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State Safety Programme

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Summary

New ICAO standards place a responsibility on ICAO Contracting States to have a State Safety Programme (SSP). An SSP is a management system for the management of safety by the State, and consists of an integrated set of regulations and activities aimed at improving safety. This study of the development and implementation of an SSP is carried out for the Dutch Expert Group Aviation Safety (DEGAS). The goal of the study is to assist the Ministry of Transport, Public Works and Water Management with the implementation of an SSP in the Netherlands. In order to do so the approaches taken in the development of an SSP by the relevant Ministries and Civil Aviation Authorities of the United States, Australia, the United Kingdom, France, and Belgium are studied and compared.

The objectives of an SSP are:

- An SSP is a prerequisite for the implementation of a Safety Management System (SMS) by service providers.
- An SSP is to be established in order to achieve an Acceptable Level of Safety (ALoS).
- An SSP enables a shift towards a more performance based environment where regulations are used as safety risk controls.
- An SSP is needed to get ahead of safety risks through the development of safety management capabilities within the State, rather than waiting for accidents, incidents or events of non-compliance.
- An SSP enables a State to adapt to changes and continuously improve safety in the air transport system.

The framework of an SSP consists of four components: State safety policy and objectives, State safety risk management, State safety assurance, and State safety promotion. The two core operational activities of an SSP are State safety risk management and State safety assurance. These core activities take place under the umbrella provided by the State safety policy and objectives, and are supported by State safety promotion.

The move to an SSP reflects a fundamental regulatory change to complement the compliance-based approach with a performance-based approach. This is reflected in a shift in type of safety indicators used, from only reactive (lagging) indicators towards a mix of reactive and proactive/predictive (leading) indicators.

The most mature implementation of an SSP is that of the CAA UK. The United Kingdom has not, at this time, agreed on acceptable levels of safety applicable to service providers, as is indicated as a need in the second element of the framework (State safety risk management). The United Kingdom is adopting a phased approach to SMS implementation and will establish ALoS in conjunction with the service providers over the next 3 years as they implement SMSs.

The United States chose to use the term (internal) SMS for their SSP. Several organizations within the FAA will develop such an internal SMS. The combination of those SMSs form the US SSP.

Australia is in the process of developing an SSP. It is intended that a first version will be completed and publicly available in November 2009. The approach is similar to that taken by the United Kingdom.

France has developed, as part of the SSP, a strategic action plan for improving safety in 2009 - 2013. One of the objectives of the action plan is the actual development of a complete SSP.

Belgium has made a document describing the development of their SSP. The focus is on the organization of the Directorate-General, the responsibilities of several actors, and the internal and external communication and dissemination of safety information. Many effort will be put in the development of a strategic action plan, which will cover safety assurance and promotion.

Some aspects of the SSP are already covered by European regulations. The United Kingdom, France and Belgium all consider the Safety Assessment of Foreign Aircraft programme (SAFA) as part of an SSP.

The countries studied make use of safety indicators and targets, and have specified action plans to improve safety. These can become part of a future ALoS. Quantitative values and time constraints are sometimes missing in the targets. All indicators used are lagging, i.e. related to the reduction of accidents, serious incidents, and other occurrences. All countries do use indicators of occurrences that can be the precursor of more serious events, and are therefore predictive. No country uses leading indicators yet. The United Kingdom does recognize the need of those indicators in their SSP.

The establishment of an ALoS needs to be a continuous process. First the safety critical areas need to be defined, than it can be determined which indicators are to be used to cover these areas. A baseline needs to be established to base the safety targets on, and action plans need to be defined. After the implementation of the ALoS it needs to be monitored if new indicators and targets are needed to cover new or underexposed safety areas.

The recommendations made related to the establishment of an SSP are:

- It is recommended to start to describe the Dutch aviation safety system, and identify how it fits into the ICAO framework of an SSP. This also allows to clearly identify which parts of an SSP are still missing, and need to be developed. The focus should be on important aspects of the Dutch aviation system, e.g. the complex operation at Schiphol, the interaction with Eurocontrol, and the small dense airspace.
- In line with France, Belgium, and the United Kingdom it is recommended to contribute to a strategic plan for improving air safety in Europe. To do so the appropriate European bodies need to be approached and joined.
- It is recommended to formulate the high-level safety objectives which are part of the first component of the SSP framework (State safety policy and objectives) as goals that have to be achieved, instead of actions that have to be done.

Recommendations made related to an ALoS are:

- It is recommended to establish targets that are concrete, measurable, acceptable, reliable, and relevant. Targets also need to contain a time constraint.
- It is recommended to formulate safety targets related to causal factors of high risk accidents and serious incidents. Such indicators are predictive, and targets to reduce the occurrence of such causal factors prevent accidents and incidents from happening. The focus should be on causal factors of important occurrence categories, e.g. CFIT, loss of control, runway incursions, runway excursions, and overruns. The data used for the indicators should be objectively measurable and reliable. The relative influence of the causal factor on the occurrence should be established. The needed data might be hard to obtain, especially for the State. Indicators using causal factors are therefore more appropriate for the use in ALoSs of service providers. The State can use these indicators when a more aggregate view is wanted, for example the number of TCAS RAs, level busts, and runway incursions. However, instead of using lagging indicators (i.e. measuring events) the SSP AloS might want to focus on the supervision of appropriate mechanism within the SMSs of service providers, using leading indicators.
- It is recommended to define leading safety indicators. These indicators can make use maturity levels of SMSs or safety culture at service providers or State level, or the maturity of the cooperation between specific service providers. It is assumed that improved

performance in a leading indicator will drive better performance in the lagging indicator. This assumption is also an important pitfall, because it will be difficult to quantify the correlation between an improvement in maturity level and an improvement in safety level. It therefore might prove difficult to establish meaningful safety targets.

- It is recommended to take a cautious approach in setting safety targets in an ALoS. If targets are set too early in the process, or if they are unduly correlated with other performance indicators, the whole process may be threatened.

Contents

1 Introduction

This study of the development and implementation of a State Safety Programme (SSP) is carried out for the Dutch Expert Group Aviation Safety (DEGAS). DEGAS is the independent advisory committee for safety in civil aviation. The study is performed on request of the Ministry of Transport, Public Works and Water Management.

The goal of the study is to assist the Ministry with the implementation of an SSP in the Netherlands. In order to do so the approaches taken in the development of an SSP by the relevant Ministries and Civil Aviation Authorities of the United States, Australia, the United Kingdom, France, and Belgium are studied and compared. The Acceptable Level of Safety (ALoS), which is part of an SSP, is studied in more detail. Therefore, the safety indicators and target used by the abovementioned countries are studied as well, because they form the basis for a future ALoS.

The report consists of six chapters including this introduction. The second chapter gives an overview of the ICAO framework of an SSP. Chapter three discusses the approach taken by other States in the development and implementation of an SSP. The fourth chapter discusses the high-level safety objectives, and the safety indicators and targets used by other States that can be part of a future ALoS. The fifth chapter discusses the lessons to be learned by the Netherlands from the approach taken by the other States. The final chapter contains conclusions and recommendations.

2 State Safety Programme

2.1 Introduction

New ICAO standards place a responsibility on ICAO Contracting States to have a State Safety Programme (SSP). An SSP is a management system for the management of safety by the State, and consists of an integrated set of regulations and activities aimed at improving safety. ICAO includes the requirement for an SSP in Annexes 1, 6, 8, 11, and 14. It is expected that it will become a standard in Annex 13 within 2 years.

