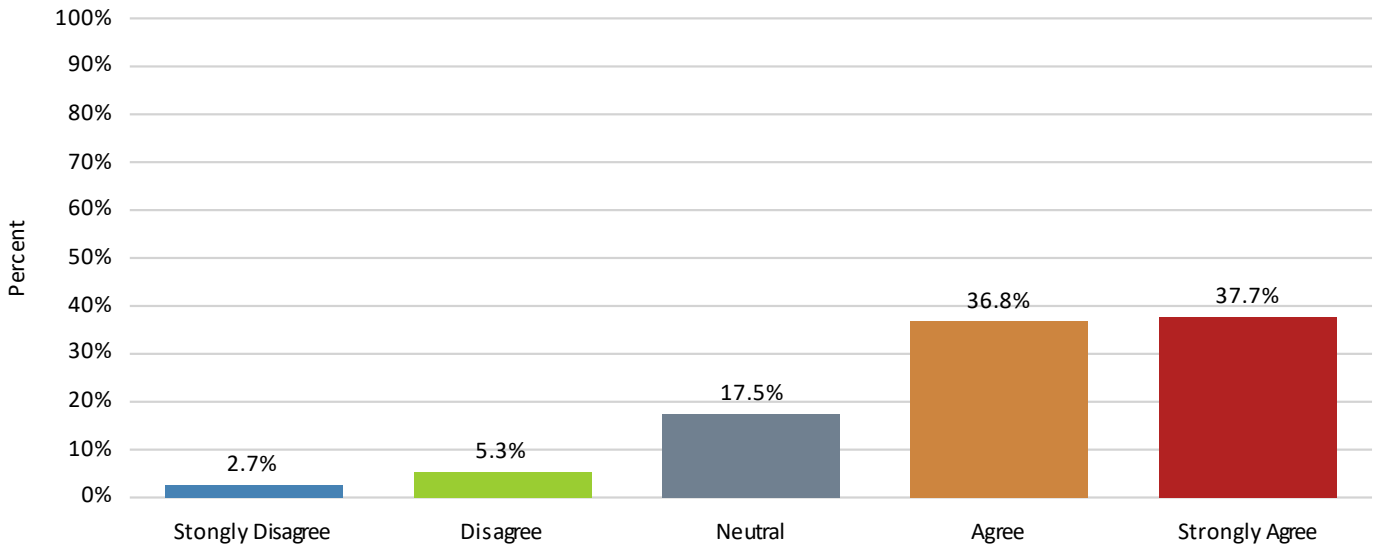
Question	N	Mean	Standard deviation	Median
Voluntary flight safety issues	337	4.25	0.85	4.00

39. Company related issues



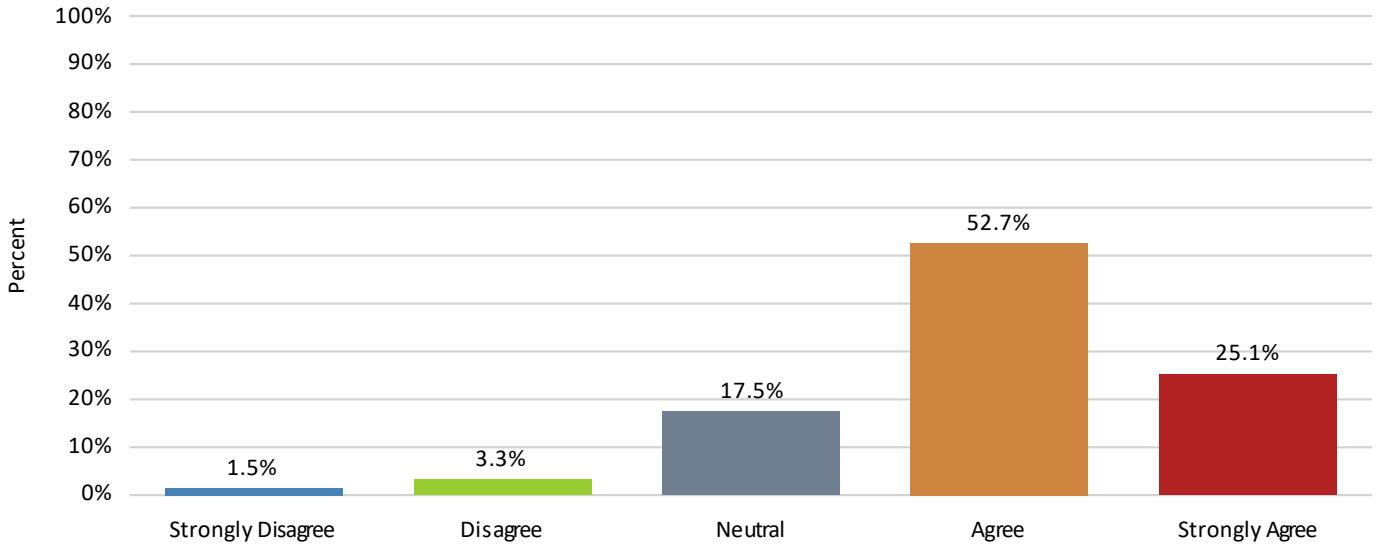
Question	N	Mean	Standard deviation	Median
Company related issues	336	4.04	1.03	4.00

40. My company always submits pilot reports, with a required authority reporting issue, to the authorities?



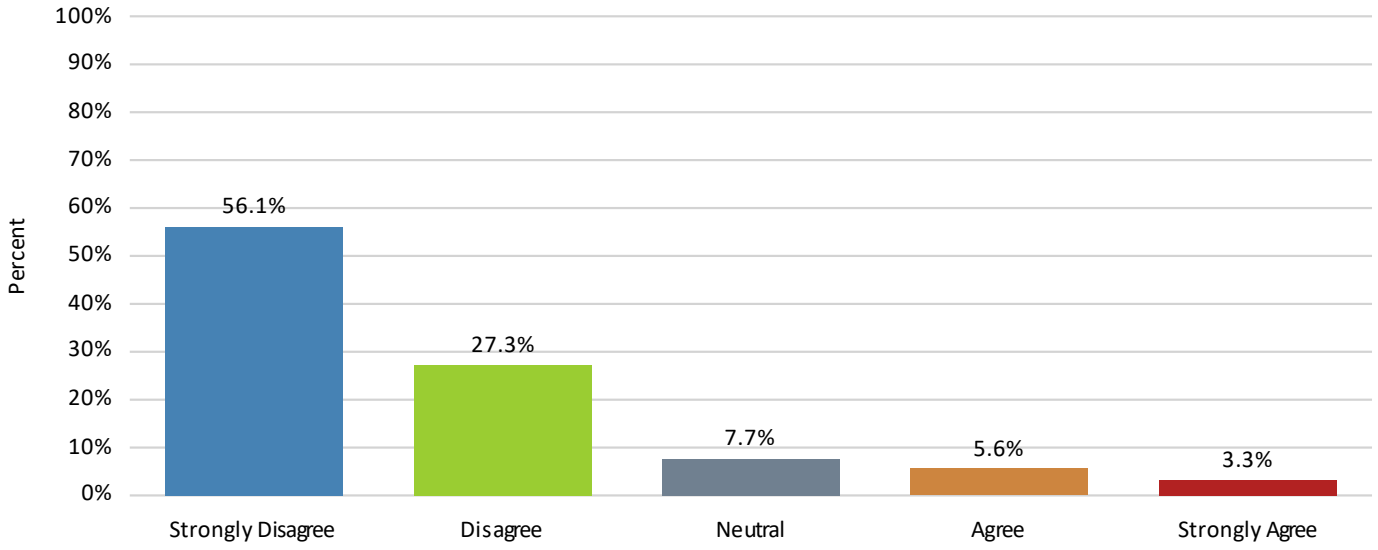
Question	N	Mean	Standard deviation	Median
My company always submits pilot reports, with a required authority reporting issue, to the authorities?	337	4.01	1.00	4.00

41. The company's report investigation team makes a clear distinction between a deliberate/gross violation and an unintentional error/mistake.



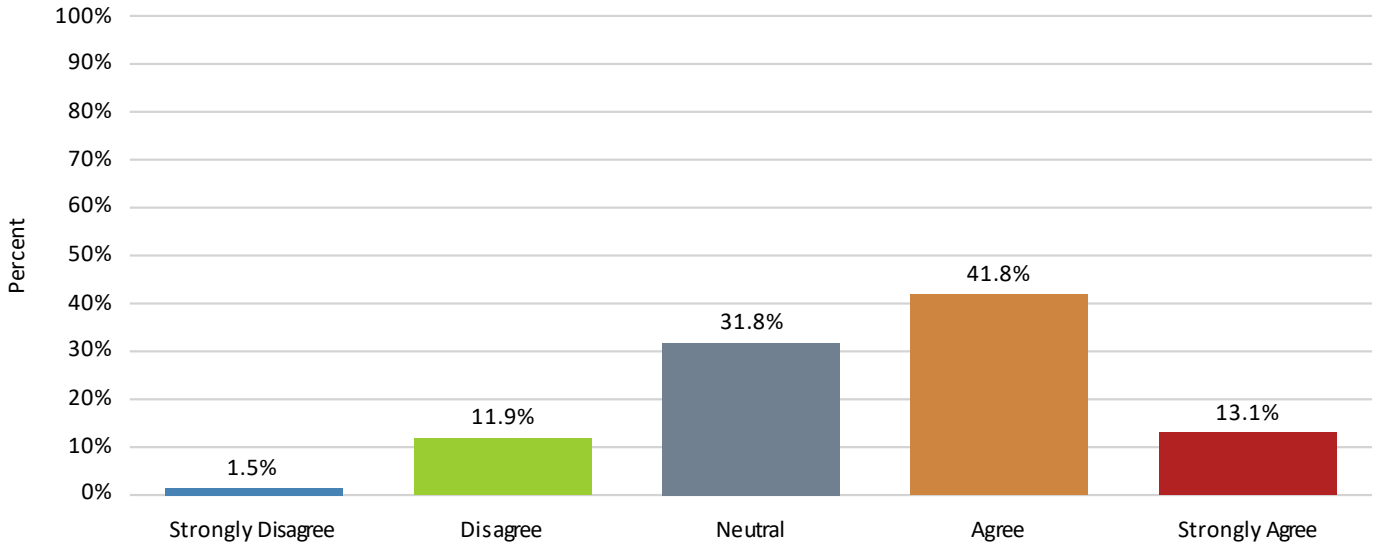
Question	N	Mean	Standard deviation	Median
The company's report investigation team makes a clear distinction between a deliberate/gross violation and an unintentional error/mistake.	338	3.97	0.83	4.00

42. I consider luck as a main safety factor in my company's daily operations?



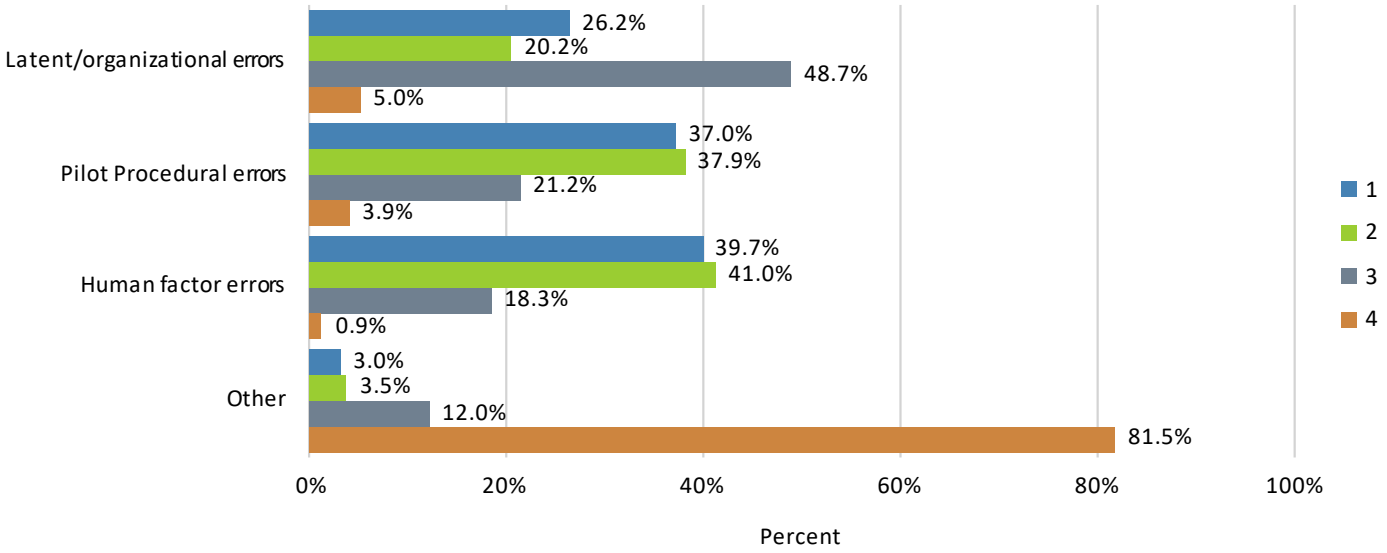
Question	N	Mean	Standard deviation	Median
I consider luck as a main safety factor in my company's daily operations?	337	1.73	1.04	1.00

43. If there is NO "reckless conduct, gross negligence or willful misconduct" performed the organization and the pilots always have a sheared responsibility when a mishap occur.



