1. INTRODUCTION

In the past five years accident rates have been on a steady downward trend with 2.1 accidents per million departures in 2016, representing the lowest annual aviation accident rate ever (ICAO, 2017). This has been achieved by the global, regional and national safety regulatory structures that govern the industry. Whilst the achievement of such low accident rates is desirable, it is universally recognised that the low accident rate in commercial aviation is deemed too low to be used as a measure of safety performance (O'Connor et al., 2011). This has led to new measures of safety performance through oversight and regulation of the management of safety. Aviation organisations including approved training organisations, aircraft operators, approved maintenance organisations, aircraft designers and manufacturers, air traffic services providers and aerodrome operators (ICAO, 2013) are now mandated to have Safety Management Systems (SMS) in place to manage safety in their organisations.

The airport domain is a complex socio technical environment where an airline receives a range of services, using both digital and physical infrastructures from several providers enabling aircraft to land and take off. In between these rotation activities, it must: unload and upload passengers; freight; mail; be cleaned; load catering and toilet services; be fuelled, receive line maintenance; and conduct a pre-departure check before push-out and taxi to the runway for departure. The providers of these services are all High Reliability Organisations (HROs) who work with multiple variables running concurrently to get the aircraft away with an on-time departure, in a safe and controlled manner. The airport is the focal point for the convergence of these activities; part of its role is creating the 'safety picture' and a 'safety space' for its industry customers to provide these services to aircraft operators.

The aim of this paper is to explore safety culture and safety challenges amongst operators in the multi stakeholder context of an airport operation. Using a case study approach, the attitudes of airport stakeholders on the effectiveness of safety management systems, their effectiveness and areas of improvement are examined.

The paper is divided into 5 sections. The first section introduces the topic and states the aim and objectives of the paper. The second section clarifies the terms used, explains Safety Management Systems and elaborates on the airport multi-stakeholder environment. The methodology used is discussed in section three. Section four summarizes and discusses the results of this research. The conclusions are reported in section five.

2. LITERATURE REVIEW

The nineteen annexes of International Civil Aviation Organisation (ICAO), that regulate aviation at an international level, are transposed into national legislation with each contracting nation state which makes them law (Pepin, 1952). The European Union formalised its rulemaking, certification and standardisation of aviation activities through the creation of the European Aviation Safety Agency (EASA). Whilst ICAO still provides the global overview for aviation safety, EASA's EU regulations provide the European legal framework for aviation activities. Regulation and regulatory oversight in each member state is the responsibility of the National Aviation Authority (NAA).

The safety literature refers to the three "safety ages": the technical age, the human factors age, and the organisational or systems age (Hollnagel, 2014; Borys et al., 2009; Hale and Hovden, 1998). The technical age refers to improvements in aircraft design, avionics and engines. The transition to the human factors age came with the introduction of cockpit voice recorders and flight data recorders as accident investigators gained a deeper level of understanding of what caused plane accidents (Oster et al., 2013). Reason (1990) studied the role of human reliability. He moved the safety conversation beyond the failing of the human as the cause of an accident to establish what were the contributing factors to the point of failure. According to Reason, incidents happen at two levels; the point of the active failure at the point of the incident and the hidden side of the incident; the latent failures. Reason (1997) stresses that causal factors are embedded in the organisational structure. The means of moving from post-accident investigation to a more progressive level of organisational safety knowledge is largely determined through the management of safety at a system level. According to Hale (2001) safety is central to aviation operations and is intrinsic to all the activities both technical and managerial. Aviation organisations can be categorised as High Reliability Organisations (HROs), as such they are required to shift away from compartmentalised approaches to safety management to a system based approach to managing safety risks and therefore safety (Hale, 2001; Reason, 1997). The implementation of a Safety Management System (SMS) enables the organisation to move the focus of safety management towards leading, predictive indicators and away from lagging, retrospective measures such as lost time or number of incidents (Flin et al., 2000).

2.1 Safety Management System (SMS)

SMS moves the safety responsibility to the level of the organisation and in particular to the management within the organisation (ICAO, 2013). There are four pillars in an aviation organisation SMS; (i) Safety Policy and Objectives: The methods and processes that the organization will use to achieve desired safety outcomes; (ii) Safety Risk Management: hazard identification, risk assessment process and risk mitigation strategies design; (iii) Safety Assurance: self-auditing, external auditing, and safety oversight; and (iv) Safety Promotion: promotion of safety in the organisation through information sharing, communication and training. SMS components are discussed in the ICAO Doc 9859 and Airport Cooperative Research Program (ACRP) report Safety Management Systems for Airports.

Implementing an SMS in an organisation is essentially a change in the organisational culture. Organisational culture governs organisational behaviour and is commonly described as 'the way we do things around here'. A healthy safety culture in an organisation seeks improvements, vigilantly remains aware of hazards and utilises systems for continuous monitoring, analysis and investigation (ICAO, 2013: 2-10). Reason (2016) argues that safety culture is formed by four critical subcomponents:

1. Reporting culture: The workforce is willing to participate in the SMS and report not only safety incidents but also errors and near misses.
2. Just culture: There exists an atmosphere of trust where positive safety behaviour is praised, but there is a clear line on what is permitted and not permitted (unsafe acts).
3. Flexible culture: HROs need to be agile to reconfigure in the face of crisis management.
4. Learning culture: The organisation is willing to learn how to draw the right conclusions from the safety data presented.

Moreover, according to Henriqson et al. (2014), training and education are essential for the successful SMS implementation. Companies that adopted SMS experienced a substantially lower number of accidents per year compared to non-adopters (Bottani et al., 2009). Finally, the communication element prevalent in SMS through safety promotion, training, lessons learnt and direct interaction with managers on safety issues has a positive effect on future safety outcomes (Chen and Chen, 2014; Remawi et al., 2011)..

Whilst SMS is an effective mean of improving safety, bureaucratisation of safety can have the opposite effect. EASA's broad regulation aims to give NAA a level of flexibility to interoperate the regulation and offer an acceptable means of compliance that is commensurate to the size and complexity of their operations (EASA, 2014). The United States regulators, regulating at national and regional level with detailed and onerous rule-based oversight, face the risk of "trapping safety into rules" (Hale et al., 2015).