ICAO has issued a Safety Management Manual (SMM) [SMM, 2009] that contains a chapter about the SSP. The majority of this section of the report is taken from that manual, completed with information from the SSP-course given by ICAO, and insights from SSP documentation from various countries. This chapter discusses the objectives, the components and elements, and the development and implementation of an SSP.

2.2 Objectives of an SSP

In the ICAO SMM [SMM, 2009] and in the different SSP documentation of the States studied [CAP 784, 2009; SAP, 2009; FAA 8000.369, 2008], various objectives of an SSP are given. In summary these objectives are:

- The realistic implementation of an SSP is a prerequisite for the implementation of a Safety Management System (SMS) by service providers[1)]. An SSP generates a context that supports the implementation of an SMS by service providers.
- An SSP is to be established in order to achieve an Acceptable Level of Safety (ALoS). The ALoS to be achieved needs to be established by the State(s) concerned.
- An SSP enables a shift towards a more performance based environment where regulations are used as safety risk controls. It is noted that also regulatory compliance will still be necessary in the future.
- An SSP is needed to get ahead of safety risks through the development of safety management capabilities within the State, rather than waiting for accidents, incidents or events of non-compliance.
- An SSP enables a State to adapt to changes and continuously improve safety in the air transport system.

[1)] Within the context of the SSP, the term "service provider" refers to any organization providing aviation services. The term includes approved training organizations that are exposed to safety risks during the provision of their services, aircraft operators, approved maintenance organizations, organizations responsible for type design and/or manufacture of aircraft, air traffic service providers and certified aerodromes, as applicable.

2.3 Components and elements of an SSP

The SSP framework consist of four components, which each consists of several elements, totaling to 11:

1. State safety policy and objectives
   - 1.1. State safety legislative framework
   - 1.2. State safety responsibilities and accountabilities
   - 1.3. Accident and incident information
   - 1.4. Enforcement policy
2. State safety risk management
   - 2.1. Safety requirements for service providers SMS
   - 2.2. Agreement on service providers safety performance
3. State safety assurance
   - 3.1. Safety oversight
   - 3.2. Safety data collection, analysis and exchange
   - 3.3. Safety data driven targeting of oversight on areas of greater concern or need
4. State safety promotion
   - 4.1. Internal training, communication, and dissemination of safety information
   - 4.2. External training, communication, and dissemination of safety information

The two core operational activities of an SSP are State safety risk management and State safety assurance. These core activities take place under the umbrella provided by the State safety policy and objectives and are supported by State safety promotion.

The first component, State safety policy and objectives, includes statements of the goals and objectives for a State to fulfill, as well as staffing and planning within the State. It defines the participation of the State aviation organizations in specific activities related to the management of safety in the State, and establishes the role, responsibilities, and relationship of such organizations, as well as the accountable executives. An independent accident and incident investigation processes needs to be established, and an enforcement policy promulgated.

Safety Risk Management includes the forward looking identification of hazards in the air transport system, i.e. the hazards are not determined using the investigation of accidents and serious incidents, but by keeping track of the service providers safety performance. The risks are analyzed and assessed and if needed controlled. The State needs to establish the

requirements which govern how service providers will identify hazards and manage safety risks.

Safety assurance gathers data on the air transport system, and analyzes and assesses that data to determine if the safety risk controls generated in the Safety Risk Management process are effective. If not, the safety assurance task is needed to make decisions regarding what appropriate corrective action should be taken. The safety data is also exchanged between relevant actors. Prescription based oversight is needed to assure risk controls are appropriately integrated in the service providers' SMS, and have the intended effect on risks.

The last component, safety promotion, includes communication, training, and the development of a positive safety culture, both internally at the State level (mainly related to SSP), and externally at the service providers' level (mainly related to SMS).

For further information regarding the content of the four components and eleven elements one is referred to the ICAO Safety Management Manual [SMM, 2009].

2.4 SSP development and implementation

ICAO proposes that States develop their SSP around the four components and eleven elements of the ICAO SSP framework. It is important to note that according to ICAO the development of an SSP does not change *"the role of the State and its aviation organizations regarding the establishment of the State's regulations and standards, or the requirement for State civil aviation personnel to possess high levels of knowledge and skill."* [SMM, 2009]. ICAO adds that there are even additional skills needed in areas such as "safety risk analysis, system evaluation, and management system assessment, as well as in the many new technologies essential for the aviation industry to achieve its production objectives."

The combination of elements and components become the framework for an SSP. The framework provides a principled guide for SSP implementation. ICAO has developed guidance for the development of an SSP framework in order to facilitate SSP implementation, which can be found in the ICAO SMM. ICAO indicates that due to the potential effort, it is important to properly manage the workload associated with the activities underlying the development and implementation of the SSP.

For detailed guidance on the development of an SSP implementation plan one is referred to ICAO SSM Appendix 5 to chapter 11. The Appendix indicates the necessity of a SSP gap

analysis, as well as the requirements of the implementation plan per SSP component. The prescribed deliverables and milestones can be found in Appendix A to this document.

One of the objectives of an SSP is to generate a context that supports the implementation of an SMS by service providers. As poetically stated by ICAO *"a service provider's SMS can flourish only under the enabling umbrella provided by an SSP"*. For this reason four steps, as given in fig. 1, aim at supporting SMS implementation by service providers.

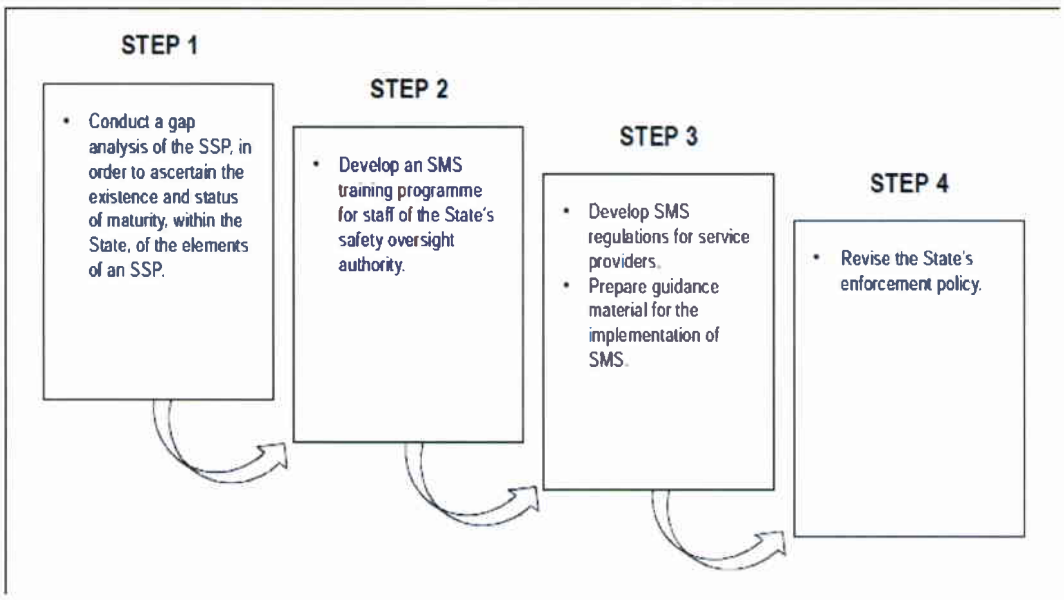

Fig.1: Role of SSP in supporting SMS implementation

2.5 Acceptable Level of Safety

The move to an SSP reflects a fundamental regulatory change to complement the compliance-based approach with a performance-based approach. It is no longer possible to assume that regulatory compliance alone will produce safety improvements. A more proactive, performance-based approach is necessary to achieve continuous safety improvement. To do this requires both the State and service provider to establish and monitor objective safety performance indicators, to establish safety performance targets and to take action, where necessary, to improve safety. An Acceptable Level of Safety (ALoS) is the combination of several performance targets, that are measured using safety indicators, and the action plans needed to be performed to achieve the targets set. An ALoS is part of both an SSP and a service provider's SMS.