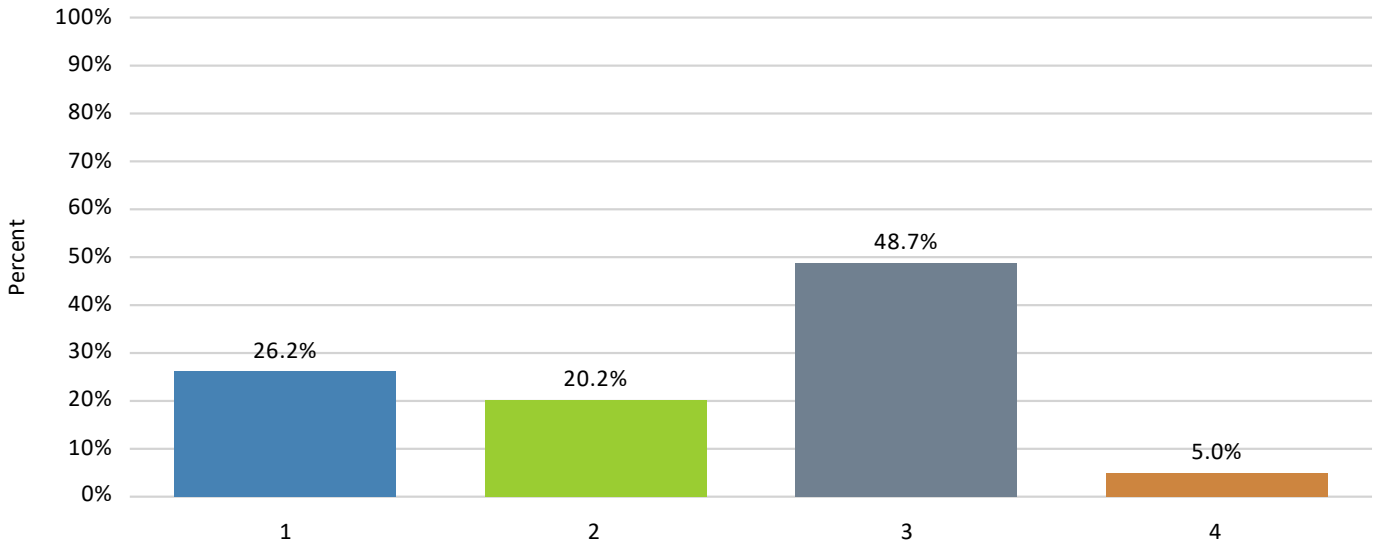
Question	N	Mean	Standard deviation	Median
If there is NO "reckless conduct, gross negligence or willful misconduct" performed the organization and the pilots always have a sheared responsibility when a mishap occur.	337	3.53	0.91	4.00

44. In my company's safety organization I consider the main focus area towards flight safety performance to be: (pls prioritize)



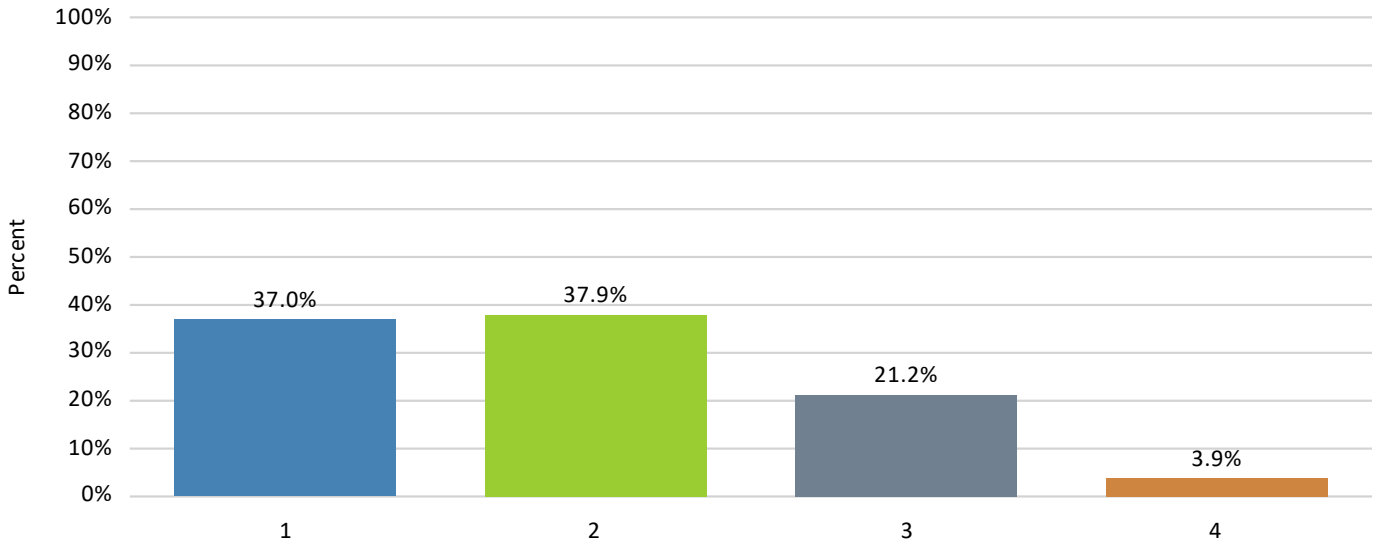
Question	N	Mean	Standard deviation	Median
Latent/organizational errors	302	2.32	0.92	3.00
Pilot Procedural errors	311	1.92	0.85	2.00
Human factor errors	317	1.80	0.76	2.00
Other	200	3.72	0.67	4.00

45. Latent/organizational errors



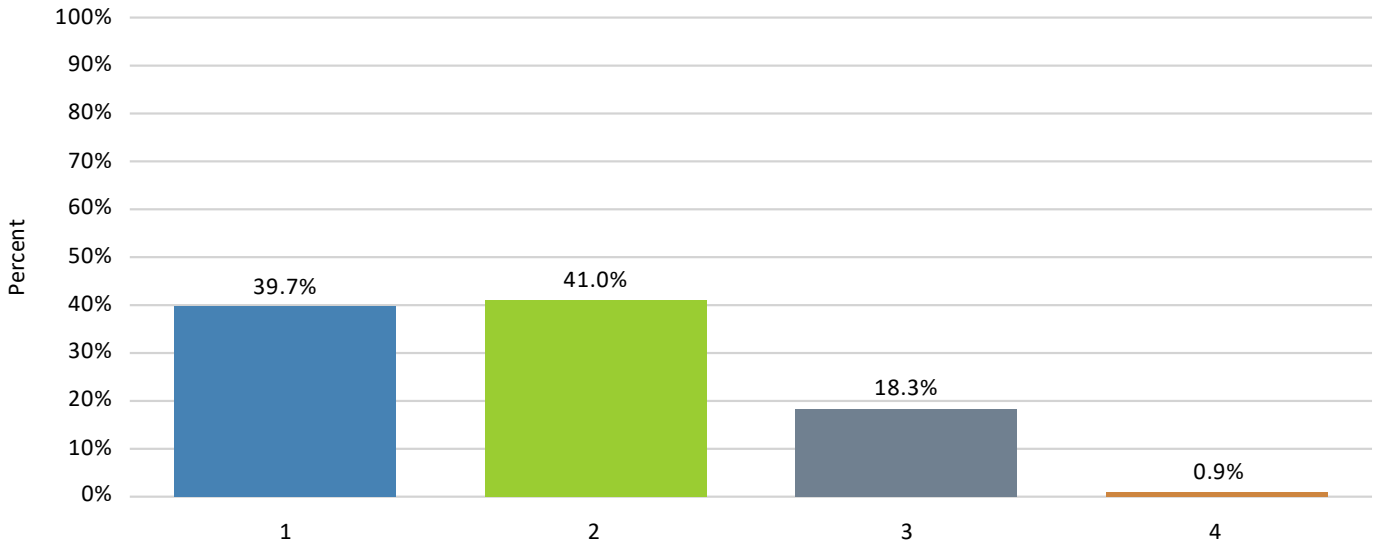
Question	N	Mean	Standard deviation	Median
Latent/organizational errors	302	2.32	0.92	3.00

46. Pilot Procedural errors



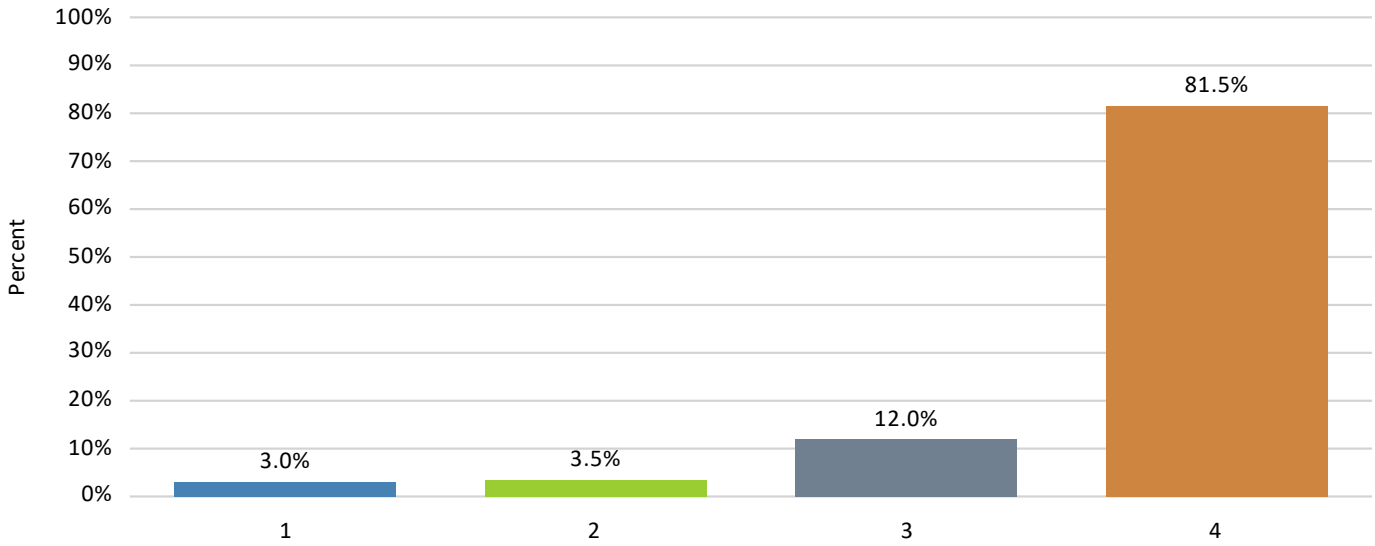
Question	N	Mean	Standard deviation	Median
Pilot Procedural errors	311	1.92	0.85	2.00

47. Human factor errors



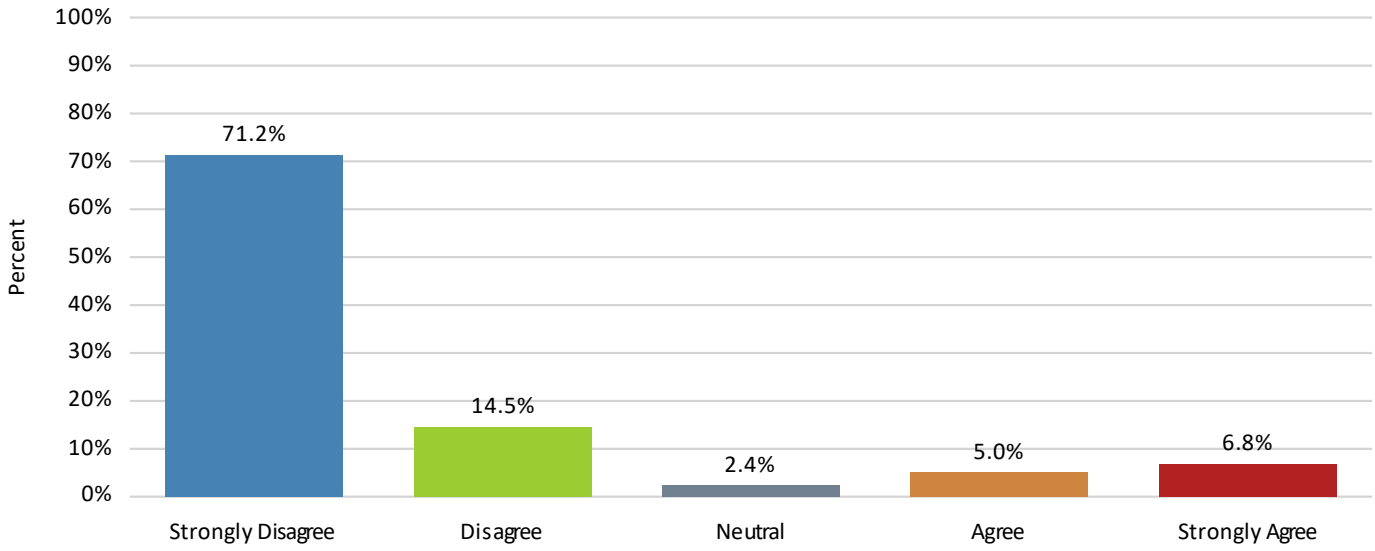
Question	N	Mean	Standard deviation	Median
Human factor errors	317	1.80	0.76	2.00