2.2 The Airport System

Airports are the centre of aviation activity, providing the modal transfer link for passengers and freight between ground and air transport. The airport is a complex, intractable, multi-stakeholder, collaborative service environment with no one party delivering the end-to-end product to either the passenger or the aircraft operator. Ashford et al. (2013) further illustrate the airport environment, that airports also supports many other services such as:

- Handling of Passengers and Freight
- Servicing, maintaining and engineering of aircraft
- Airline operations from crew facilities, ground operations facilities etc.
- Concessionaires, food and beverage, retail, car parks
- Aviation support facilities Air Navigation Service Provider (ANSP) Meteorology etc. (EU139/2014)

The safe and efficient delivery of operations is a complex and choreographed daily activity with interplay between the various stakeholders (Ashford et al., 2013). That takes place at tactical, operational and strategic levels (Schaar and Sherry, 2010). Airports are considered High Reliability Organisations (HROs). The distinguishing characteristics of HROs are outlined by Weick and Sutcliff (2007) as the following principles: a) preoccupation with failure, b) reluctance to simplify, c) sensitivity to operations, d) commitment to resilience and e) deference to expertise. The differentiation between airport systems (not an airport operator) and other HROs is that the nature of airport operations is complex; with multiple stakeholders, requiring both coordination and cooperation at operational and technical levels, this complexity adds a level of vulnerability into the airport system (Wilke et al., 2014). The main stakeholders in the area of airport and safety are the ANSP, flight crews, ground handers, and the national safety regulator.

Airport stakeholders may have performance objectives for the airport operator to fulfil that are outside of the full control and management of the airport operator (Schaar and Sherry, 2010). The availability of airport infrastructural capacity is critical to airport growth. In the realm of aviation safety, the airport operator has a level of responsibility under the regulation for safety on the site, when the actors may well not be part of the airport organisation.

Wilke et al. (2014) noted the vulnerability inherent in the airport multi stakeholder environment given the complexity of operations with multiple interdependencies while the prevailing safety management approach is not integrated. Each regulated entity manages safety risk via their own SMS based on their operation and predicating safety outcomes for their operation. The various organisations will have their own risk SMS. Wilke et al. (2014) argued that amongst the five main players in the airport, (i.e. the airport authority, ANSP, airline operator, ground handler and the regulator), there is little collaboration in the area of safety. This was also acknowledged by EASA (2014) through the formation of multi stakeholder committees (Apron Safety Committee, Local Runway Safety Committee, Wildlife Committee, Emergency Management Committee).

One important stakeholder is the Ground Handling Service Providers (GHSPs). Most accidents in the aviation environment and damages to aircraft are attributed to ground handling. During 2016 the Irish Air Operator's Certificates (AOCs) holders submitted 7,530 Mandatory Occurrence Reports (MORs) and the Aerodrome managers submitted 308 MORs (IAA, 2017). Ground handling is in the three most commonly assigned occurrences categories. GHSPs are currently not covered by aviation safety regulation and are regulated by the community NAA's via the oversight of AOCs holders. According to ACI (2016), ICAO have created a Ground Handling Task Force (GHTF) to develop an ICAO manual on Ground Handling and include guidance material for aerodromes on how they could regulate, licence and provide safety oversight to GHSPs. The literature is largely void as to why this area has not been regulated (Schmidberger et al., 2009).

Dublin Airport for example has an active safety management system. The aerodrome operator first introduced an SMS in the late 2000's in line with the ICAO Safety Management Manual Doc 9859. The SMS operated as an integrated yet separate function which is contrary to the spirit of the regulation. Both the document and the organisational structures were amended in 2014 to reflect the organisational requirements of being an entity regulated via the SMS.

In parallel to this process the EU Regulation 139/2015 was pending ratification to bring Aerodromes under the remit of EASA.

EASA documentation is more descriptive than that of ICAO. The formal committee structures for internal stakeholder consultation referenced in ICAO Doc 9859 outlined the necessary committee levels for the regulated entity. EASA goes further and proposes the structures for the external environment. The two external multi stakeholders committees reflected in the Dublin Airport SMS are the Local Runway Strategy Team and the Apron Safety Committee (Dublin Airport, 2017; EASA, 2014).

Irish registered aircraft were involved in 17 accidents between 2010 and 2013, 22 accidents between 2012 and 2016 (IAA, 2013; IAA, 2017). In all years the most common cause of accidents was ground handling. Ground handling accidents cover any occurrence that happens while servicing, boarding, loading or manoeuvring the aeroplane or occurrences that can cause serious or fatal injuries to people from propeller/fan blade strikes or jet blast. During the period 2013-2015, incidents in Region of Aircraft Movement and Parking (RAMP) were the leading category of all aviation incidents in Ireland (IAA, 2017).

3. METHODOLOGY

The methodological approach for this study is the case study method. According to Yin (2009: 18) "A case study is an empirical inquiry that: Investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". Dublin Airport was used for the purposes of this study. A mixed method approach utilising both quantitative and qualitative methods of data gathering was used. The online survey was circulated to 292 experts from April 2017 until June 2017; 135 experts responded representing a 46.2% response rate. Interviews with senior managers from the airport stakeholders were also conducted.

A pilot survey was conducted and the initial questionnaire was tested using 15 experts. The questionnaire was shortened and simplified. The final survey questionnaire comprised of twenty-four questions that were arranged over six sections and covered three core themes. The first grouping of questions in the "General details "section gave the candidates the opportunity to opt into the survey or opt out and deal with issues of consent. The following five questions were a mix of nominal and ordinal questions covering demographics information. This was followed by three thematic sections; 1) a section entitled "Safety and

culture in your organisation", 2) a section entitled "Regulation and compliance", and 3) a section entitled "Effectiveness". The final section allowed participants to add comments in an open text format. The majority of the questions in the thematic section of the questionnaire were presented with variables measured with a Likert five-point scale. The survey's target group was organisations and individuals that operate primarily in the airside environment at Dublin Airport. Table 1 lists the forums and groups that were used to distribute the questionnaire.