Safety indicators are parameters that characterize and/or typify the level of safety of a system. Meaningful safety indicators must be representative of the elements that characterize system safety, for example; accidents and incidents, accident and incident rates, and level of regulatory compliance. Safety targets are concrete objectives to be achieved related to the safety indicators, an example could be a reduction in fatal accidents. Action plans are measures taken by the State to be able to achieve the safety target set, an example could be an awareness campaign to let actors become aware of certain risks.

The move towards a more performance based environment is also reflected in a shift in type of safety indicators used: from only reactive indicators towards a mix of reactive and proactive/predictive indicators. ICAO describes that shift in their SMM as follows [SMM, 2009]:

> *"Since accidents (and serious incidents) are relatively random and rare events in aviation, assessing safety health based solely on safety performance indicators may not provide a valid predictor of safety performance, especially in the absence of reliable exposure data. Looking backwards does little to assist organizations in their quest to be proactive, putting in place those systems most likely to protect against the unknown. The safest organizations employ additional means for assessing safety performance in their operations."*

The additional means could be proactive/predictive indicators. Eurocontrol established the Safety Data Reporting and Data Flow task force (SAFREP) that amongst other topics studies issues related to the establishment of safety performance indicators [SAFREP]. SAFREP defines two types of indicators: lagging and leading. Lagging indicators, or reactive indicators, measure events (e.g. safety occurrences, such as accidents, incidents, etc) that have happened while leading indicators, or proactive/predictive indicators, are identified principally through the comprehensive analysis of the organizations (service providers, States)[2]. SAFREP assumes that there is a relationship between the two indicators that suggest that improved performance in a leading indicator will drive better performance in the lagging indicator. To capture that, both types of indicators must be present in an ALoS. Chapter 5 discusses lagging and leading indicators in more detail, including some examples.

[2] It is noted that an indicator using the comprehensive analysis of an organization can still be reactive, because the indicator is based on the current (and recent past) status of an organization. A true leading indicator would indicate the future state of an organization (or operation). Acting on such an indicator would mitigate risks of the future. However this is not the case, therefore instead of lagging and leading indicators, the indicators could also be called operational and organizational. It is decided, however, to use the Eurocontrol terminology in this report.

The Acceptable Level of Safety to be achieved by the SSP shall be established by the State. Furthermore, agreement between the State and the service provider of the service provider's SMS and its associated ALoS is also part of the SSP.

2.6 Conclusion

New ICAO standards place a responsibility on ICAO Contracting States to have a State Safety Programme (SSP). The objectives of an SSP are:

- An SSP is a prerequisite for the implementation of a Safety Management System (SMS) by service providers.
- An SSP is to be established in order to achieve an Acceptable Level of Safety (ALoS).
- An SSP enables a shift towards a more performance based environment where regulations are used as safety risk controls.
- An SSP is needed to get ahead of safety risks through the development of safety management capabilities within the State, rather than waiting for accidents, incidents or events of non-compliance.
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The framework of an SSP consists of four components: State safety policy and objectives, State safety risk management, State safety assurance, and State safety promotion. The two core operational activities of an SSP are State safety risk management and State safety assurance. These core activities take place under the umbrella provided by the State safety policy and objectives and are supported by the State safety promotion.

The move to an SSP reflects a fundamental regulatory change to complement the compliance-based approach with a performance-based approach. This is reflected in a shift in type of safety indicators used, from only reactive (lagging) indicators towards a mix of reactive and proactive/predictive (leading) indicators.

3 Foreign SSP approaches

3.1 Introduction

This chapter discusses the approaches taken by five States in the development and implementation of an SSP: the United Kingdom, the United States, Australia, France, and Belgium. The majority of the chapter describes what items the states expect to put in place under the different components and elements of the SSP framework. The lessons to be learned from the approaches of the countries studied can be found in Chapter 5.

The United Kingdom is discussed first because its SSP is most mature, is recommend by ICAO in their SMM, and follows the outline of ICAO more than other States' SSP. The other countries are discussed in arbitrary order.

3.2 The United Kingdom

The United Kingdom has produced a document containing its State Safety Programme [CAP 784, 2009]. The UK SSP has been developed using the ICAO SSP framework and guidance material.

The UK SSP is produced by the United Kingdom Civil Aviation Authority in conjunction with the Department for Transport's Aviation Directorate, the Air Accident Investigation Branch, the Ministry of Defense, and Air Safety Support International. The primary responsibility for the UK SSP rests with the Department for Transport's Director General of Civil Aviation. However, as the CAA is the specialist aviation safety regulator and performs many safety-related functions under directions from the DfT, the DfT has agreed that the CAA should co-ordinate the production of the UK SSP document.

The UK SSP documentation consists of five main chapters. One chapter details the UK aviation safety oversight arrangements, in the United Kingdom and the so-called oversees territories and crown dependencies. The four other main chapters discuss the four SSP components; aviation safety policy and objectives, aviation safety risk management, aviation safety assurance, and aviation safety promotion.

The UK CAA has not changed its organization for the implementation of the SSP. The SSP document States this clear and open [CAP 784, 2009]:

"The UK SSP is a new concept. This UK SSP document describes how the United Kingdom addresses items raised by ICAO under an SSP. However, any organizational changes required to assure the continuing management and future accountability for the SSP have yet to be defined. Until then, the CAA will oversee the updating and production of the UK SSP in conjunction with other bodies and will continue to develop and continuously improve the SSP."

The CAA UK carried out a gap analysis based on the ICAO Safety Management Manual. This analysis did not identify any areas where it was necessary for the United Kingdom to draft new national legislation to govern the functioning of the SSP.

The UK SSP document discusses the UK implementation of the four components and eleven element of the SSP framework. To get an idea what the United Kingdom has considered under the several components and elements of the framework, the UK SSP is treated per element below.

3.2.1 State safety policy and objectives

State safety legislative framework

The safety objectives that are stated in the UK SSP are obtained from the following documentations: The Future of Air Transport White Paper published by the Department for Transport[3] (DfT), DfT's business plan, and the Civil aviation act 1982[4]. On European level, the basic regulation and the SES legislation are named as material that is used by the CAA UK to determine its safety policy and objectives. The safety objectives of the United Kingdom are discussed in more detail in Chapter 4.

State safety responsibilities and accountabilities

The primary responsibility for the UK SSP rests with the DfT Director General of Civil Aviation (DGCA). But because the CAA is seen as the specialist aviation safety regulator the CAA is coordinating the production of the UK SSP document. Since the role and responsibilities of EASA are expanding the United Kingdom expects to amend the UK SSP when required.