48. Other



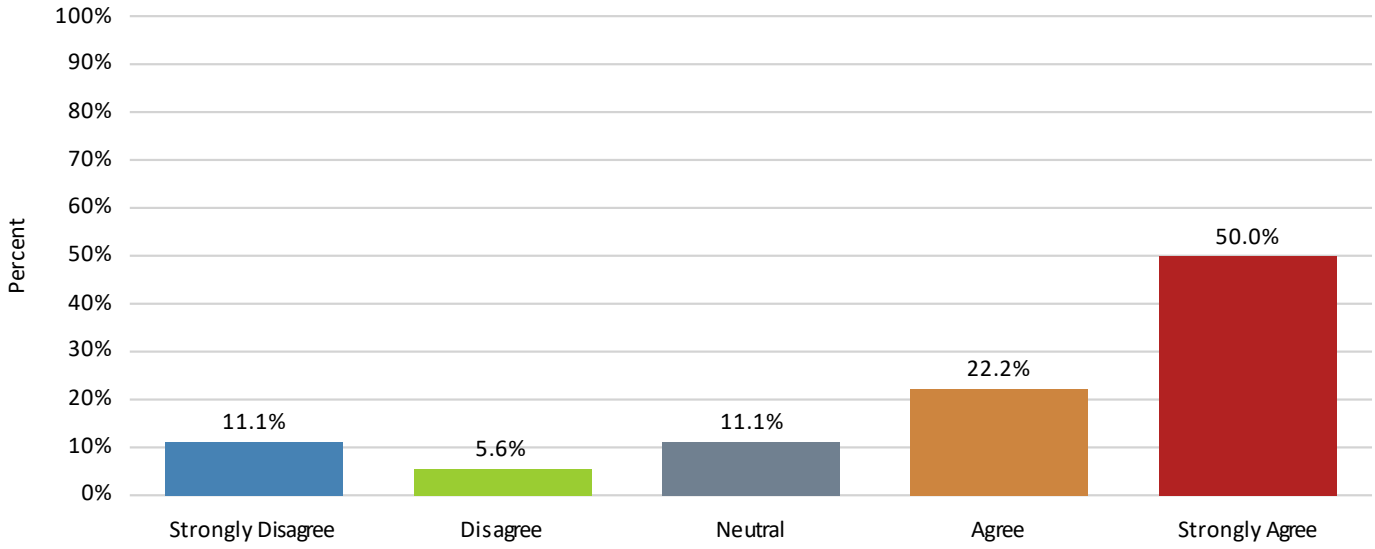
Question	N	Mean	Standard deviation	Median
Other	200	3.72	0.67	4.00

49. Pilot employment models do not affect flight safety.



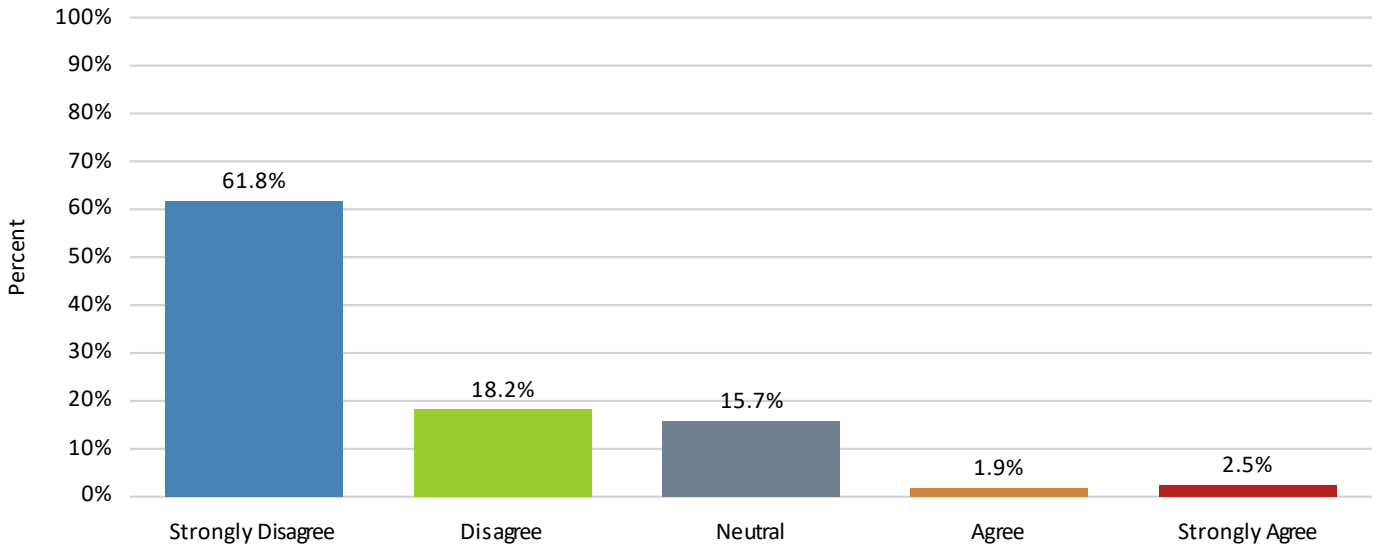
Question	N	Mean	Standard deviation	Median
Pilot employment models do not affect flight safety.	337	1.62	1.19	1.00

50. I would report more safety related issues if I had a permanent (unlimited) contract with my company?



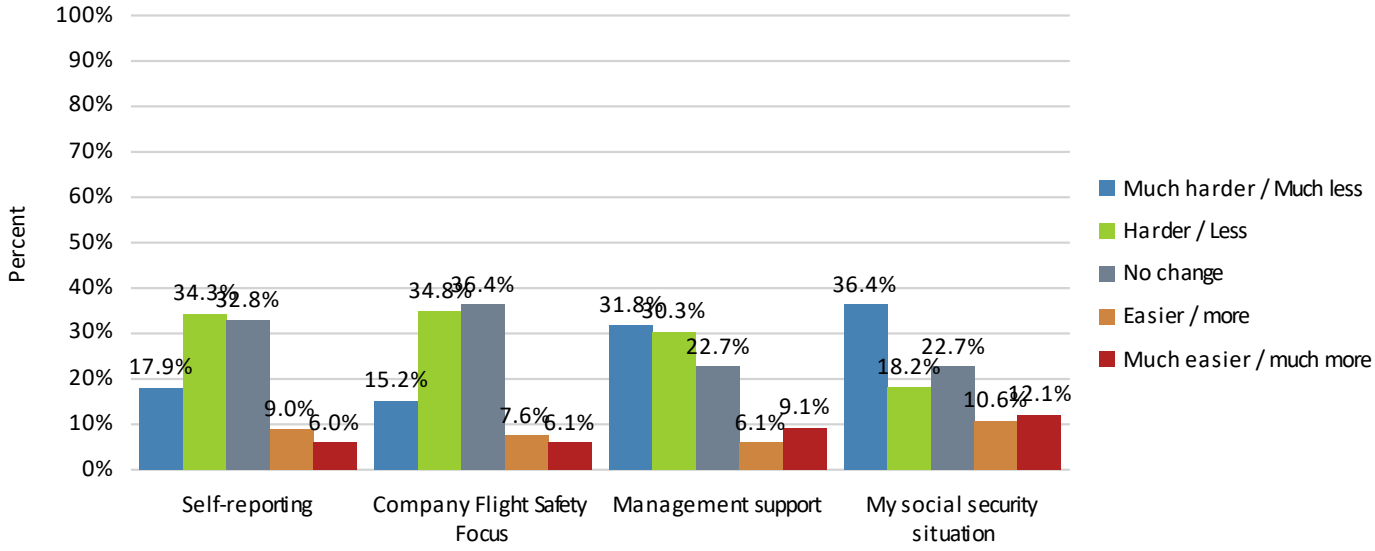
Question	N	Mean	Standard deviation	Median
I would report more safety related issues if I had a permanent (unlimited) contract with my company?	18	3.94	1.35	4.50

51. I would report more safety related issues if I had a temporary contract with my company?



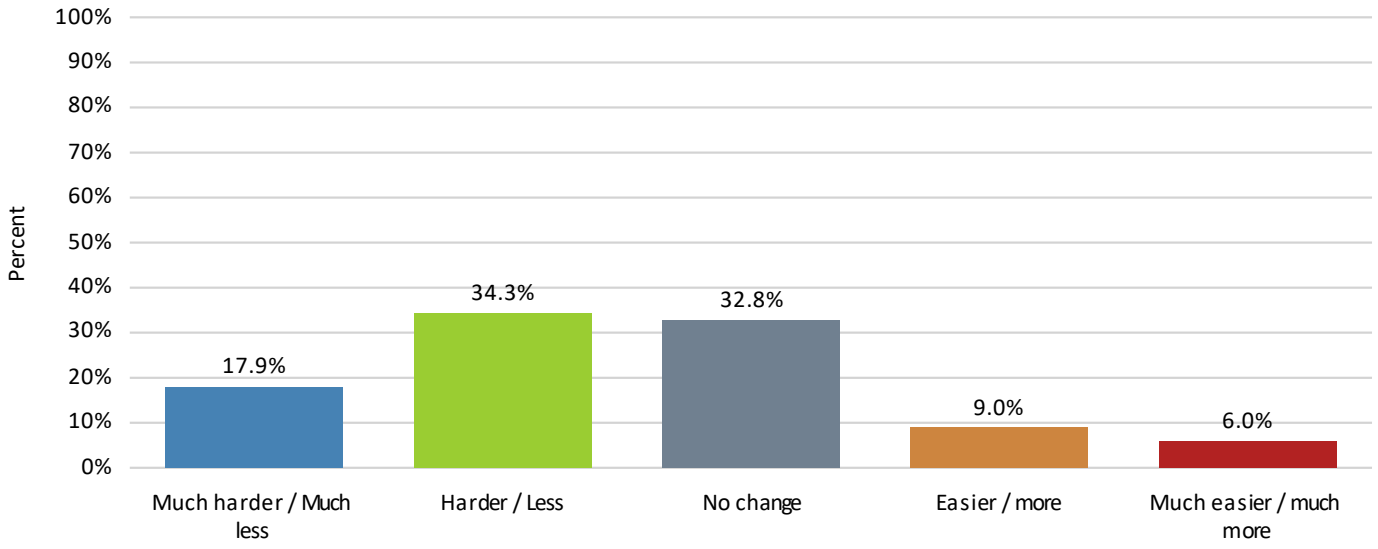
Question	N	Mean	Standard deviation	Median
I would report more safety related issues if I had a temporary contract with my company?	319	1.65	0.98	1.00

52. You have changed employer the last 5 years; with your PREVIOUS employer, how would you rate the following criteria?



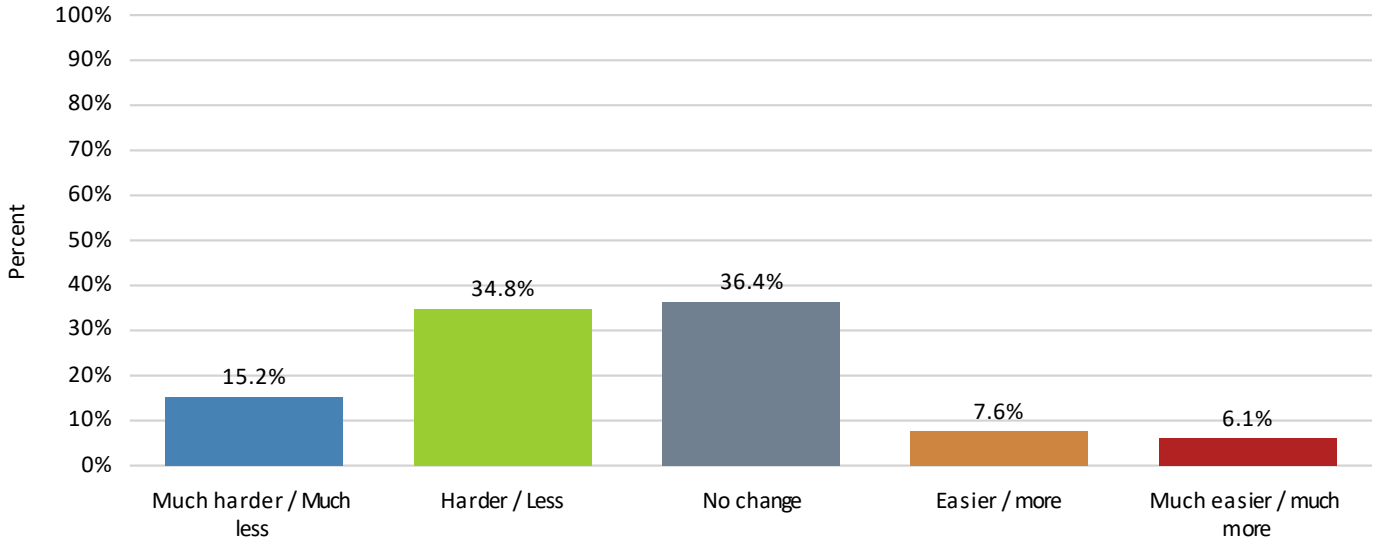
Question	N	Mean	Standard deviation	Median
Self-reporting	67	2.51	1.07	2.00
Company Flight Safety Focus	66	2.55	1.03	2.50
Management support	66	2.30	1.23	2.00
My social security situation	66	2.44	1.38	2.00