Table 1: Stakeholder groups and forums

Multi Stakeholder Group	Chaired By	Area of Focus	Attendees
Airport Operators Committee	Airline/GHA	Efficiency/performance /continuous improvement of airport infrastructure (tends to be more focused on terminal issues; Gate issues bring the focus to apron activities as the two processes are interlinked.	Airlines, GHSPs.
Dublin Airport Operators User Group	Airport/ANSP	Efficiency/performance /continuous improvement of airside infrastructure – (Runway/Taxiway/Stand Infrastructure) Review of infrastructure works.	ANSP, Base Captains, Airport Senior Ops, Met Eireann, Aerodrome Regulator
Airside Safety Committee	Airport Ops/Airport Safety	Safety on Apron areas and operational issues and challenges. Review of infrastructure works and operational /safety impacts. Efficiency/performance /continuous improvement are considered with a safety focus.	Airlines, GHSPs, Frontline operation managers, supervisors and trainers
Local Runway Safety Team	Airport Operations	Safety of operations on Runway Taxiway Systems. Review of current infrastructural works and operational /safety impacts. Strategic look at infrastructure improvements/ future projects	ANSP Mgt, Base Captains, Airport Senior Ops and Safety Mgt, Airport Corp Compliance, Aerodrome Regulator, Flight Ops Regulator.

Furthermore, a series of interviews with members from the identified stakeholder groups were conducted. Table 2 lists the interviews in terms of the stakeholder type, interview methods and organisational seniority of the interviewees. Prior to commencing the interview, the interviewee was briefed on the purpose of the interview and was reassured of the confidentiality of their identity and that of their organisation (where possible, as there is only one airport operator, one regulator, and one ANSP). The interviews were semi-structured in style and were centred on the key themes for the purpose of the research, i.e. on safety culture, compliance and effectiveness. This method allowed for the questions posed to be generally framed, and also catered for flexibility in the order of questions asked, and the ability to focus on any areas of particular interest.

Table 2: Interview distribution

Stakeholder type	Organisational Seniority	Interview method
Airport Operator	Senior Manager - Operations	Face to Face
Airport Operator	Senior Manager - Safety	Face to Face
Airport Operator	Senior Manager - Compliance	Telephone
Airline Operator	Senior Manager – Operations	Face to Face
Airline Operator	Senior Manager – Operations	Face to Face (at Airline HQ)
GHSP	Senior Manager - Operations	Irish Airline Operator
Competent Authority (CA)	Standards Regulation Division	Face to Face
Competent Authority (CA)	Standards Regulation Division	No response
ANSP	Senior Manager	Face to face

4. RESULTS AND DISCUSSION

4.1 Demographics

The online survey for this study was circulated to 292 experts; 135 experts responded representing a 46.2% response rate. Of the 135 experts 91.1% answered the entire questionnaire. Table 3 summarises the range of the participants according to the response rates. Many respondents hold a primary role with multiple functions, e.g. "Flight Crew and Trainer" or "Oversight/Compliance & Trainer". The most prevalent areas represented were amongst senior managers, frontline managers and trainers.

Table 3: Distribution of invitations, % of Reponses and % of Total responses by organisation type

Organisation Type	Dist. of invitations	Dist % of total	No of Responses	Resp % by Org Type	Resp.% of total
Airline Operator	130	44%	53	41%	42%
Ground Handler	75	25%	18	24%	14%
Aircraft Maintenance Organisation	10	3%	4	40%	3%
Air Navigation Service Provider	13	4%	13	100%	11%
Aerodrome Operator	54	18%	31	57%	25%
Competent Authority	14	5%	6	43%	5%

In relation to the question "My organisation's aviation safety procedures are audited by: (please tick as appropriate)", the 123 respondents from the airline operators, GHSPs, ANSP and aerodrome operators noted that they used benchmarking / industry bodies as an internal tool to gauge compliance (Table 4). Several airline operators and GHSPs experts added IOSA audits, an auditing standard provided for by International Air Transportation Association (IATA).

Table 4: Entities auditing the organisation's aviation safety procedures

	Airline Operator	GHSP	Aircraft Maintenance Organization	ANSP	Aerodrome Operator	Competent Authority
My organisation's internal compliance function	79%	82%	50%	69%	83%	50%
My organisation's quality function	57%	65%	100%	38%	20%	0%
IAA	85%	71%	50%	85%	97%	17%
Customer Airlines	28%	76%	75%	0%	7%	0%
Aerodrome Operator	8%	53%	0%	0%	13%	17%
EASA/ICAO	57%	29%	0%	77%	47%	33%
Industry benchmarking (ACI, IATA, etc.)	53%	24%	0%	8%	17%	0%

While all respondents noted correctly that they are audited by the IAA as the competent authority; 57% of airline operators; 77% of ANSP; 29% of GHSP and 47% of aerodrome

operator experts, mistakenly believed that they were audited by EASA/ICAO. All regulated entities are regulated by the NAA only that is regulated by EASA. Given that the ANSP at Dublin Airport is also part of the IAA group there is the perception that the question refers to the entire IAA organisation rather than the ANSP functional division.

The Competent Authority (CA) is the only one that is audited by either EASA or ICAO in their representation as the oversight authority of the "State". In answer to the why all other parties marked the EASA/ICAO option as applicable to them could be down to a misunderstanding between compliance with the published regulations/standards, and the oversight function. The responses illustrate a perceived oversight by these bodies.

Airline Operators, GHSP, Aircraft Maintenance Organisations and Aerodrome Operators all have some exposure to customer airline audits. The respondents are based in Dublin Airport and one of the main base carriers Aer Lingus also holds a 3rd Party Ground Handling license which would account for the positive responses (15 out of 53 respondents from the category of Airline Operators). Moreover, all respondents noted that the CA provides regulatory oversight of their operation. This includes the GHSPs, who are not currently directly regulated by the IAA, but may be audited via the IAA oversight activities of Irish AOC holders. Finally, all respondents' organisations 'have an internal compliance and or quality function that has a level of internal oversight on operational safety standards and compliance responsibilities. The survey was divided broadly into three themes; safety culture, compliance and effectiveness.

4.2 Safety Culture

The questions regarding safety culture covered the topics of leadership, training, the ability and ease to report incidents as well as the general communications and effectiveness of feedback relating to safety information. There were nine questions in this section, seven of which were measured on Likert scales and two multiple choice questions.