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3) http://www.dft.gov.uk/about/strategy/whitepapers/air/

4) http://www.opsi.gov.uk/RevisedStatutes/Acts/ukpga/1982/cukpga_19820016_en_1

Accident and incident investigation

The accident and incident investigation regulation in the United Kingdom are discussed in the document. The regulations as provided by the Civil Aviation Act 1982 provide for the continued establishment of the Air Accident Investigation Branch (AAIB). The AAIB has the necessary legal powers to conduct accident investigations and fulfils the United Kingdom's obligation in relation to ICAO Annex 13 and EU directive 94/56/EC.

Enforcement policy

The UK SSP document discusses the needed administrative measures such as licenses and certificates. The CAA has powers to vary, suspend or revoke a permission where it is no longer satisfied that the relevant criteria are met. A failure to comply with UK regulations or specified European aviation regulation is a criminal offence, and will lead to prosecution in appropriate cases.

3.2.2 State safety risk management

The CAA UK has a long-term agenda for safety, which is captured and tracked through its Safety Plan and Safety Plan Updates. The Safety Plan contains both risks and actions the CAA takes to mitigate those risks. To determine the risks and mitigating actions a Safety Risk Management Process is set-up, coordinated by the CAA Safety risk team.

Safety requirements for the service provider's SMS

The CAA UK requires SMS for ANSPs and Airport Operators. The CAA is promoting the implementation of SMS by airline operators and maintenance organizations. This is in line with ICAO regulations.

Agreement on the service provider's safety performance

The United Kingdom has not, at this time, established an acceptable level of safety that is applicable to service providers in the operation of their SMS but believes the primary objective is to achieve a continuous improvement in safety. The United Kingdom is adopting a phased approach to SMS implementation and will establish ALoS in conjunction with the service providers over the next 3 years as they implement SMSs.

3.2.3 State safety assurance

Safety oversight

Safety oversight is only discussed shortly. It is mentioned that the CAA is focusing substantial resources on ensuring service providers implement SMS requirements.

Safety data collection, analysis and exchange

Several initiatives of the CAA regarding the safety data collection, analysis and exchange are discussed. Most were established many years ago. The reporting arrangements named in the document are:

- Mandatory Occurrence Reporting Scheme (MORS)
- Mandatory Birdstrike Reports
- UK Airprox Board (UKAB)
- UK Confidential Human Factors Incident Reporting Programme (CHIRP)
- UK National Wake Vortex Reporting System

Safety-data-driven targeting of oversight of areas of greater concern or need

In this section the Safety Assessment of Foreign Aircraft programme (SAFA) as launched by ECAC to complement ICAO audits is discussed, as well as the CAA oversight of service providers. It is especially noted that procedures are in place for operators that show safety trends that could lead to unacceptable safety levels.

3.2.4 State safety promotion

Internal training, communication and dissemination of safety information

Internal training given to CAA UK staff is discussed, as well as communication and dissemination of safety information. For the latter the MORs (Mandatory Occurrence Reports) are mentioned, as well as information regarding safety-significant events that is given to senior managers.

External training, communication and dissemination of safety information

External training as given by the commercial branch of the CAA, CI, is discussed. For external communication and dissemination of safety information the following items are named; CAA Annual Report, CAA Safety Plan, the UK AIP, meteorological information, information published on the website such as NOTAMs, and the publication of MORs. Furthermore engagement with the stakeholders is mentioned using safety conferences and workshops as

examples. Lastly, the UK Flight Safety Committee (UKFSC) and General Aviation Safety Council (GASCo) are mentioned.

3.3 The United States

The United States Department of Transportation Federal Aviation Authority (FAA) has chosen the same nomenclature as service providers, hence the U.S. SSP is referred to as the (internal) FAA SMS. The FAA SMS will be comprised of interoperable SMSs being implemented within the Office of Aviation Safety (AVS), the Air Traffic Organization (ATO), the Office of Airports (ARP), and the Office of Commercial Space. The approach to use the term SMS is partly due to the fact that the FAA has both oversight organizations (AVS, ARP), as well as a service provider organization (the ATO, or the US ANSP). Due to the interoperability of the SMSs, issues of mutual concern can be managed cooperatively.

The FAA has published an Order [FAA 8000.369, 2008] which provides guidance for the implementation of a common Safety Management System within the FAA. The Order establishes the internal SMS standard for the FAA. The Order also establishes an FAA SMS Committee to coordinate SMS implementation among the aforementioned organizations. The FAA SMS will provide most of the elements of an SSP as per ICAO standards.

3.3.1 SSP implementation in the United States

It is expected that an SMS will be implemented in the Air Traffic Organization, Office of Aviation Safety, and Office of Airports in fiscal year 2010. In fiscal year 2012, the SMS policy will be implemented in all appropriate FAA organizations.

Office of Aviation Safety

The Office of Aviation safety has produced an Order [FAA 8000.367, 2008] that lays down the requirements for the Safety Management System in Aviation Safety (AVSSMS). The document addresses the four components of the SMS: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion. This is concurrent with ICAO.

The underlying elements of each components as prescribed in the order are not the same as ICAO prescribes. From the high-level documents it is not possible to determine if the FAA is incorporating the same elements in their SSP as prescribed by ICAO.

Air Traffic Organization

The Air Traffic Organization (ATO) has produced an Order [FAA 1000.37, 2007] that lays down the requirements of the SMS of the ATO. The order addresses the four components of the SMS. Successful implementation of an SMS in the Air Traffic Organization is foreseen in March 2010. Since the ATO is a service provider, this SMS does not formally constitute a part of the SSP, in the sense that the SMS of ANSP of other States are not part of that State's SSP. ICAO also notes that when a State is responsible for the provision of air navigation services the organization providing the service should develop and implement an SMS.

Office of Airports

The office of Airports has not yet published guidance material on the development of an SMS. The website does mention that the Office is currently developing its SMS and plans to begin implementing key components in early 2009 across the country [APR, 2009].

It is stated that to meet the requirements of safety risk management under the SMS, formalized safety risk management will be incorporated into the planning process evaluations of requests for modification to standards, reviews of safety during construction plans, and advisory circulars. The formalized safety risk management will also be incorporated into the planning and development processes for new airport projects. The other three components of an SSP, besides safety risk management, are not mentioned.

Office of Commercial Space

The Office of Commercial space is also going to develop an internal SMS. However, due to the nature of the office this SMS is not further discussed here as it is considered out of scope from a Dutch perspective (no such office is expected to be established in the Netherlands in the near future). It does constitute a part of the U.S. SSP.

3.4 Australia

Australia is in the process of developing an SSP. The approach is similar to that taken by the United Kingdom. The primary responsibility for developing the SSP rests with the Department of Infrastructure, Transport, Regional Development and Local Government. Other agencies with aviation safety responsibility are Airservices Australia (ANSP), the Australian Transportation Safety Bureau, the Civil Aviation Safety Authority and the Australian Maritime Search Authority (SAR provider).

The Department will develop a plan meeting the ICAO requirements that encompass the overall State approach. The other authorities develop their own Safety Plan, material from which will be incorporated in Australia's SSP. Work is underway on the Safety Plans. It is intended that these will be completed and become publically available in November 2009.

3.5 France

France has produced a strategic action plan for improving safety in commercial air transport for the year 2009 - 2013 [SAP, 2009]. The action plan is developed as innovative action performed under the SSP. Interestingly one objective of the action plan is to set up an organized and effective SSP. It is intended to produce future versions of the action plan, thereby incorporating changes due to identified problems arising from the implementation of regulations.