53. Self-reporting



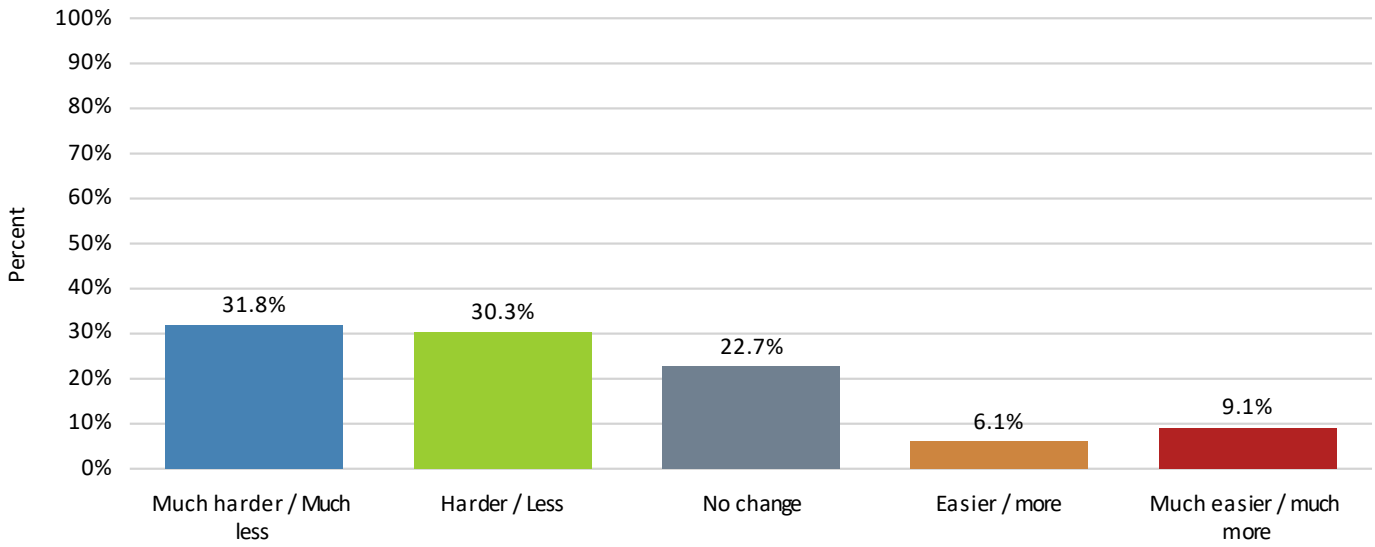
Question	N	Mean	Standard deviation	Median
Self-reporting	67	2.51	1.07	2.00

54. Company Flight Safety Focus



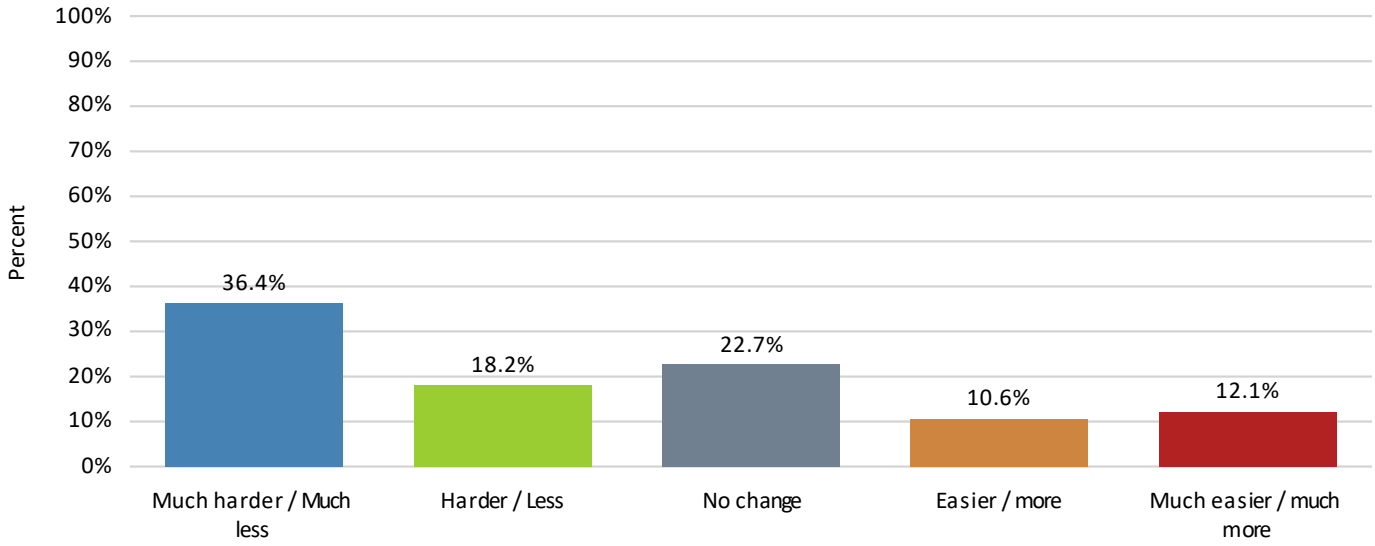
Question	N	Mean	Standard deviation	Median
Company Flight Safety Focus	66	2.55	1.03	2.50

55. Management support



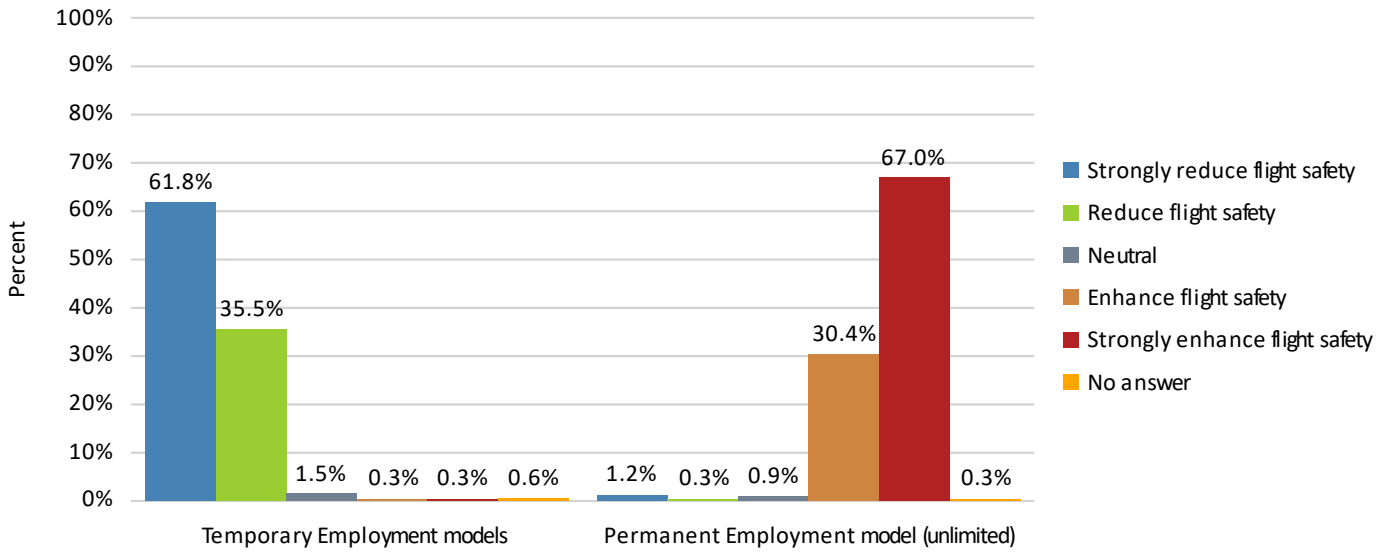
Question	N	Mean	Standard deviation	Median
Management support	66	2.30	1.23	2.00

56. My social security situation



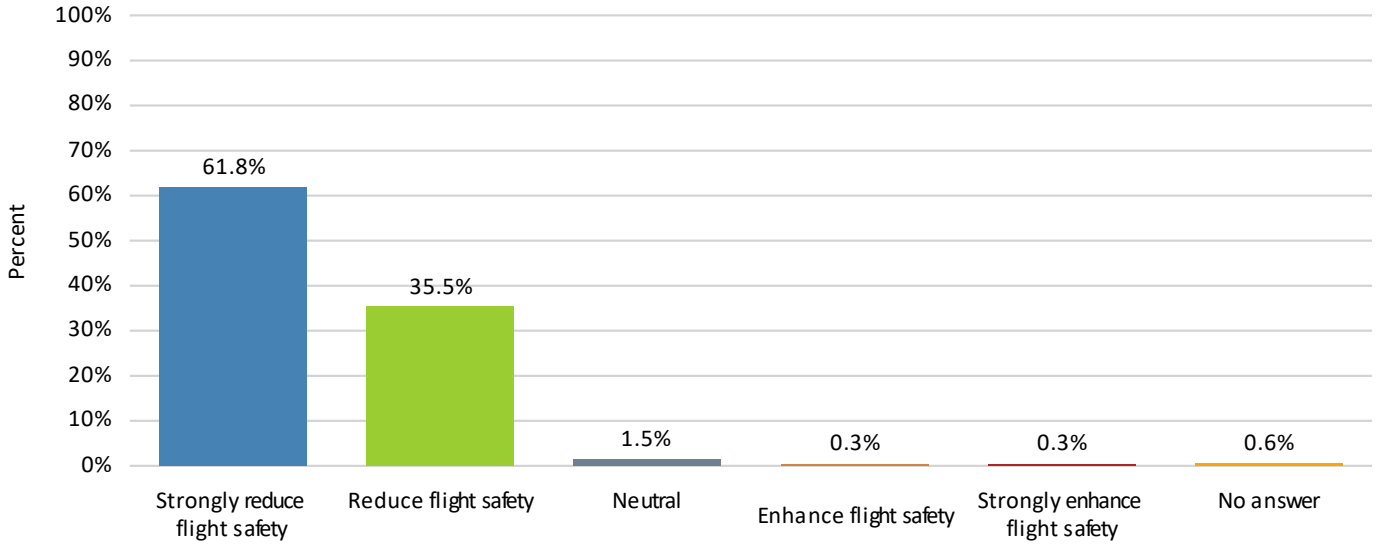
Question	N	Mean	Standard deviation	Median
My social security situation	66	2.44	1.38	2.00

57. Employment models versus flight safety in Europe.



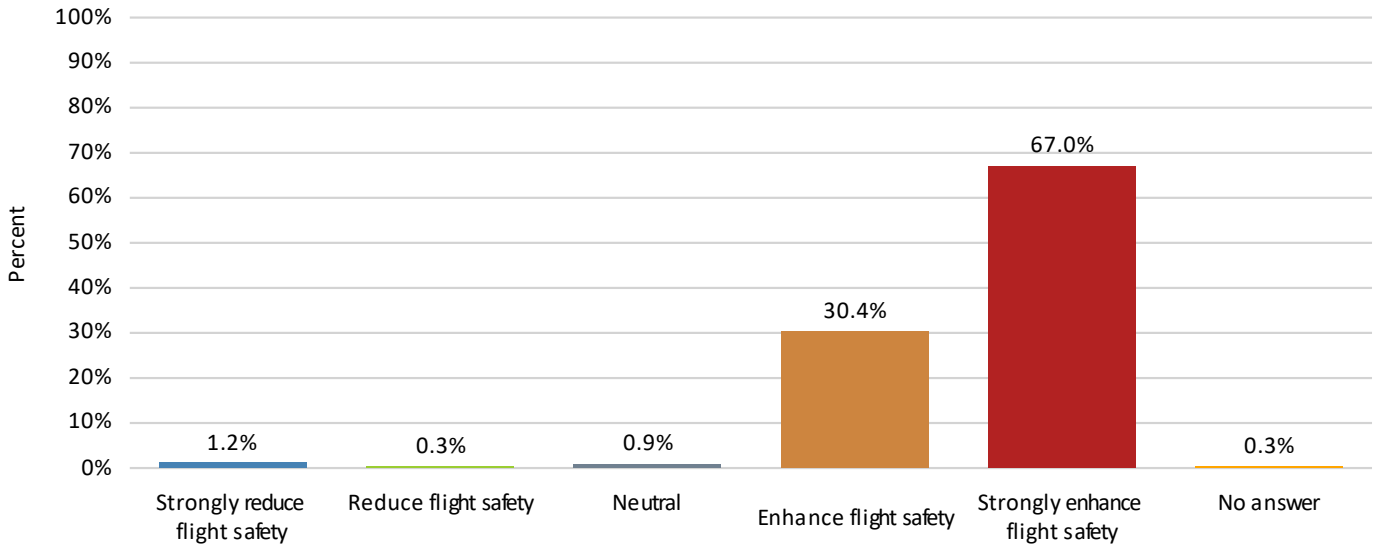
Question	N	Mean	Standard deviation	Median
Temporary Employment models	338	1.43	0.67	1.00
Permanent Employment model (unlimited)	339	4.63	0.65	5.00

58. Temporary Employment models



Question	N	Mean	Standard deviation	Median
Temporary Employment models	338	1.43	0.67	1.00