The link between organisational change and culture are well documented (Schein, 2010); successful implementation of SMS requires a shift in culture to move safety ownership out of the safety office and into the day to day deliverables of the line management teams and ultimately to the individual (Reason, 2016). Leadership is a critical part to the success of the roll-out and ongoing improvement of a safety management system (ICAO, 2013). According to ICAO (2013), a safety manager should be: a safety advocate; a leader; a communicator; a

developer and a relationship builder; an ambassador and an analyst. All 121 participants who responded to the question strongly supported that strong leadership skills are instrumental in promoting a positive culture.

Training is part of the fourth pillar of SMS theory, i.e. Safety Promotion. 121 respondents strongly agreed with the statement that staff training is an integral part in fostering a better safety culture (mean=4.9). Two GHSPs experts stated that there are duplications in the training area from Dublin Airport, their company and airlines.

According to interviewees, the bureaucratisation of safety is seen to have a negative impact on safety. The interviewed GHSP manager said that his organisation has nineteen customer airlines that require their bespoke training and Standard Operating Procedures (SOPs) to be delivered to each employee involved with their operation. Furthermore, the regulation for the Aerodrome Operator also has a safety training requirement to be met, which overlaps with other training material. The GHSP also has its own SMS and training material to deliver to its employees. This training provides solid evidence that professional training was delivered and subsequently recorded. In the examination of incident occurrences of Dublin Airport (ground incidents), which ranged from near misses to serious accidents. The 3rd party handlers are the most frequently cited group in occurrence reports.

In an effort to mitigate the risk of aircraft damage during ground handling activities by third party GHSPs, the airlines interviewed mentioned that they have various strategies to reduce the level of risk to their operations and fleet. The interviewed airline operators also reflected specifically on the challenges faced when working with 3rd party GHSPs who have multiple airline customers. Airline A commented that where possible they negotiate a "one to one" relationship with the GHSP which delivers a de facto 'self-handling service'. Where this is not possible (i.e. where the 3rd party GHSP are serving many carriers), they push for dedicated teams. The main benefits are increased accountability and cooperation amongst the team, reduced training costs, higher levels of compliance and decreased error rates together with reduced incidents of damage to aircraft.

Airline Operator A noted that the level of incidents and aircraft damage were considerably less than at those airports where the airline is being served by a GHSP who handled several carriers. Airline Operator B said that this level of leverage in their ground handling contracts is not available to them as they do not have the volume or frequency of operations to enjoy either a self-handling ground operation or one to one ground handling relationship with the

GHSP. Airline Operator B found that the process for safety communications was challenging, the airlines' specific safety procedures and culture is difficult to communicate effectively when the GHSP is handling multiple airlines, often with the same aircraft type.

Airline Operator B described that there is a level of dependency on the relationship with the GHSP to communicate the airline message to the teams dealing with their aircraft. Though aviation and handling safety messages are often universal, there are airline specific operational safety messages. For the airline that is operating into an airport with a low frequency of flights and to a GHSP that is servicing multiple airlines, the delivery of a turnaround service to exact company standards can be difficult to achieve while turnaround and dispatch (load) error rates can be higher according to Airline Operator B interviewee. This presents a challenge to both the airline and the GHSP.

Reporting is part of the 'Safety Assurance' pillar of SMS and it is a mandatory requirement for all regulated entities to have an official reporting channel as well as a voluntary one. Reporting is not only about reporting on incidents and accidents that have happened, but there is also a focus on the freedom of staff to raise all safety concerns without fear. The IAA has a voluntary reporting service on their website for any member of the public or the industry to report any safety concern.

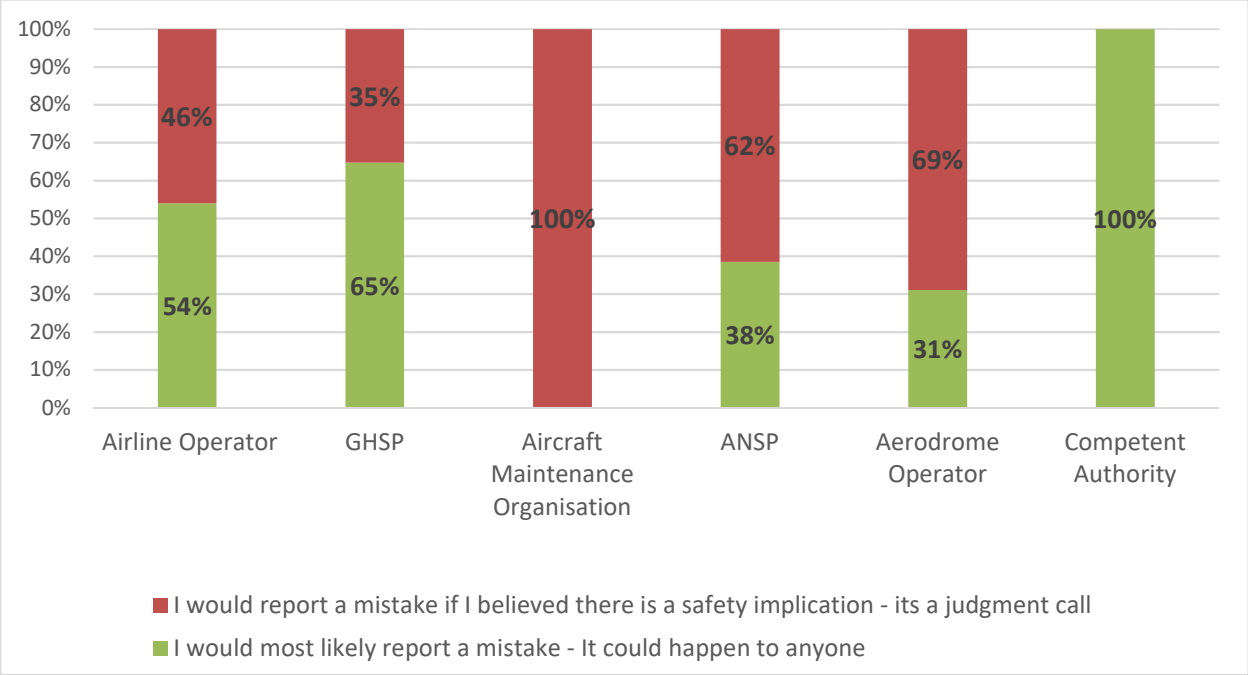
121 participants responded to the statement 'it is easy for me to report a safety concern in my organisation'. The responses were 97% positive to the statement, with 59% marking "strongly agree" and 38% marked "agree"; 1.5% of respondents (one respondent from an airline operator and one respondent from a CA) had "no opinion". Finally, 1.5% of respondents disagreed with the statement and both were airline operators.