The action plan contains a section giving 13 objectives of an SSP. Although not divided in components by France, the objectives can be divided in the four components of an SSP. The objectives of an SSP according to the French Action Plan will be discussed hereafter.

State safety policy and objectives

An objective of France is to establish a safety culture in all the DGAC's activities to bring about effective aviation safety management, based on feedback and experience, and to make safety paramount at all times.

France also has the objective to make the regulatory duties which offer the best return in terms of safety the priority when it comes to allocating national resources. The safety objectives of France are discussed in more detail in Chapter 4.

Safety risk management

An objective is to set up processes for continuous safety improvements (CSI) in all of DGAC's departments concerned with SMSs, thereby optimizing their work. Operators are encouraged to implement SMSs and CSI processes for all their activities which are subject to risk. In partnership with operators and BEA (France AAIB) initiatives which focus on identifying and quantifying risks will be adopted.

Safety assurance

The objectives defined in the strategic action plan will be used as benchmarks for measuring safety performance. As part of a proactive approach, systems will be set up for collecting

safety-related data and make those available to all the bodies concerned. Furthermore, oversight methods and regulatory activities will be developed and optimized so that they can comply with the new requirement for operator SMSs. Just as the CAA UK France mentions the SAFA program as part of the SSP.

Safety Promotion

The active participation of operators in areas such as improving regulations, monitoring the industry, promoting safety and identifying priority areas to improve safety are encouraged. Training courses will be developed to explain the principles of the SSP, promote the idea of a 'safety culture' and the processes involved, and raise awareness of the role all actors must play to ensure the programme's success. It needs to be ensured that all DGAC staff involved in safety matters in aviation receive the necessary information with which to carry out their duties, are competent in their particular field, and are assigned to tasks which match their abilities.

France also has the objective to contribute to a strategic plan for improving air safety in Europe. France indicates that most components of an SSP have a European side to them. Therefore the French want to contribute to the progressive implementation of a strategic action plan for improving air safety at an European level in accordance with, wherever possible, the actions of ICAO and the stated purposes of the national action plan. The actions needed to be able to do so include: the distribution of the French strategic action plan to the relevant European bodies, suggesting to them the setting up of a European Plan, and asking the stakeholders (DGAC and operators) who liaise with these bodies to support the establishment of a European plan.

3.6 Belgium

Belgium is also in the process of developing an SSP. The Aviation Directorate-General (DG) is responsible for drawing up the Belgium SSP. A document with the safety policy is publicly available [Belgium, 2009]. The goal of an SSP is, according the DG, a constant improvement of aviation safety by an intensive collaboration between the Belgium aviation sector and the Directorate-General.

An important part of the Belgium SSP is the strategic action plan. It tries to mitigate potential sources of safety hazards by regulatory measures and oversight. The action plan especially encompass the requirements of State safety assurance and promotion. The action plan will be

arranged for a period of 5 years, but will be evaluated, adapted, and published every year. It is expected that the first action plan will be finalized in the first quarter of 2010.

The document also discusses training to improve the understanding of one's role in the realization of an SSP. It mentions the need to adapt and optimize regulatory and oversight activities due to the introduction of SMS by Belgium service providers. Safety data collection and analysis is discussed in the document. A safety committee has been established as per Appendix 5 to Chapter 11 of the ICAO SMM. The responsibilities of accountable actors is discussed, as well as the communication and dissemination of safety information, both internally and externally. Just as the CAA UK and France, Belgium mentions the SAFA program as part of the SSP.

In line with the French the Belgium Directorate General supports European cooperation. The DG supports the development of an European Safety Programme at the level of EASA, the regulatory committees of the European Commission and the Safety Regulation Commission (SRC) of Eurocontrol.

3.7 Conclusion

The United Kingdom has developed a document describing its SSP. The document treats all four components and eleven elements of an SSP. No organizational changes have been made by the CAA UK. Some elements of the SSP are covered by European regulations, and can be expected to already be in place in other European States, including the Netherlands, as well.

Although all components and elements of the ICAO SSP Framework have been treated, not all elements are fulfilled. For example, the United Kingdom has not, at this time, agreed on acceptable levels of safety applicable to service providers. The United Kingdom is adopting a phased approach to SMS implementation and will establish ALoSs in conjunction with the service providers over the next 3 years as they implement their SMSs.

The approach of the United States has been somewhat different. Instead of SSP they chose to use the term (internal) SMS. Several organizations within the FAA will develop an internal SMS. The combination of those SMSs form the US SSP. This includes the SMS of the Air Traffic Organization, the US ANSP, while ICAO considers that as an SMS of a service provider, and not as part of the SSP. The status of most SMSs of the organizations within the FAA are implementation plans in the form of Orders that lay down the framework of the SMS. This framework is similar to that proposed by ICAO.

Australia is in the process of developing an SSP. It is intended that a first version will be completed and publicly available in November 2009. The approach is similar to that taken by the United Kingdom.

France has developed, as part of the SSP, a strategic action plan for improving safety in 2009 - 2013. One of the objectives of the action plan is the actual development of a complete SSP. The action plan contains several purposes of the SSP, which fall into the four components of the ICAO SSP framework.

Belgium has made a document describing the development of their SSP. The focus is on the organization of the Directorate-General, the responsibilities of several actors, and the internal and external communication and dissemination of safety information. Many effort will be put in the development of a strategic action plan, which will cover safety assurance and promotion.

Some aspects of the SSP are already covered by European regulations. An example named by the United Kingdom, France, and Belgium is the Safety Assessment of Foreign Aircraft programme (SAFA). Belgium and France also suggest European cooperation to come to an European Safety Programme. The UK CAA mentions European initiatives in their SSP as well: *"In Europe there is activity in both EASA and Eurocontrol to address both an SSP and the ALoS, but the activities have yet to be linked".*

4 Safety objectives and ALoS

Two important aspects of the SSP are the State's high-level safety objectives, which are part of component 1 of the SSP framework (State safety policy and objectives), and the Acceptable Level of Safety (ALoS). These aspects are important because they indicate what the State wants to achieve, and they can be used to verify if the State is achieving its goals. This chapter discusses the approach taken by the countries in relation to these two important aspects.

The ALoS will be expressed by multiple safety performance indicators and safety performance targets, never by a single one, as well as by safety requirements in the form of action plans that formulate remedial actions. Although most States do not have a mature implementation of an SSP, and have not yet established a formal ALoS as part of the SSP, they do have publications that indicate which safety indicators and targets are already in use. It can be expected that these indicators and targets will become part of the ALoS. Action plans are also formulated in most cases, but these will only be addressed briefly.

It is noted that the safety indicators and targets discussed here are the ones in use by the State, mostly the Civil Aviation Authority, and not those used by service providers. This excludes safety indicators in use by ANSP in most cases, although in some cases, e.g. the United States, the ANSP is part of the Authority, and its safety performance indicators are reflected in those of the State.

4.1 High-level safety objectives

The high-level safety objectives of the States can be found in SSP documentation, and other safety related documentation concerning aviation. The objectives do not contain quantitative targets. The scope of the objectives differ from State to State. The objectives can be expressed in terms of what can be done, e.g. improve expertise and training in the Aviation sector, or in terms of what has to be achieved, e.g. reduce the number of fatalities.