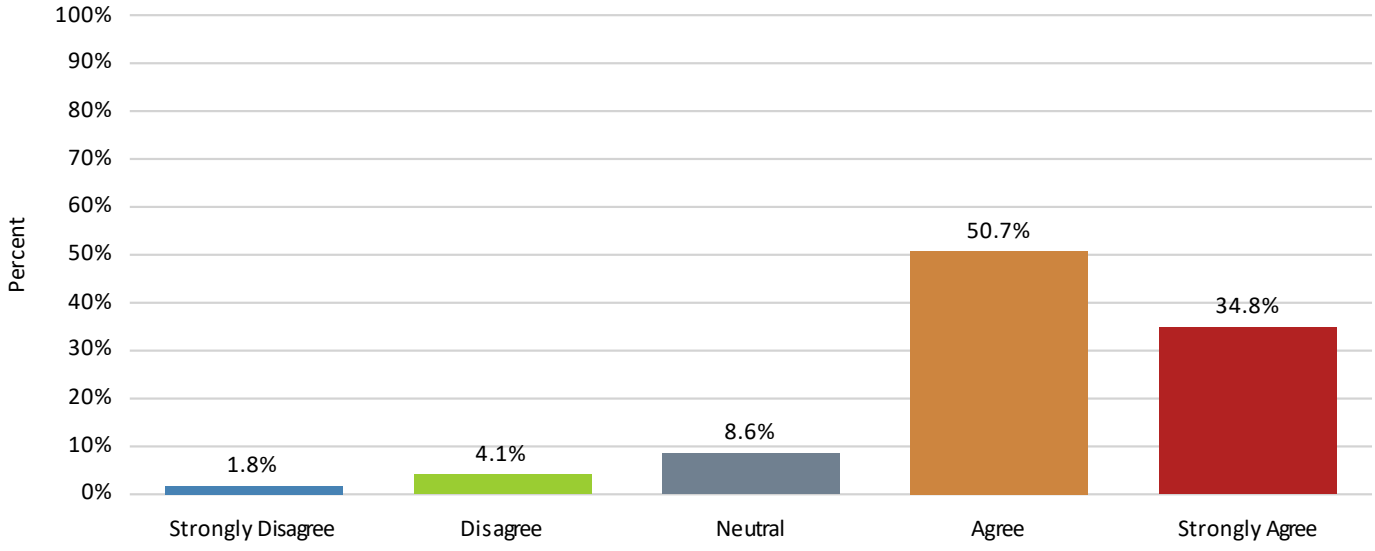
59. Permanent Employment model (unlimited)



Question	N	Mean	Standard deviation	Median
Permanent Employment model (unlimited)	339	4.63	0.65	5.00

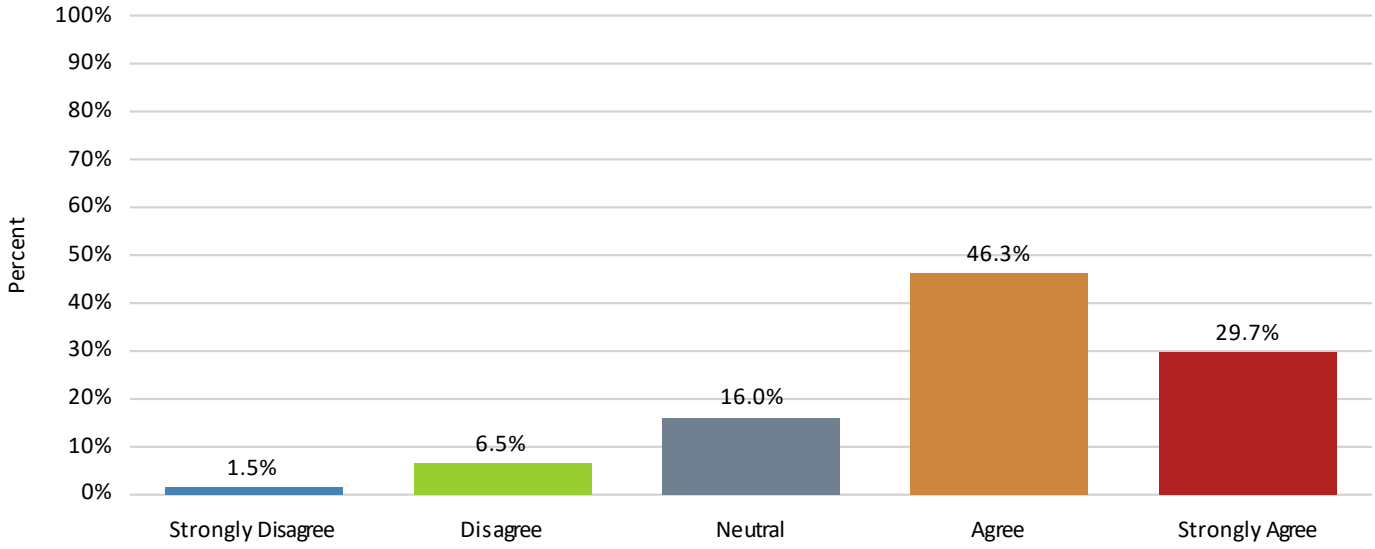
60. Pilots who report safety-related occurrences are treated in a just and fair manner by my company.

When answering the following questions, we presume there is NO "reckless conduct, gross negligence or willful misconduct" performed.



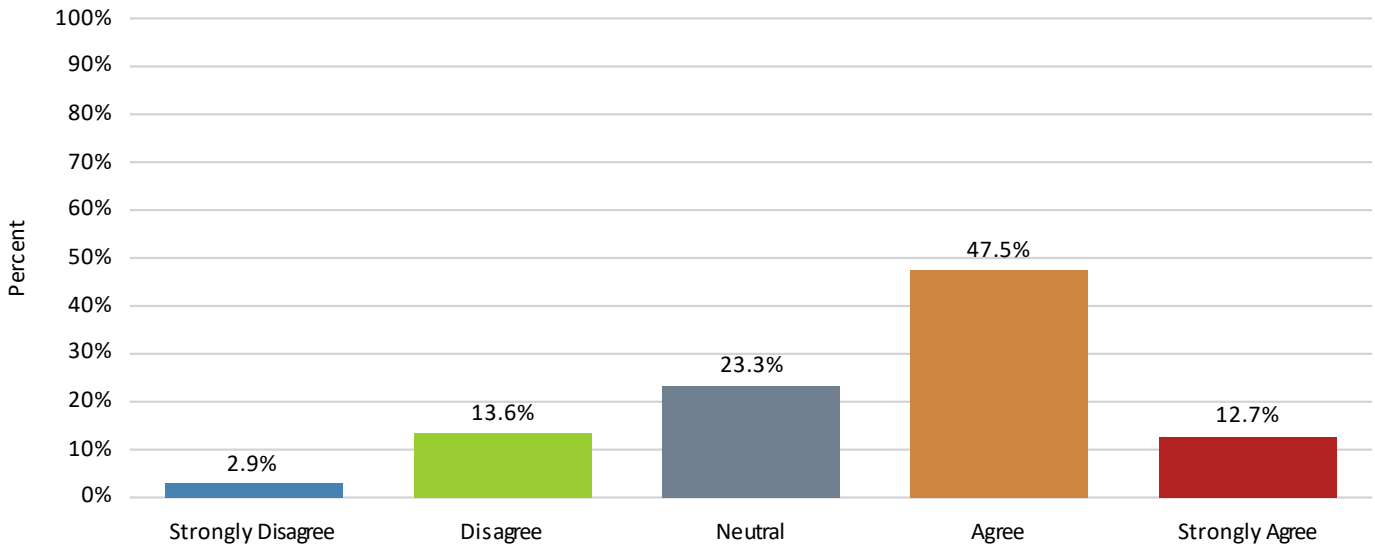
Question	N	Mean	Standard deviation	Median
Pilots who report safety-related occurrences are treated in a just and fair manner by my company.	339	4.13	0.86	4.00

61. In my company; voicing concerns about safety is encouraged.



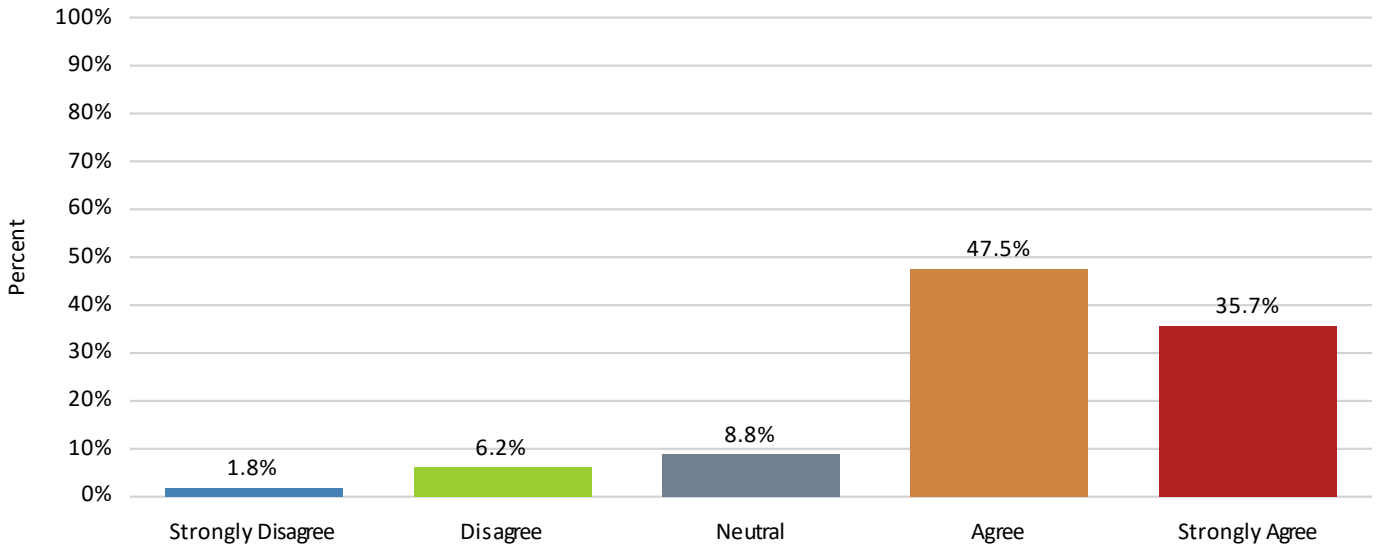
Question	N	Mean	Standard deviation	Median
In my company; Voicing concerns about safety is encouraged.	337	3.96	0.92	4.00

62. In my Company; we get timely feedback on the safety issues we raise.



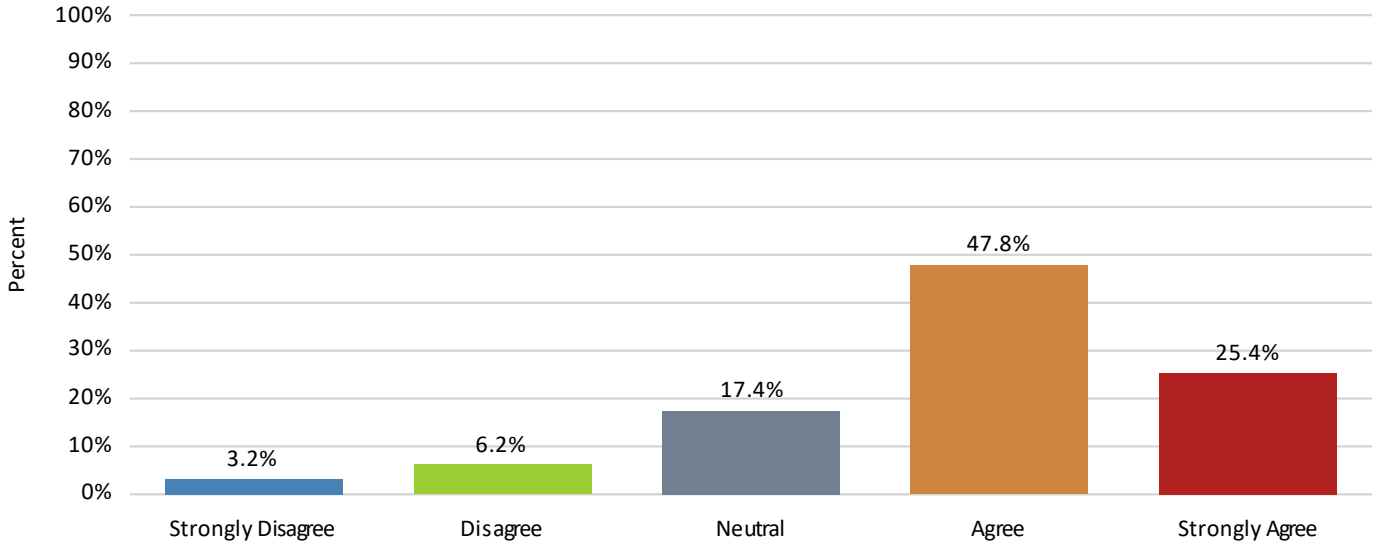
Question	N	Mean	Standard deviation	Median
In my Company; We get timely feedback on the safety issues we raise.	339	3.53	0.98	4.00

63. I am prepared to speak to my direct manager when unsafe situations are developing.



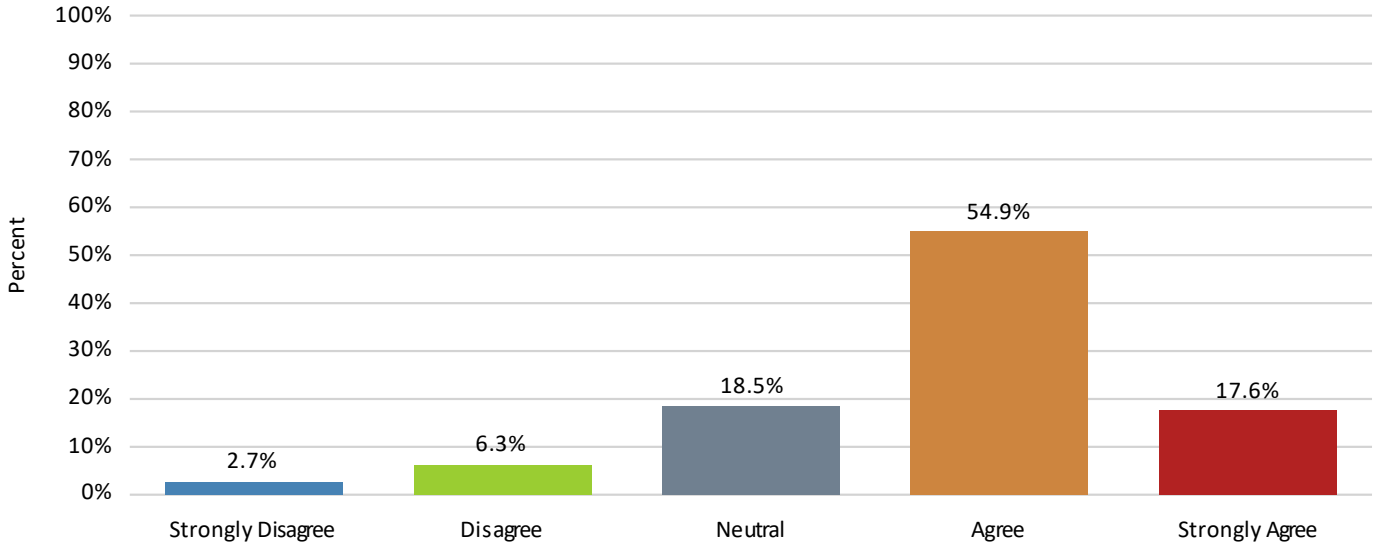
Question	N	Mean	Standard deviation	Median
I am prepared to speak to my direct manager when unsafe situations are developing.	339	4.09	0.92	4.00

64. If there is NO "reckless conduct, gross negligence or willful misconduct performed", self-reporting errors would have NO consequences to my career.