119 participants claimed that they would most likely or definitely report a mistake as outlined in Figure 1. An airline operator stated that the industry is becoming very competitive with time constraints, and raising or admitting safety incidents or occurrences on a voluntary basis is a difficult and sometimes risky endeavour. The interviewee from Airline A noted that the airline has worked incessantly to create a healthy reporting culture in the organisation, thus they receive "four times the amount of incident reports" as other airlines. This is supported by a dedicated safety team who are charged with the categorisation and analysis of the data to identify trends. The amount of data is critical to moving the safety message into the proactive rather than reactive space. Moreover, the volume of data is generated from incidents, accidents and near misses that enable smart use of the data, which is fed into the

company communications system which is across the network. The presence of a just culture environment is essential to having a healthy and vibrant reporting culture. The two are interdependent. If an operator feels that their position or status will be in jeopardy by raising a safety issue or reporting an incident the safety management system is weak and will be unable to fulfil its true purpose of continuous improvement.

The participants were asked if they are regularly informed about lessons learnt from incidents or near misses. The aerodrome operation respondents, CA and aircraft maintenance organisation all scored below the mean score (=4.1). Furthermore, all 121 respondents agreed that communication is an essential mechanism in fostering a better safety culture (mean= 4.9).

Figure 1: Reporting of a mistake

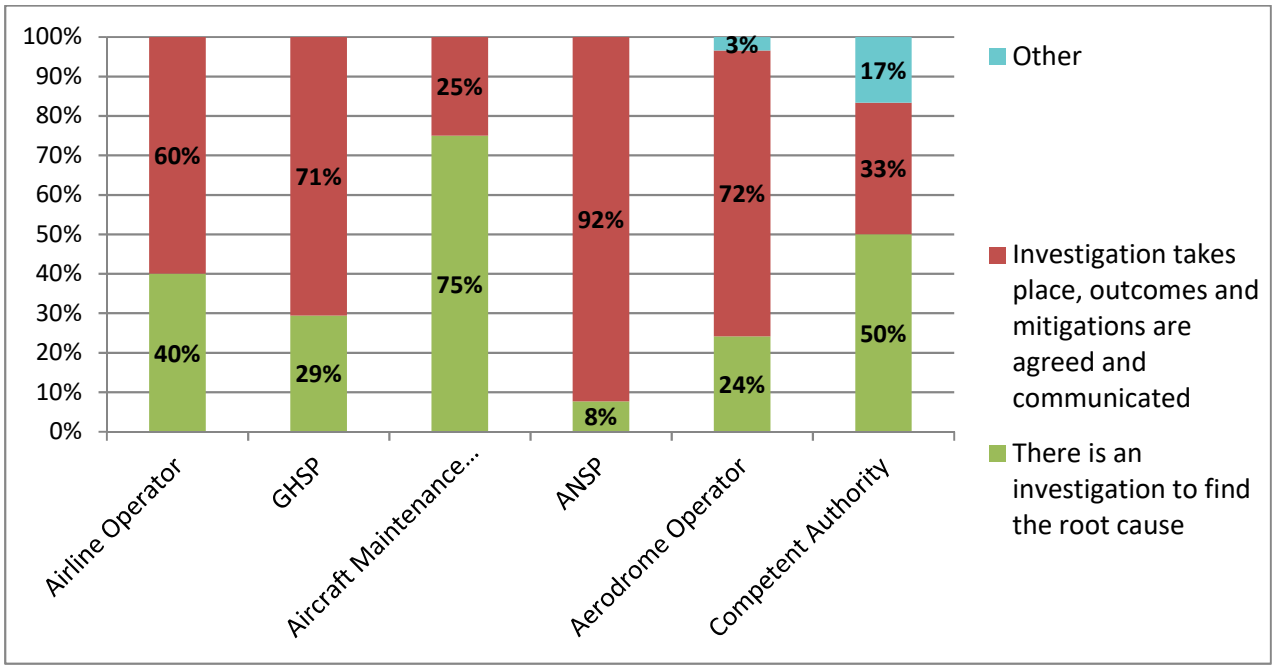


The airline interviewees highlighted the existence of internal ongoing programmes that aim to communicate lessons learnt and other safety messages on a regular basis. The interviewees also suggested that having a single aircraft fleet type makes the safety message in their communications with GHSP (both self-handling and 3rd party handlers) clearer and simpler. Airline A operates a safety awards scheme, where they reward frontline operators for reporting safety issues and for making suggestions to further safety improvements. The reward can be for example a presentation plague or promulgation via newsletter. The promotion of such activities is fed into the communication stream across the network, awards

are for everyone who interfaces with their operations including third party GHSP and other contracted agencies. The airline interviewees said that promotional activities for safety reporting are important.

Organisations ask of their teams to engage openly and confidently with the safety process. The reciprocal side to this relationship is that the organisation responds in a prompt manner to safety issues raised by the workforce. The participants were asked about the actions following the identification of a safety issue (see Figure 2). Their scores were closely aligned, with little variance in opinion between the organisation types and the answers given. This includes the GHSPs who currently are not within the same regulatory framework as the other aviation parties.