United Kingdom

The United Kingdom has included several safety objectives in their SSP documentation [CAP 784, 2009]. The CAAs objective for safety according to its Corporate Plan is [CCP, 2009]:

> To develop our UK world-class aviation safety environment, in partnership with industry, by driving continuous improvements in aviation safety in the UK, and in partnership with EASA, across Europe.

The strategic objectives of the CAA are [CAP 784, 2009]:

- **The CAA regulates the safety of UK aviation, in partnership with EASA, by approving and overseeing the organisations and individuals involved in UK aviation that fall within its remit**
- **The CAA will continue to use and develop risk-based approach to ensure that UK aviation complies with European and UK legislation and requirements**
- **The CAA will work collaboratively with industry to continuously improve aviation safety and address safety issues**
- **Where required, the CAA will take any necessary actions to ensure safety is not compromised and will ensure that the high safety standards within UK airspace, and its supporting infrastructure, are maintained, with potential risks identified and appropriate mitigating actions taken**
- **The CAA will draw upon worldwide and UK data to identify safety trends applicable to UK aviation, prioritizing this information to focus on the most significant safety issues**
- **The resulting safety improvement initiatives will be captured in the CAA Safety Plan, which will be used as means of monitoring progress and effectiveness.**

Most objectives describe what the tasks are of the CAA, but it is also indicated what the CAA has to achieve by the statement that it will work to continuously improve aviation safety and address safety issues.

United States

The United States have drafted the "FAA Flight Plan 2009-2013" [FFP, 2009] containing objectives related to increased safety, greater capacity, international leadership and organizational excellence. Per year the goals are assessed in a portfolio [Portfolio, 2009]. For the SSP the objective of increased safety is paramount, although part of the objective to have international leadership includes the promotion of improved safety and regulatory oversight in cooperation with bilateral, regional, and multilateral aviation partners.

The goal of the United States is to achieve the lowest possible accident rate and constantly improve safety. Specifically the following objectives are stated:

- **Reduce commercial air carrier fatalities**
- **Reduce general aviation fatalities**
- **Reduce the risk of runway incursions**

- Ensure the safety of commercial space launches
- Enhance the safety of FAA's air traffic systems
- Implement a Safety Management System (SMS) for the FAA

The last objective is of course the implementation of an US SSP, and as such would not be part of the actual SSP. The objective regarding space launches is considered out of scope from the Dutch perspective. The other objectives could be part of the US SSP. These objectives are all objectives that have to be achieved.

Australia

Australia drafted a document containing the strategic direction for the years 2008-09 to 2010-11 [CASA, 2008]. The Australian aviation authority CASA formulates four goals; achieve safety effectiveness, improve efficiency, improve industry and other stakeholder relations, improve accountability. The first goal is of interest for this report.

The following objectives are stated in order to reach the goal to achieve safety effectiveness:

- Improve industry oversight including entry control, certificate management and enforcement
- Work with the aviation industry to develop and implement clear outcome-based aviation standards and rules which enhance safety
- Identify and address the most significant safety-related trends and risk factors in the system of civil aviation safety in Australia
- Improve the safety of airways, aerodromes and associated services
- Ensure the safety of international operations
- Encourage greater industry acceptance of its responsibilities for aviation safety
- Improve management and regulatory regime of Australian-administered airspace

The safety objectives of Australia are a combination of what has to be done, e.g. encourage greater industry acceptance of its responsibilities for aviation safety, and what has to be achieved, e.g. improve safety of airways, aerodromes and associated services.

France

France has drafted several safety related goals in their Strategic Plan [SAP, 2009]. The goals are divided in goals reducing general risks and goals reducing specific risks. The goals to reduce general risks can be considered as high-level safety objectives. These goals are:

- Operators must implement effective SMSs
- Set up an organized and effective State Safety Programme
- Limit the risks associated with the interfaces between the various systems run by operators
- Make effective safety measures the priority when regulating and monitoring the air transport industry
- Improve expertise and training in dealing with human factors
- Identify the reasons for and react to any deliberate breach of the rules of routine deviation from procedures
- Contributing to a strategic plan for improving air safety in Europe

It is noted that one of the objectives is to set up an organized and effective SSP. This objective will of course not be part of the SSP itself. Most objectives are formulated in the form of what has to be done, except the limitation of risks associated with the interfaces between the various systems run by operators, which is something that has to be achieved.

Belgium

Belgium will most probably include safety indicators and targets in their 5-year strategic action plan, which is foreseen to be completed in the first quarter of 2010.

4.2 Acceptable Level of Safety

As stated in section 2.2 an SSP is to be established in order to achieve an Acceptable Level of Safety (ALoS). The ALoS to be achieved needs to be established by the State(s) concerned.

The ALoS consists of (values of) safety indicators and targets, and action plans to achieve the targets. Service providers also need to establish an ALoS that has to be agreed with by the State, and is as such part of the SSP. The ALoS is needed to have the ability to verify satisfactory performance of the SSP and the SMSs. The requirements of the safety indicators and targets used in the ALoS of a State and a service provider are similar, but the actual indicators and targets will differ, as will be discussed in Chapter 5.

Only the United Kingdom discusses the establishment of an ALoS in their SSP documentation. They do not establish one however, as of yet. Many countries do use safety indicators and targets already, that could be part of a future ALoS. These will be discussed below. It is also indicated if action plans are defined, but these are not detailed any further.

United Kingdom

The key safety target of the CAA is as follows:

Ensure that the frequency of fatal (and, in some cases reportable) accidents does not increase in line with the forecast growth in air traffic

In order to support this objective, the CAA has created a set of safety indicators, which it uses to monitor the frequency of fatal (and reportable) accidents. A reportable accident is an aircraft occurrence that has resulted in a person being fatally or seriously injured and/or the aircraft sustaining significant damage. The safety indicators are:

- UK-Registered/AOC fixed wing passenger aircraft above 5700kg MTWA[5)] fatal accident rate
- UK registered/AOC fixed wing freighter aircraft above 5700kg MTWA fatal accident rate
- UK-Registered/AOC fixed wing public transport aircraft below 5700kg MTWA fatal accident rate
- UK-registered/AOC public transport helicopters above 3175kg MTWA fatal accident rate.
- UK general aviation below 5700kg MTWA fatal accident rate
- UK registered/AOC fixed wing public transport aircraft above 5700kg MTWA reportable accident rate
- Fixed wing public transport aircraft above 5700KG MTWA in UK airspace fatal accident rate.

Figure 2 gives an example of the method used by the United Kingdom. The figure shows the fatal accident rate (3-year moving average) of UK-Registered/AOC fixed wing freighter aircraft above 5700KG MTWA. Using statistics a forecast and upper limit are determined to be able to determine if the goal of a reducing trend is achieved.