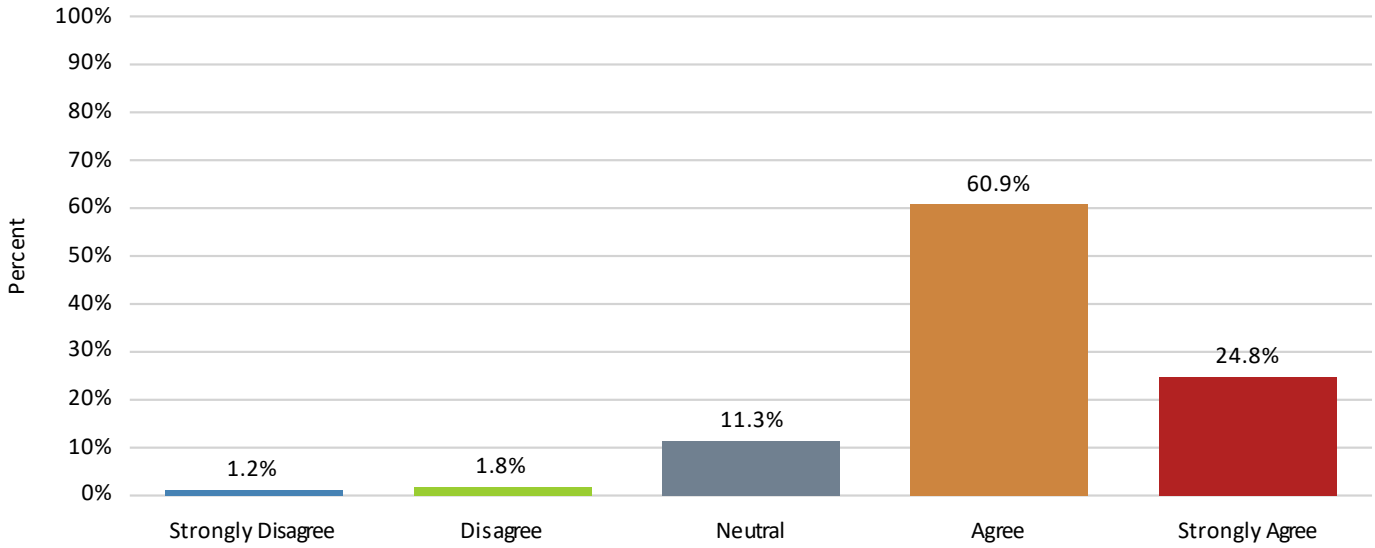
Question	N	Mean	Standard deviation	Median
If there is NO "reckless conduct, gross negligence or willful misconduct performed", self-reporting errors would have NO consequences to my career.	339	3.86	0.97	4.00

65. Information about safety-related changes within this company is clearly communicated to staff.



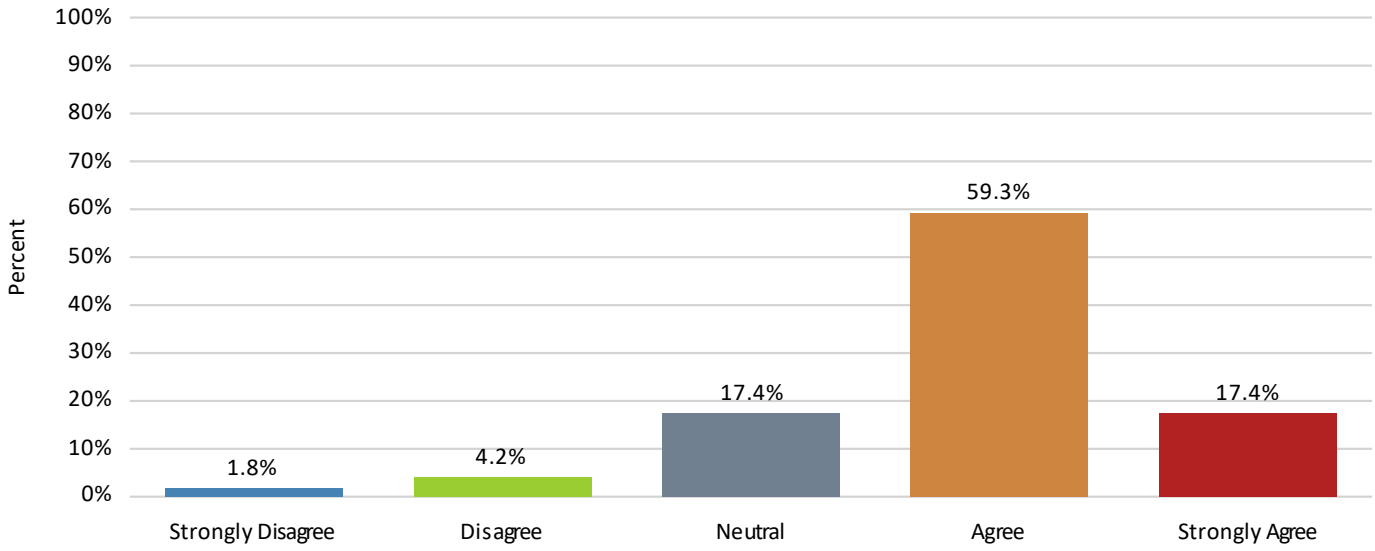
Question	N	Mean	Standard deviation	Median
Information about safety-related changes within this company is clearly communicated to staff.	335	3.79	0.90	4.00

66. We learn lessons from safety related incident or occurrence investigations.



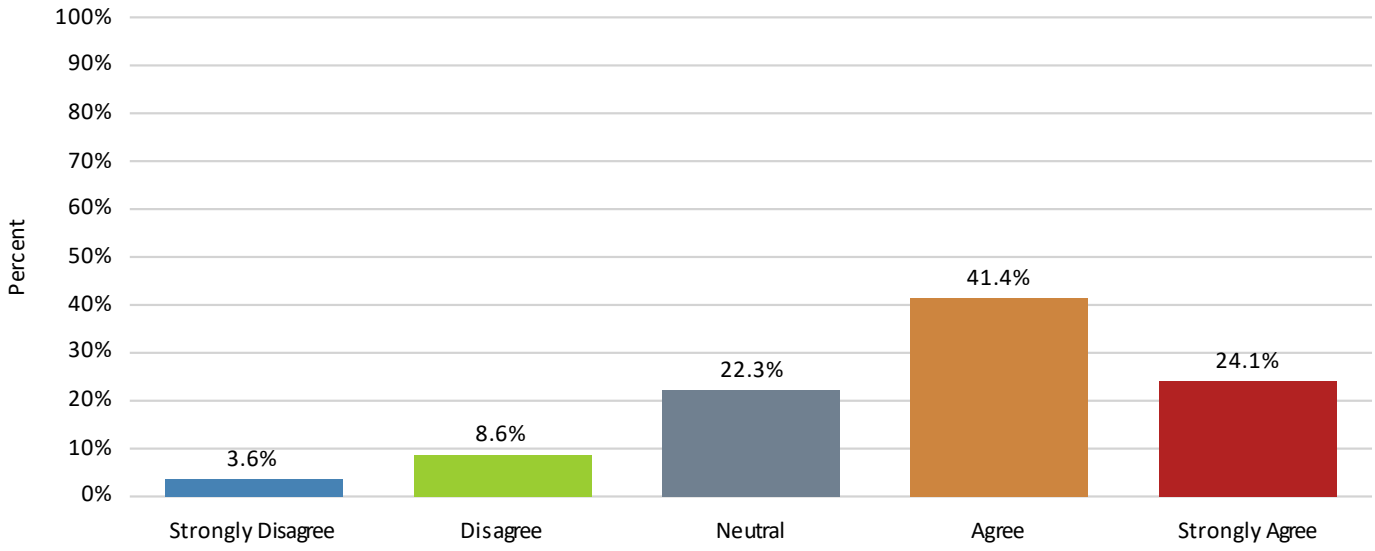
Question	N	Mean	Standard deviation	Median
We learn lessons from safety related incident or occurrence investigations.	335	4.06	0.73	4.00

67. People in this company share safety related information.



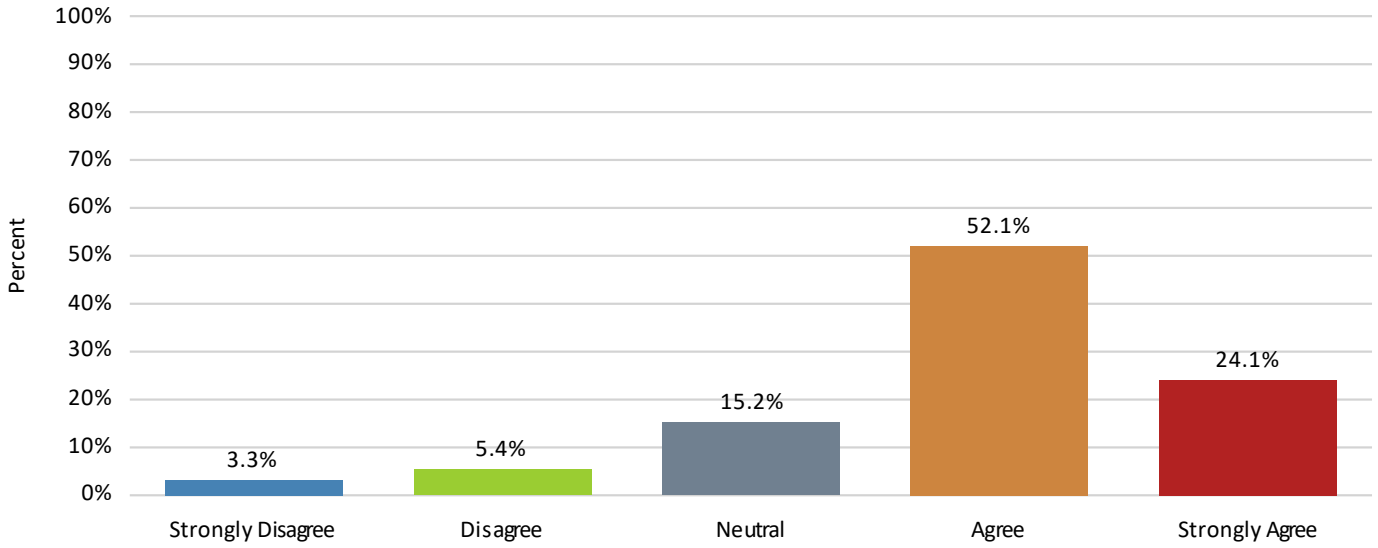
Question	N	Mean	Standard deviation	Median
People in this company share safety related information.	334	3.86	0.81	4.00

68. My company fully supports my decision if I step down from duty because of fatigue.



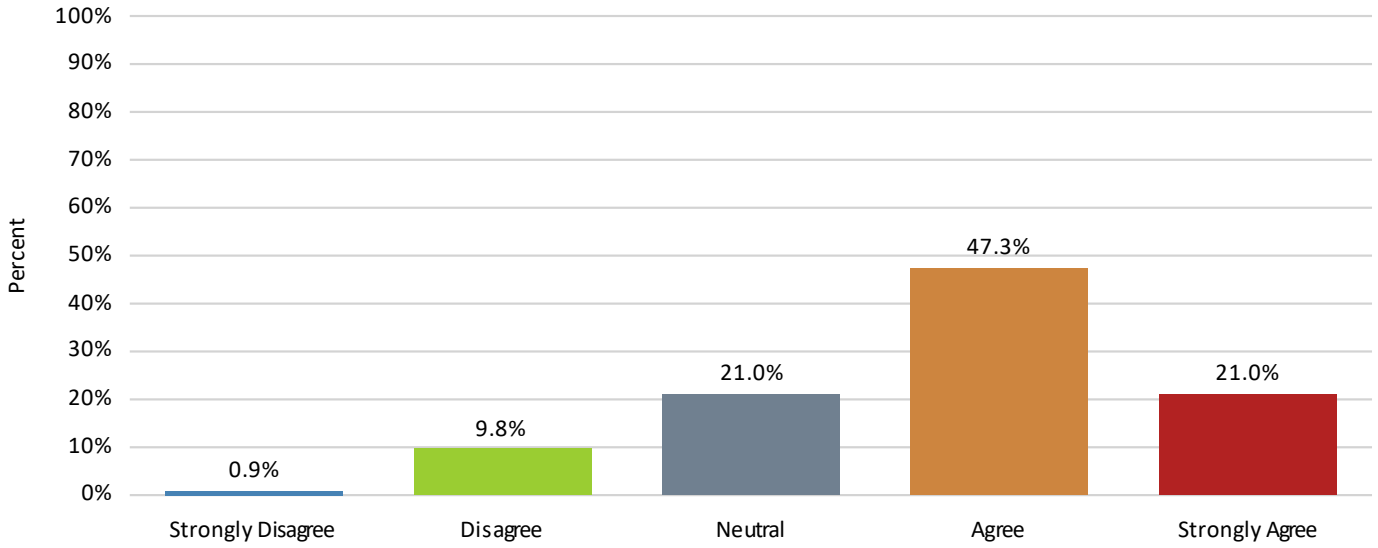
Question	N	Mean	Standard deviation	Median
My company fully supports my decision if I step down from duty because of fatigue.	336	3.74	1.03	4.00

69. If I reported an error I am confident my company would treat me according to "just culture" principles, i.e. make a clear distinctions between human errors and "reckless conduct/ gross negligence/willful misconduct".