Figure 2: Actions after the identification of a safety issue



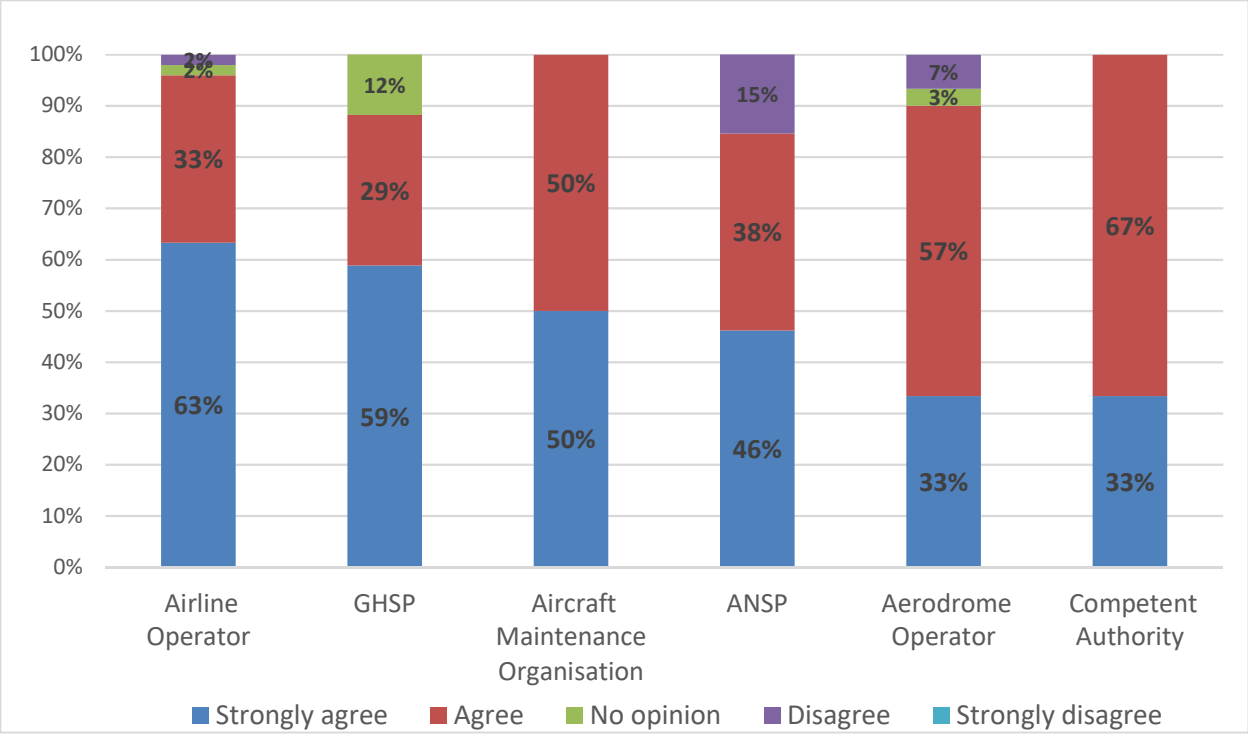
The aerodrome operator mentioned that there is not always an investigation. The respondent from the CA said that during his/her service there was never an internal safety issue that required to be reported or handled.

The concept of "just culture" is a concept that is in EU regulation. It refers to the ability of the operator to be able to report on an issue, or a mistake they have made, an accident they may have caused without fear of punitive action. This ethos behind the concept is to encourage people to acknowledge their errors and mistakes to prevent an accident happening

and/or to highlight a near miss that may have caused an accident on another day. This is aligned to "human factors" thinking.

The 119 respondents (see Figure 3) were very positive to the statement 'safety incidents can be reported in a non-punitive atmosphere'. 92% answered "strongly agree" or "agree" and the remaining 8% split between "no opinion" and "disagree ". 15% of the ANSP disagreed with the statement. It is notable that overall 4% of respondents disagreed with the statement. This was spread across airline operators, aerodrome operator and slightly a higher proportion from the ANSP. Nevertheless, the mean score was 4.3.

Figure 3: Safety incidents can be reported in a non-punitive atmosphere



All interviewees supported just culture and stated that it was practiced in their organisations. The element of complexity with "justness" is that it is a subjective construct. The perception of the receiver of "just culture", may not agree that the system is dealing with them in a just way. They may have to go through a retraining exercise or they may be sent home on full pay pending an investigation. To counter this issue of perception the ANSP have issued a document to their staff to outline what "just culture" means in their organisation.

The final question in this section on reporting, relates to the perceived timeliness and effectiveness of organisations to respond to safety issues. The mean score was 4.1 and 119

participants responded to the question. All operators seek to quell safety concerns as quickly as possible but the results show that some operators would like to move quicker on safety issues.

A safety issue could be a serious matter that has become known because of an incident or an accident (lagging), or it could arise from observed near misses (lagging) or from general perception without a safety event (leading). The aerodrome operator interviewees noted that gaining access to information to complete an investigation post event can be challenging at times. The aerodrome operator is mandated to report on all incidents that occur airside, some of which are part of the Mandatory Occurrence Reporting (MOR) scheme which are reportable to the CA that is governed by Regulation (EU) No 376/2014 and Regulation (EU) 2015/1018. This includes incidents involving airport personnel or regarding airport equipment occurring airside. The objective of an investigation is to establish the root cause while identifying and addressing the underlying causal factors.

Gathering information after an incident for investigation can on occasion prove challenging as access to information from airport third parties, personnel and incident reports may be delayed, may not be available, or may be withheld. The aerodrome operator should report all safety incidents encountered at the airport to all operators, but often they only have the occurrence data as other stakeholder incident reports are slow or not forthcoming. The reporting of safety incidents and the way that an organisation(s) deals with safety issues, and communicates the learnings are a key part of a working SMS.

Apart from gathering information, another main challenge stems from the nature of airport immediate mitigations to emergent safety issues. Given that the airport is the provider of infrastructure, it has a number of mitigations it can deploy instantly to meet an immediate risk. Safety issues that require immediate rectification may result in the temporary closure of a facility, or the deployment of a resource to manage the risk on the ground to keep the facility open while identifying more permanent mitigations. Negotiating more permanent solutions, requires an inter stakeholder approach to identify and implement the most effective and efficient solution for the airport as well as for all stakeholders.

Finally, if the mitigation does require an infrastructural change, the solutions can take a number of months to implement (dependant on the complexity of the issue). For example the process of taxiway realignment (i.e. moving the line), requires a number of phases such as feasibility, redesign, risk assessment which are submitted to the CA for approval that meet

an Aeronautical Information Regulation and Control (AIRAC) cycle for regulatory promulgation (issued every 56 days). In addition, the hire of a contractor, design of works, risk assessment of work phases, construction phase, notification of closures, Air Traffic Control (ATC) contingencies must be assessed for manoeuvring aircraft around the site, and finally upon completion of construction a "go live" date to final implementation. This involves many stakeholders that need to communicate and coordinate effectively.