[5)] Maximum takeoff weight authorized

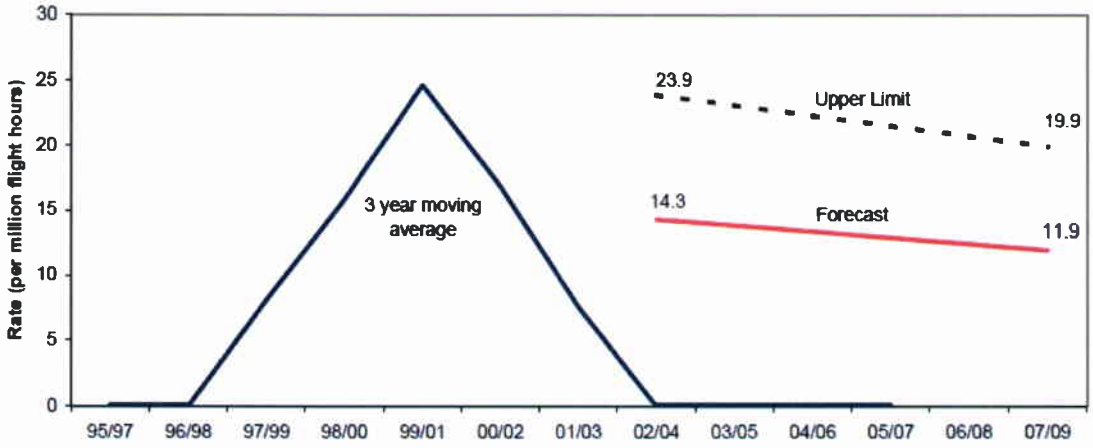


Fig 2: Fatal accident rate of UK-Registered/AOC fixed wing freighter aircraft above 5700KG MTWA.

These indicators used by the United Kingdom are lagging indicators. However, the United Kingdom states in their SSP that they recognize that there is a need towards leading indicators and targets (see section 2.5 for an explanation of lagging and leading indicators):

> *"In addition to examples of traditional safety performance indicators (for example the number of runway incursions per 100,000 movements) it will be necessary to develop safety performance indicators in relation to proactive and predictive safety management processes."*

This is again reflected in the CAAs most up-to-date safety plan for the years 2009-2011 [SRG SP, 2009]. The safety plan is published by the Safety Regulation Group. It is noted that in the safety plan there is greater emphasis on safety performance. The safety performance indicators mentioned in the safety plan are:

- High-risk[6] UK total occurrences
- High-risk UK public transport occurrences
- High-risk UK occurrences in controlled airspace
- High-risk UK non-public transport occurrences

[6] High-risk is described as follows in the safety plan: *"Using well-established risk assessment techniques, each occurrence is assessed and graded by CAA specialists. Those that are graded as 'A' or 'B' are considered to be high-risk occurrences. These can include accidents and serious incidents as well as other events where the risks was assessed to be significant.*

- High-risk UK runway incursions
- High-risk UK level busts
- High-risk UK airspace infringements
- High-risk UK public transport airprox occurrences

The high-risk occurrences in the above are accidents, serious incidents, and other significant occurrences. All these indicators are of the lagging type, since they measure events that have happened. However, some of the indicators are related to events that can be the precursor of serious incidents and accidents. A level bust for example can result in a mid-air collision. The indicator, although lagging, can therefore also be seen as predictive for the occurrence of a mid-air collision. The same can be said of the other indicators that are related to occurrences that can result in serious incidents and accidents. The indicators are not normalized. The need to normalize indicators is explained in the next chapter.

The CAA UK remarks in the safety plan that with the move towards greater use of safety performance to determine safety strategies, the CAA plans to develop a wider range of indicators. The CAA safety plans are frequently updated and contain action plans that are performed to achieve the targets set [SRG SP, 2008; SRG SP, 2009].

United States

In the FAA Flight Plan 2009-2013 [FFP, 2009] the United States formulate the following performance targets (it is noted that there is also a target set for commercial space operations, but that is considered out of scope for this report):

- Cut the rate of fatalities per 100 million persons on board in half by 2025
- Reduce the fatal accident rate per 100,000 flight hours by 10 percent over a 10-year period (2009-2018)
- By 2010, reduce Category A and B (most serious) runway incursions[7)] to a rate of no more than 0.45 per million operations, and maintain or improve through FY 2013.
- By the end of FY 2013, reduce total runway incursions by 10 percent from the FY 2008 baseline.
- Limit Category A and B (most serious) operational errors[8)] to a rate of no more than 1.95 per million activities by FY 2012 and maintain through FY 2013

[7)] Category A: Separation decreases to the point that participants take extreme action to narrowly avoid a collision. Category B: Separation decreases, and there is a significant potential for a collision. There are also Category C and D runway incursions which are less severe.

In the Portfolio of Goals [Portfolio, 2009] for the for the fiscal year 2009 the following targets are set:

- **The commercial air carrier fatality rate will not exceed 8.4 fatalities per 100 million people on board**
- **Limit the general aviation fatal accident rate to no more than 1.11 fatal accidents per 100,000 flight hours**
- **Reduce accidents in Alaska for general aviation and all part 135 operations to no more than 99**
- **Limit Category A and B (most serious) runway incursions to a rate of no more than 0.472 per million operations**
- **One percent reduction in total number of runway incursions from the FY 2008 baseline of 1009 runway incursions**
- **Limit Category A and B (most serious) operational errors to a rate of no more than 2.10 per million activities.**

The safety indicators are number of fatalities, fatal accidents, runway incursions, and operational errors (from an ANSP perspective). These are lagging indicators, although the last two can be predictive for more serious events, in this case collision on the ground and in mid-air. The targets contain quantitative requirements and time constraints for the goals to be achieved, and are therefore particularly specific.

The FAA Flight Plan contains action plans per objective in the form of strategies and initiatives.

Australia

In the "Strategic Direction 2008-09 to 2010-11" document [CASA, 2008] the following safety targets are set by CASA:

- **Reduce the trend in number of accident per hours flown, by industry sector**
- **Reduce the trend in number of incidents per hours flown, by industry sector**
- **Reduce the trend in number of fatal accidents involving uncontrolled flight into terrain**
- **Reduce the trend in number of runway incursions over three years**

8) Category A: A loss of airborne separation where the separation conformance percentage is less than 34. In events with wake turbulence where the lateral separation retained is less than 70 percent. Category B: A loss of airborne separation where the separation conformance percentage is 34 or more, but less than 75. In events with wake turbulence where the lateral separation retained is equal to or greater than 70 or more percent, but not including 85 percent. There is also a less severe Category C operational error.

The safety indicators used are number of accidents and incidents, and two specifically related to types of accidents, namely uncontrolled flight into terrain, and runway incursions. The indicators are of the lagging type, although again the indicator of incidents can be predictive for more serious events. The targets are not quantified. Since a trend reduction is continuous in time, no time constraints are given.

The document also contains quite a few action plans in the form of initiatives and projects with associated milestones.

France

The French Strategic Action Plan for the years 2009-2013 [SAP, 2009] contains objectives that involve the reduction of specific risks that are considered by France to have the greatest potential for improving safety. They are the result of issues identified by a risk management process and a panel of experts. The following targets where established:

- Reducing the number of unstabilized approached and limit the seriousness of any consequences of such an undesirable event
- Reducing the number of runway incursions and limiting the seriousness of any consequences of such an undesirable event
- Reducing the risks linked to aircraft loading errors and entering data into the FMS
- Improving assistance to crews making decisions in hazardous weather conditions
- Reducing risks linked to icing
- Limiting the risks linked to airport works

The indicators used are related to specific errors and incidents. The formulation is rather high-level, no quantitative values are given, nor time constraints. Interestingly, some of the targets also include the goal to limit the seriousness of the consequences, thereby also reducing risk. The reduction of the number of unstabilized approaches, although of the lagging type, is predictive. Unstabilized approaches can be the precursor of several accidents and incidents, e.g. landing overshoots and undershoots, veer-offs. The number of unstabilized approaches is therefore a predictive measure for such events. The same can be said for the reduction of risks linked to aircraft loading errors and entering data into the FMS.