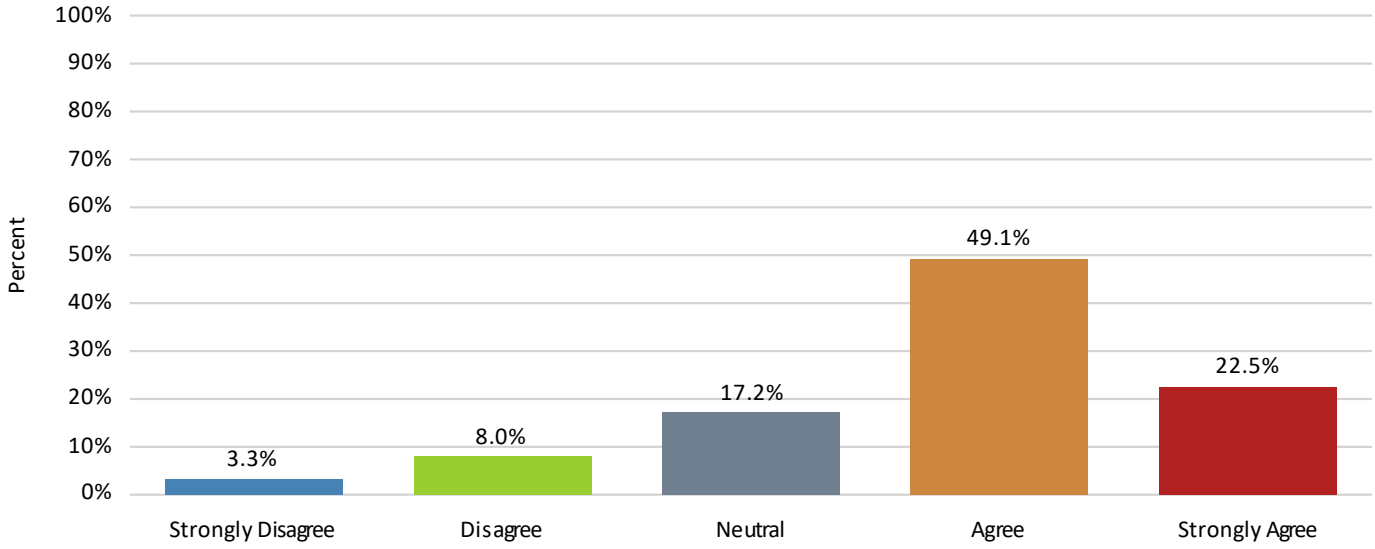
Question	N	Mean	Standard deviation	Median
If I reported an error I am confident my company would treat me according to "just culture" principles, i.e. make a clear distinctions between human errors and "reckless conduct/ gross negligence/willful misconduct".	336	3.88	0.94	4.00

70. Pilots in this company are often tired at work.



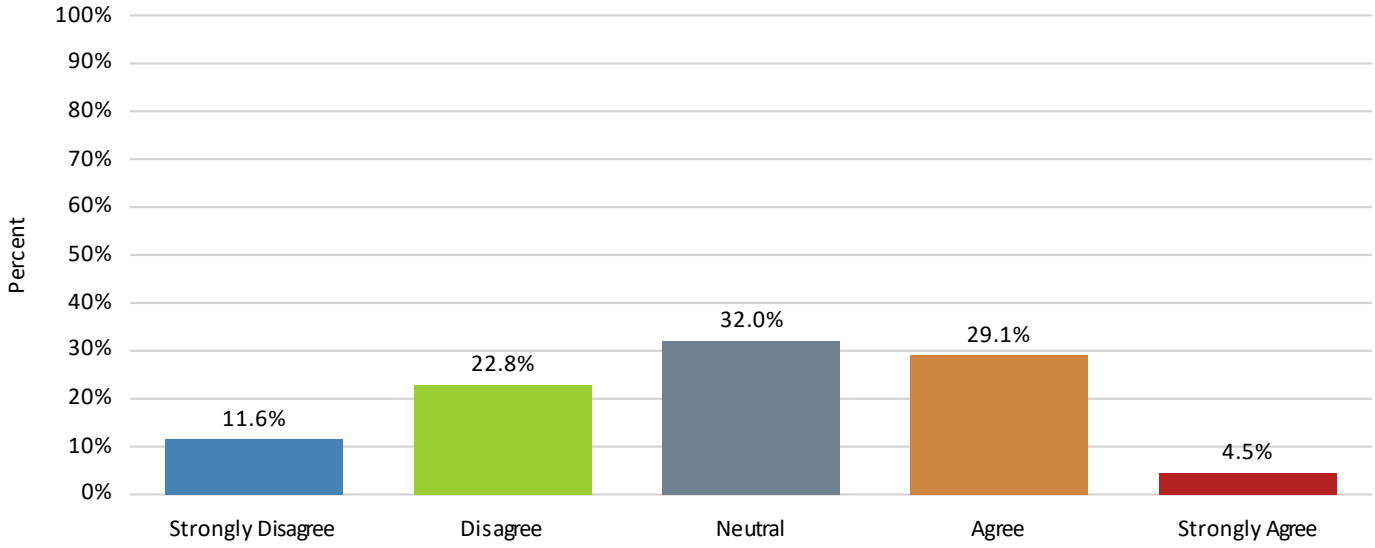
Question	N	Mean	Standard deviation	Median
Pilots in this company are often tired at work.	338	3.78	0.92	4.00

71. I would feel comfortable to complete a fatigue report.



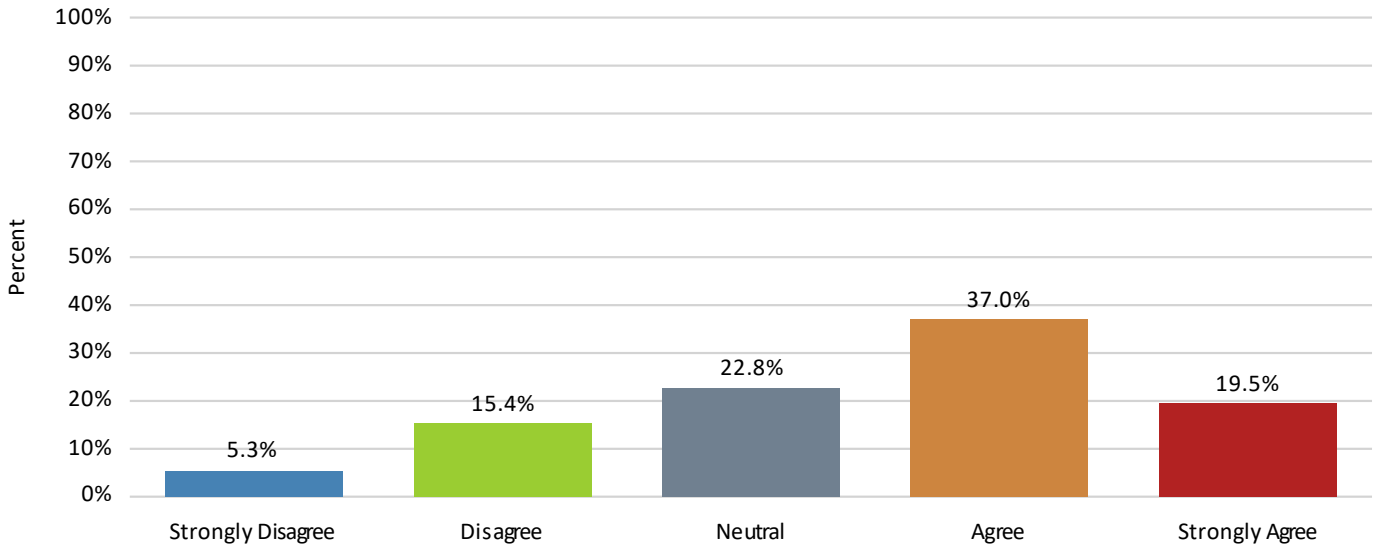
Question	N	Mean	Standard deviation	Median
I would feel comfortable to complete a fatigue report.	338	3.80	0.98	4.00

72. The issue of fatigue is taken seriously by this company.



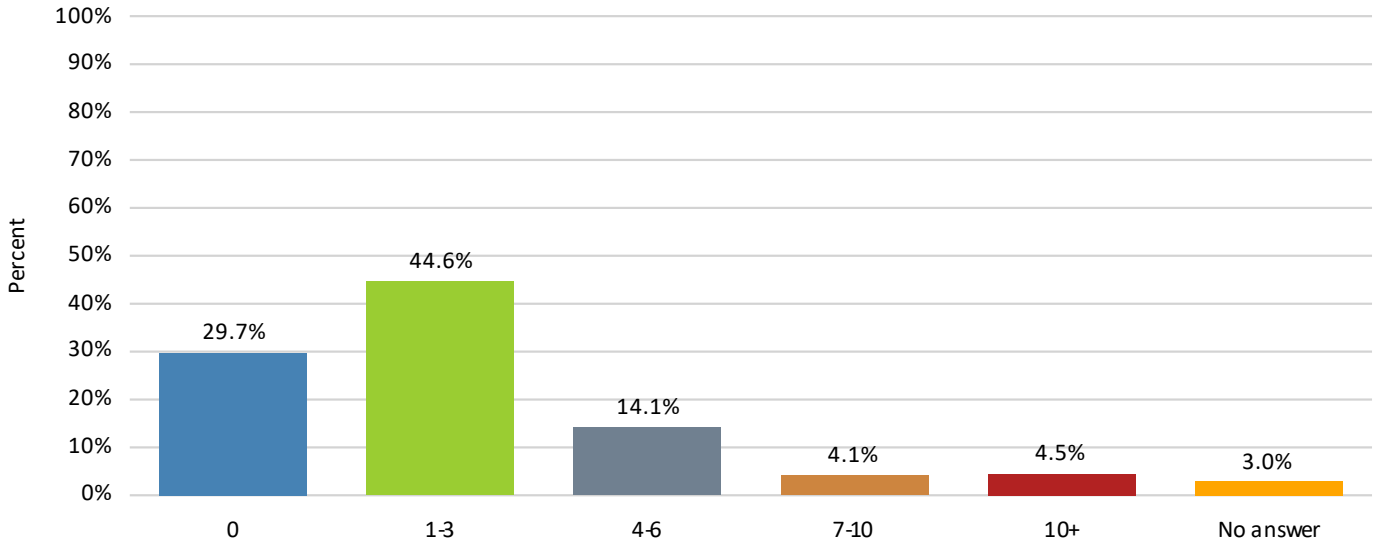
Question	N	Mean	Standard deviation	Median
The issue of fatigue is taken seriously by this company.	337	2.92	1.07	3.00

73. I always file a fatigue report when it is required by the authorities.



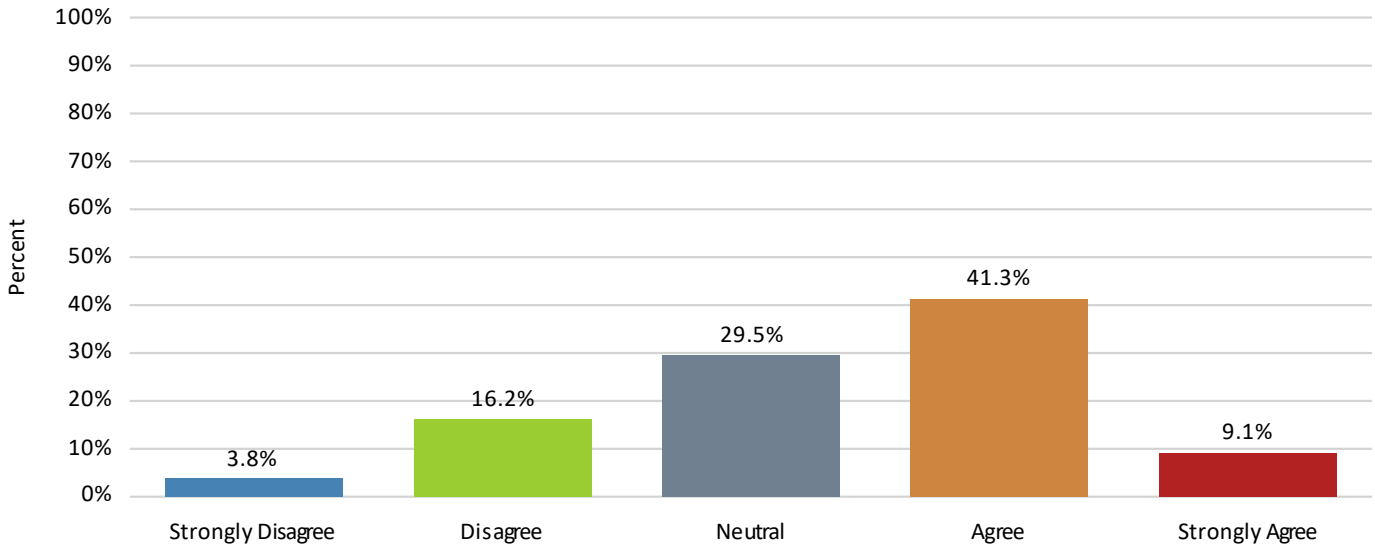
Question	N	Mean	Standard deviation	Median
I always file a fatigue report when it is required by the authorities.	338	3.50	1.13	4.00

74. Your previous answer indicates you don't always file fatigue reports when required, approximately how often have you skipped a fatigue report the last 12 months?