4.3 Compliance

The next set of questions are centred around compliance and attitudes towards compliance. The objective of this set of questions was twofold. Firstly, to measure the maturity of the relative safety management systems, and secondly to capture the interplay between compliance and safety. In the interviews with the safety and operational professionals this area raised the most comments.

119 participants responded to the statement "Compliance and safe operations are the same thing". It showed the largest variance in scoring on the survey, with 5% scoring "no opinion", 48% who responded negatively and 47% who responded positively. The detractors of the statement were from all operators, but the lowest scores were ANSP, Aerodrome Operator and CA. The challenge with compliance is that it does not guarantee safety. There is also an added complexity of what may be compliant for one operator's operation that may introduce an unacceptable level of risk to another operator. An audit of technical compliance is relatively easy to assess as it is based on tangibles and meeting physical targeted standards, to assess the level of safety in an operation is more challenging to assess.

118 respondents viewed regulation as an enabler for safe operations (mean=4.1). The lower scores were from the ANSP (3.85) and the Aerodrome Operator (3.7). The sequence of questions on compliance progressed to asking how operators viewed evidencing compliance. Another question, replied by 118 survey participants, investigated the challenge of whether compliant operations are safe operations and determined if the relationship between evidencing compliance was as important as safe operations. The mean score for this question was 3.8. The highest score was from GHSP (4.29) and the lowest from ANSP (2.69).

The activities that operators undertake in a normal course of operations and in particular the SMS activities they carry out, generate an audit trail. Records include safety artefacts such as policies, procedures, licences, approvals and more tactical operational documents such as

risk assessments, investigation reports, training records, read and sign materials. A further question established the view on whether compliance with regulatory requirements is viewed as essential in maintaining a good safety culture. The mean score of the 115 respondents was 4.3.

Throughout the "compliance "section of the survey there are consistently lower scores from the Aerodrome Operator and ANSP. An ANSP participant said that compliance with local SOPs does not always guarantee safe operations, particularly if the SOP is 'weak' under certain circumstances.

For those who are audited under the EASA regime, the technical specifications are part of the initial certification for the entity and ongoing compliance programme process under EASA, which was previously the licensing process under ICAO standards and recommend practices transposed into national legislation. It is worth noting that compliance with a technical specification is not necessarily the safest option available to an operator. The certification specification (i.e. EASA), and/or the standard (i.e. ICAO), is an expression of the minimal required/expected standard for compliance.

Similar to aircraft regulation, where the aircraft manufacturer will publish the operating minima for the aircraft type, the airline operator adds the company regulations to create a larger safety space to operate in. SMS provides continued assurance to multiple stakeholders such as operators and the regulator as any changes must be pipelined through hazardous identification and risk assessment. This includes: the introduction of a new aircraft type; introduction of a new operator; a new piece of infrastructure; a new piece of equipment; a change to infrastructure; or a change to a working procedure. This would provide the operator with the assurance that an acceptable level of safety has been met and any risk has been reduced to a level that is as low as reasonably practicable. This would provide the regulator with evidence that the SMS is working and that the operator is managing change as prescribed in the Safety Management Manual (ICAO, 2013). Wilkes et al. (2014) suggests that this level of risk assessment may not be enough to assure safety, as operators are only assessing their own risk against their own criteria.

The interviewees from the Aerodrome Operator and the ANSP commented on the changes that have transpired with the introduction of EASA regulation and the way that the competent authorities are now mandated to regulate. Regulators are moving away from prescriptive regulation to a risk-based approach. This change is a recognised paradigm shift for both the

regulator (now the CA) and the regulated entity (the Operator). The change for the operator to a safety management system approach presents a recognised cultural change for the organisation involved. This onus of responsibility is on the operator to ensure that they are meeting the acceptable means of compliance, whilst it is the responsibility of the regulator (i.e. the CA) to measure the effectiveness of the SMS to ensure that the entity is managing the change of operation, procedure or infrastructure using the SMS methodologies (risk assessment and safety cases as required). Even with the dual approach of looking at safety through the quality of a technical specification lenses and a system perspective, the response from the survey indicated that there is still some work to be done to raise the level of assurance that safe and compliant operations are easier to achieve for all stakeholders. This is significant as the emergent risk may only become apparent through assessing the change via the various stakeholder lenses. What constitutes a safety initiative for one, could result in a new hazard for another.

A practical example of this was given by the GHSP interviewee who commented on a particular carrier who did not permit the use of baggage loading equipment to their aircraft. While this was contrary to the GHSP's internal procedures, the customer wanted their operation carried out in this way. This had the negative impact of increased manual handling injuries for the GHSP workforce, a breach in occupational health and safety procedures, employee downtime, and ultimately a human factors pressure point, which could result in a more serious incident.

The Aerodrome Operator interviewee gave the example of a safety initiative by the ANSP to simplify the workload for air traffic controllers on surface movements by introducing a new frequency and rearranging existing frequencies. This works well for aircraft operations that are moving sequentially through the frequencies to the point of departure/parking on an aircraft stand. The unintended consequence is that vehicles have lost some situational awareness of their working environment. Recognising where the critical touch points are and working collaboratively would aid to close the gap on whether a compliant operation is a safe operation.

4.4 Effectiveness

Effectiveness in this section focuses on operator's attitudes to working in a multi-stakeholder environment and the emergent need to approach safety management in a collaborative cross organisational way. 92 out of 115 survey participants strongly agreed with the statement that the inter-stakeholder airport safety forums and committees are effective to furthering safe

operations. Aircraft Maintenance Organisations gave the lowest score (3.5). The mean was 4.3 and the standard deviation was 0.79. When asked if the operational safety issues sometimes require inter-stakeholder collaboration to reach a solution, all 115 participants strongly agreed (mean=4.4; standard deviation=0.64). While respondents were generally positive to the idea of an inter stakeholder collaborative approach, they are not as confident that the outcomes of collaboration offer the best safety solutions as this received an average score of 3.8 (standard deviation= 0.86) from the 113 responders.