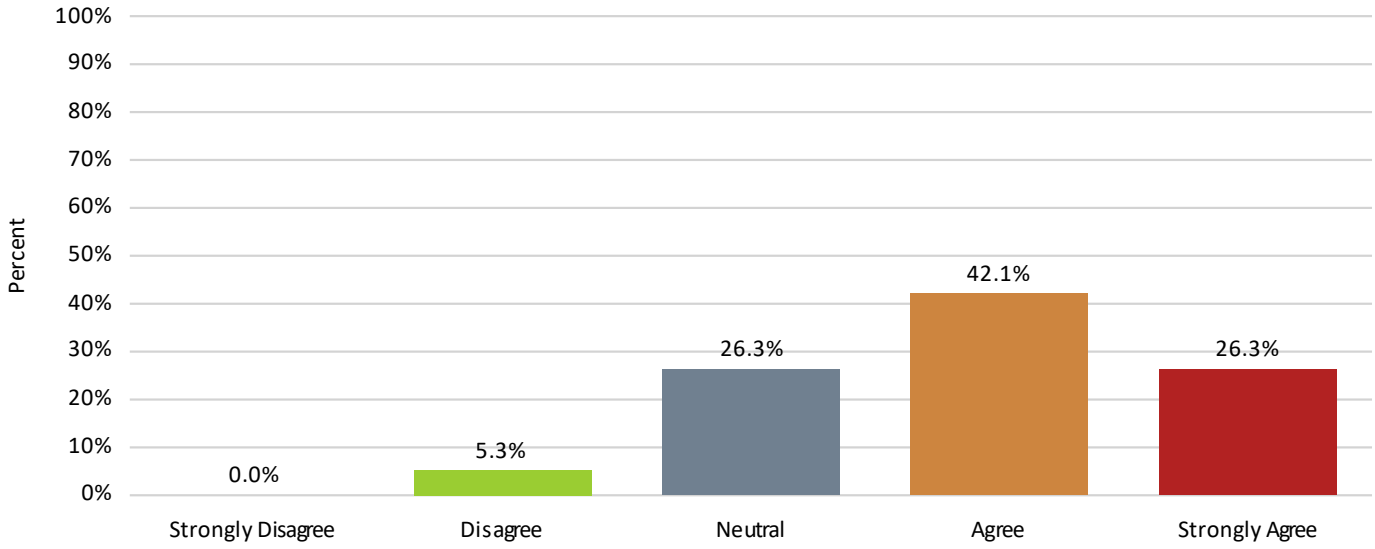
Question	N	Mean	Standard deviation	Median
Your previous answer indicates you don't always file fatigue reports when required, approximately how often have you skipped a fatigue report the last 12 months?	269	2.18	1.20	2.00

75. Colleagues are sometimes fatigued to a level where flight safety is at risk.



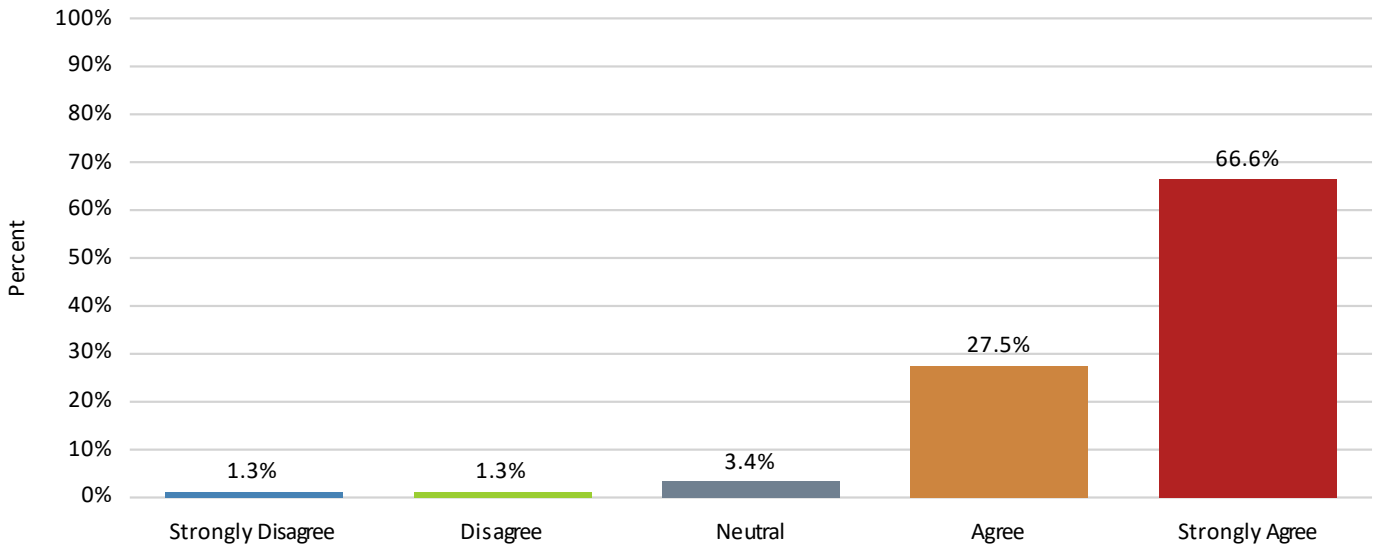
Question	N	Mean	Standard deviation	Median
Colleagues are sometimes fatigued to a level where flight safety is at risk.	339	3.36	0.98	4.00

76. If I had a permanent (unlimited) employment contract it would be easier to step down from duty, when fatigued.



Question	N	Mean	Standard deviation	Median
If I had a permanent (unlimited) employment contract it would be easier to step down from duty, when fatigued.	19	3.89	0.85	4.00

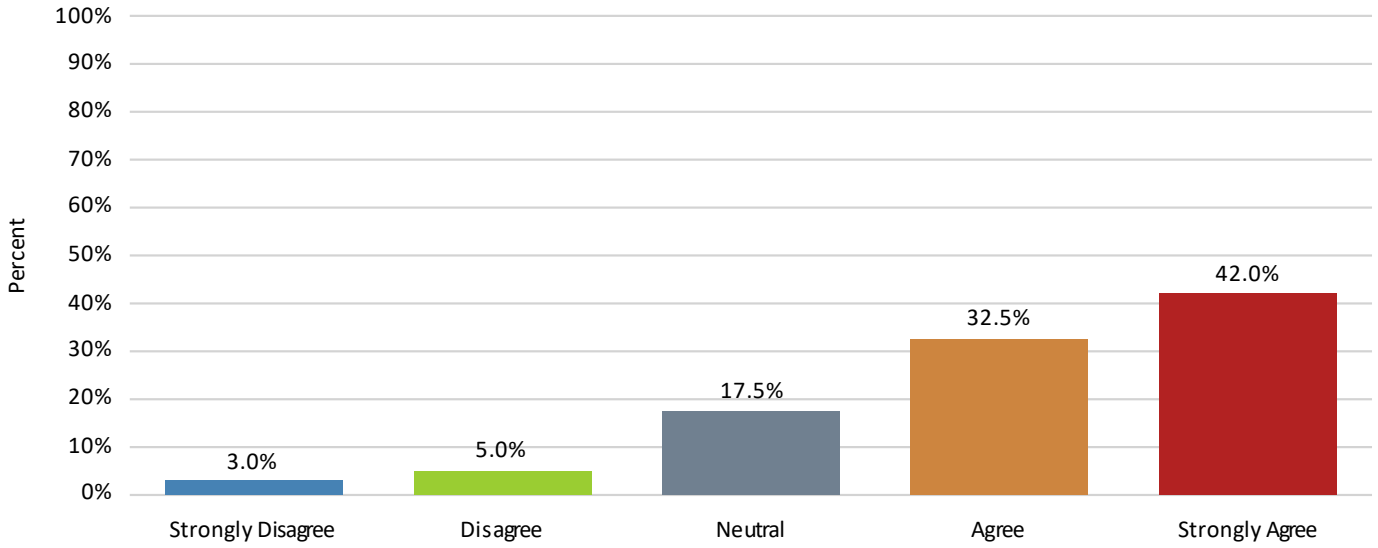
77. If I was employed through a temporary contract it would be harder to step down from duty, when fatigued.



Question	N	Mean	Standard deviation	Median
If I was employed through a temporary contract it would be harder to step down from duty, when fatigued.	320	4.57	0.73	5.00

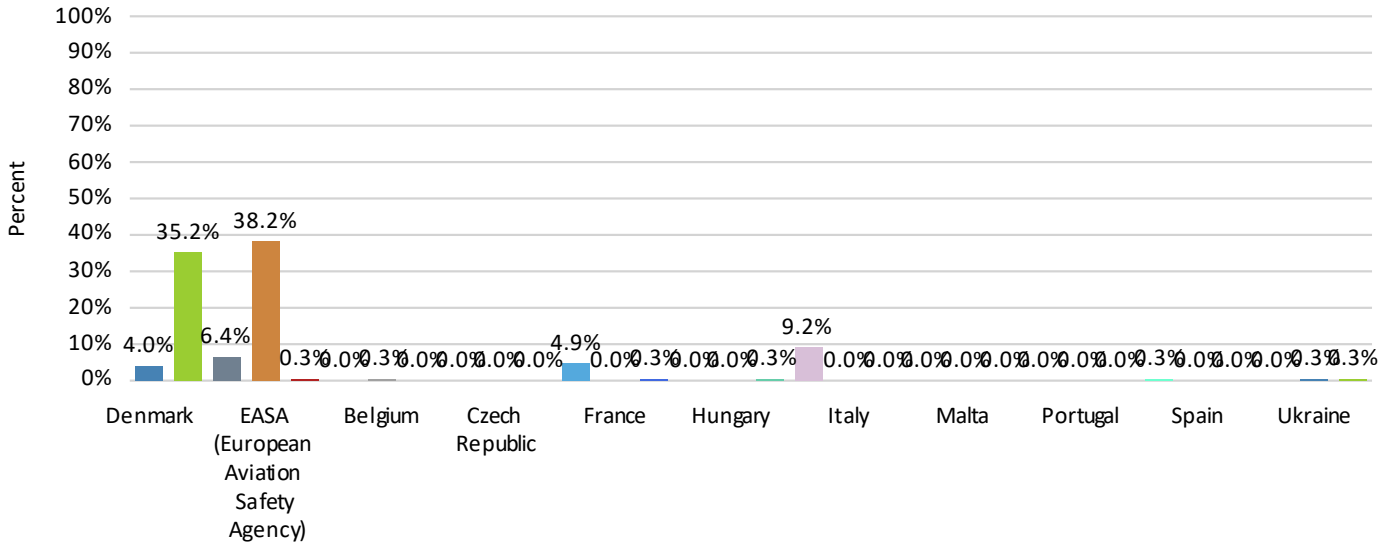
78. The national aviation safety authorities (CAA/EASA) are politically governed to a degree that flight safety is jeopardized.

CAA = Civil Aviation Authorities
EASA = European Aviation Safety Agency



Question	N	Mean	Standard deviation	Median
The national aviation safety authorities (CAA/EASA) are politically governed to a degree that flight safety is jeopardized.	338	4.06	1.03	4.00

79. Please specify the country, or Europe (EASA), you were thinking of in the previous question.



Question	N	Mean	Standard deviation	Median
Please specify the country, or Europe (EASA), you were thinking of in the previous question.	327	5.11	5.37	4.00

3. Mail to OSM Aviation:

Pilot survey, MBA thesis University Nord (Norway)

Ole Knutsen <ole.k@online.no>

Sendt: tir. 17.01.2017 10:09

Til: '[redacted]@osmaviation.com'

Dear [redacted],

I am conducting a survey as a part of a master thesis, primary focused on pilots flying for major Nordic airlines, and seek respondents whom fly for such airlines on contracts or directly employed, the strength of such an survey would be significantly enhanced if we get hold of more "contract" pilots.

The survey is a follow up of the LSE survey published late 2016, I am not quite sure this survey is valid in the Nordic countries.
If at all possible, would you distribute a survey link to pilots who fly for major Nordic airlines? –Or put a link on your page, the survey will end ultimo February 2017.

I hope you are willing and able to distribute such an survey! Please contact me for further information.

Best regards,