The final question (Table 5) in this commentary on the survey interrogates the opinion of 115 participants on the balance between production and protection. There was a significant divergence in the views held by the oversight function of the CA to those held by the other practitioners. This highlights the fundamental difference between commercial entities and oversight functions. Commercial organisations follow efficiency–thoroughness trade-off principles to maintain competitive advantage. This does not necessarily mean that operators choose an unsafe option, but they reach an acceptable level of safety to meet the operational demand and commercial drivers. ICAO recommends that when undertaking a risk assessment, the participants strive to achieve an acceptable level of safety. One respondent from the ANSP category mentioned that the system does not seem to recognise a 'common-sense' approach to safety management, but requires a hazard analysis to justify the changes to practices or procedures. The respondent also supported that in a committee-based approach there are too many people involved with no actual or valuable input. The respondent stressed that this approach leads to over-analysis and identification of 'safety issues' which do not actually exist, or prescriptive procedures which are not actually required. Finally, the respondent added that safety management has become career-oriented, rather than safety-oriented.

Table 5: Responses to 'While safety is important there is a limited supply of resources available and so it's not possible to invest fully in safety' statement

	Strongly agree (5)	Agree (4)	No Opinion (3)	Disagree (2)	Strongly disagree (1)	Total	Weighted Average
Airline Operator	13%	27%	2%	42%	17%	42%	2.77
GHSP	13%	33%	13%	27%	13%	13%	3.07
Aircraft Maintenance Org.	0%	25%	0%	50%	25%	3%	2.25
ANSP	17%	33%	8%	42%	0%	10%	3.25
Aerodrome Operator	3%	33%	10%	43%	10%	26%	2.77
Competent Authority	0%	17%	0%	83%	0%	5%	2.33
Total (n=115)	10%	30%	6%	43%	12%	100%	2.74

Dublin Airport has experienced expediential growth over the past number of years with six years of consecutive growth from 18.4 million in 2010 to 27.9 million in 2016 (Dublin Airport, 2017). Whilst the growth has been beneficial for all, the increase in traffic correspondingly produces a change in operations, albeit an incremental one. The volume increases the numbers of air traffic movements which increases the general level of ground operational activity; the number of persons employed airside, the amount of ground service equipment required, the aircraft towing and the amount of wear and tear on the pavement structures. All of these elements can contribute to the erosion of previously established and acceptable safety margins. Increased workloads, pressure, time constraints are all part of the established human factors that can be a contributory factor in invoking an accident. The operator needs to remain vigilant and factor in the increased activity while at the same time employ mitigation strategies. Gaining operational efficiency and reducing cost through lean management of resources is becoming even more important particularly in a capital-intensive industry such as aviation.

The ANSP interviewees spoke of their vigilance to see what factors outside of the Dublin ATM network may introduce risk to their operation. The example given was that if there is any change to adjacent airspace, Dublin ATC must assess the possible risks or impacts that this may have on their operation. The ANSP stated that for this reason their safety teams' attendance at the multi stakeholder operational efficiency forums (i.e. Dublin Airport Operations Planning Group -DAOPG) is as critical as attendance at the safety forum (i.e. Local Runway Safety Team-LRST). Every change to the operation, if not managed, can result in an erosion of previously established safety margins.

In 2014 and 2015 respectively there were two aircraft accidents that happened in the same collision location/area (AAIU, 2016; AAIU, 2015). The recommended action from the CA was for a collaborative approach from the aerodrome operator, the ANSP and the airlines who could technically argue that they were not at fault. A sub group of the DAOPG is tasked with improving the level of safety in the particular area of those two collisions. It was a case that the area in question on the airfield had been in use for many years, but due to change in the prevailing direction of operations, a hidden risk was introduced into the system. This was resolved in part by work done by a multi stakeholder group of the base carriers, ANSP and the airport operator. This collaboration happened post event and under specific instruction from the regulator. Both the ANSP and the Aerodrome operator spoke of the challenges of working collaboratively on such matters. The balance of power and willingness to work

collaboratively is not distributed evenly between these stakeholders. Fear of litigation and allocation of fault were cited in the interviews as a barrier to better interaction on joint assessment of risk.

5. CONCLUSIONS AND RECOMMENDATIONS TO AVIATION PRACTITIONERS

The implementation of SMS across regulated entities in the aviation sector has improved the understanding of safety, the management of change, hazard identification and risk assessment and mitigations within the aviation community. The aim of this paper was to address the gap in the current aviation safety literature of the role of multi stakeholder groups in furthering more efficient and safe operations into the airport system. The in-depth survey which specifically targeted the stakeholders at Dublin airport was undertaken to ensure this. The implementation of the Dublin Airport SMS and the use of inter stakeholder safety forums are deemed positive and have evolved a more community based sense of safety culture amongst airside users.

The research showed that safety management systems are effective for individual operators' organisations and have enabled effective safety management as well as delivering a healthy safety culture. Operators are actively engaging with their individual safety management systems and have a uniform approach, understanding the application of the four safety management pillars (i.e. i) Safety Policy and Objectives; (ii) Safety Risk Management; (iii) Safety Assurance; and (iv) Safety Promotion). The evidence from the survey shows that there are effective safety sub cultures: learning culture; reporting culture; informed culture and just culture within each of the operators' organisations at Dublin Airport. Furthermore, all the players in the airport environment have their own maturing safety management systems as they are committed to continuous improvement as well as better levels of safety engagement.

Moreover, the research showed that the operators at the airport have an insightful understanding of the relationship between compliance and safe operations which are cognisant of the myopia that compliance is equal to safety. The operators favour safe operations over compliant ones. Changes in the GHSP regulatory regime may bring new opportunities for the aerodrome operator to engage more with the GHSPs on airside issues.

Stakeholders are somewhat open to the multi stakeholder management, but only where it is appropriate and with the caveat of concern around possible legal exposure to liability. A more open working relationship with better sharing of safety information to create a mutually more

informed culture would be preferable. A more comprehensive level of understanding of each other's operations and a new way of committing to meet broader safety objectives should be considered. Continued work on stakeholder relationships is required. Process mapping of the tactical stakeholder relationships is recommended which would aid the aerodrome operator to engage more confidently in multi stakeholder forums.

The implementation of a Safety Management System is effectively an organisational change project and as such it should be integrated into the organisational strategy. The SMS ethos requires that safety culture is part of the organisational culture. The safety teams should become part of the efficiency drives, to elevate the safety culture and to embed it truly in the "this is way we do things around here" aspect of the operation. SMS will be the prevailing safety management framework for at least the next decade. Certainly, it can be a powerful tool if deployed successfully within an organisation.

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