Action plans are also formulated at a high-level in the Strategic Action Plan. Some targets actually read more like action plans, e.g. the fourth bullet can be interpreted as an action plan to help reduce incidents and accidents in hazardous weather conditions.

4.3 Conclusion

The scope and detail of the safety objectives vary per State. Furthermore, some focus on what has to be done, others on what has to be achieved. Since a certain action has to be done to achieve a positive outcome, it is favorable to at least state what has to be achieved, i.e. in its most general form an improvement of safety level. It is therefore recommended to formulate the high-level safety objective(s) as goals that have to be achieved.

The countries considered already make use of safety indicators and targets, and have specified action plans to improve safety. Not all countries are specific in the formulation of their targets. Quantitative values and time constraints are sometimes missing. Arguments why safety indicators and target should be specific are given in the next chapter.

All indicators used are related to the reduction of accidents, serious incidents, and other occurrences, i.e. lagging indicators. All countries do use indicators of occurrences that can be the precursor of more serious events, and are therefore predictive. No country uses leading indicators yet, which use comprehensive analysis of the organizations involved. These indicators are discussed in more detail in the next chapter. The United Kingdom does recognize the need of those indicators in their SSP.

For most countries the safety indicators and targets and associated action plans can be found in separate documents. The assessed countries also use different set-ups. The advantage of an ALoS will be that the safety targets and associated action plans will be available in one place, easily recognizable for internal and external actors.

5 SSP implementation in the Netherlands

5.1 Introduction

This chapter explores how the Netherlands can learn lessons from the approach taken by other countries in the development of an SSP in general, and the establishment of an ALoS, with associated safety indicators and targets, in particular. Previous studies on safety indicators will also be used in recommending an approach in establishing an ALoS.

It is important to note that according to ICAO *"the implementation of an SSP must be commensurate with the size and complexity of the State's aviation system, and may require coordination among multiple authorities responsible for individual elements of civil aviation functions in the State"* [SMM, 2009]. It is therefore possible that some of the State's approaches discussed above are not representative for the approach of the Netherlands.

5.2 State Safety Programme

From the SSPs from other countries discussed in chapter 3 it becomes clear that the United Kingdom is furthest with its implementation. Most of the elements and components of the ICAO SSP framework are already in place in the United Kingdom. In a similar fashion it is recommended to start to describe the Dutch aviation safety system, and identify how it fits into the ICAO framework of an SSP. This also allows to clearly identify which parts of an SSP are still missing, and need to be developed. This approach is described in the project plan of the development of a new policy agenda aviation safety in the Netherlands [Project plan, 2009].

In developing the Dutch SSP special attention should be given to unique aspects of the Dutch aviation system that could be safety critical, e.g.:

- Schiphol, which is a busy airport, with complex operations and a continuing pressure to reduce noise hindrance;
- Eurocontrol, who executes upper area control, for which the regulation and supervision is not entirely taken care of by the Dutch State; and
- The relatively small airspace with a large traffic density.

In line with France, Belgium, and the United Kingdom it is recommended to contribute to a strategic plan for improving air safety in Europe. To do so the appropriate European bodies need to be approached and joined. This action is also part of the policy agenda project plan [Project plan, 2009].

5.3 Acceptable Level of Safety

The Dutch Government has published the "Luchtvaartnota" in which it outlines its vision on Dutch aviation in the next 20 years [Luchtvaartnota, 2009]. The document defines 47 actions to achieve the objectives set. Action 41 of the "Luchtvaartnota" is the formulation of concrete and measurable safety targets for the most risky activities. This action is done for the benefit of the new "Beleidsagenda luchtvaartveiligheid" and the State Safety Programme. This action hence entails the first step in the establishment of an ALoS.

The service providers and the State both need to establish ALoSs as part of their SMSs and SSP. The ALoSs of these actors need to be established in close liaison to assure a proper coverage of safety critical areas. The requirements for safety indicators and targets in the remainder of this chapter are valid for both the State and the service providers, but the focus will be on the establishment of safety indicators and targets by the State.

As has been outlined in this report, ICAO expect a shift towards a more performance based environment, including the use of leading safety indicators. There will still be a need for lagging indicators however. Furthermore, there are some pitfalls in the use of leading indicators. In this section requirements valid for both types of indicators will be discussed first, followed by a discussion of lagging and leading indicators and targets.

5.3.1 General requirements

Action plan 41 indicates the need for concrete and measurable targets. It is indeed recommended to establish targets that are concrete and measurable. However, according to generally accepted quality assurance principles the targets also need to contain a time constraint, and they need to be acceptable, reliable, and relevant.

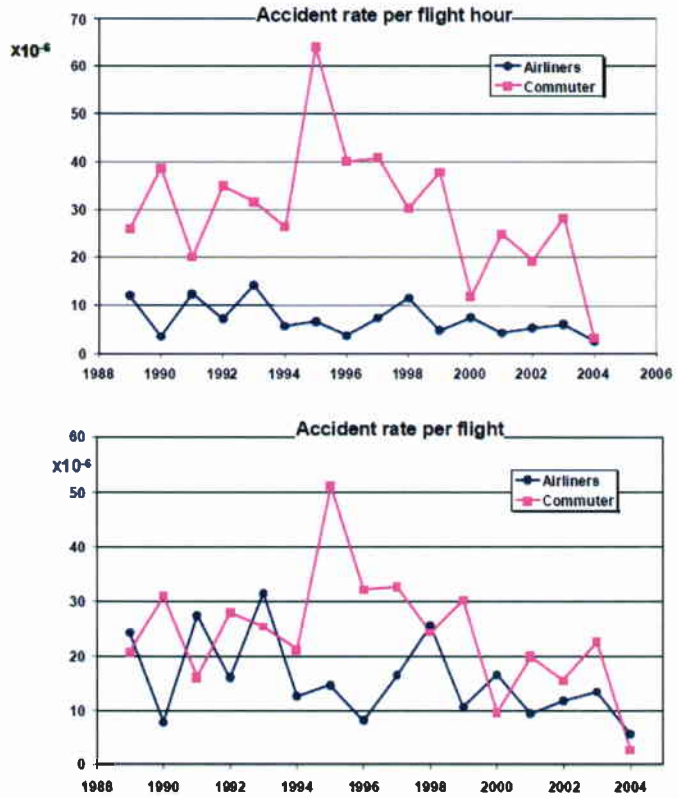
The time constraint is needed to assure accountability if a target is not met in time. The time period used should be long enough to increase the statistical certainty of the calculated trends. A good example of such a target is the US target to reduce the fatal accident rate per 100,000 flight hours by 10 percent over a 10-year period (2009-2018).

The safety target needs to be acceptable from the point of view of the State and service providers, but also for the general public. The latter can be seen in connection with ICAO's advice that when establishing an ALoS consideration must be given to the public expectations about the safety of the aviation industry [SMM, 2009]. For example, an accident with a foreign

operator in the Netherlands should be reflected in one of the performance indicators, even if nor the State nor one of the Dutch service providers is responsible for the accident. This notion is reflected by the UK safety indicators. Most are related to UK-registered aircraft, but fatal accident rate of fixed wing public transport aircraft in UK airspace is also included as indicator.

The safety indicator also needs to be reliable. The reliability depends on the source of data used for the indicator. A safety indicator is only as good as the quality of the source data on which it is based. A study performed by NLR concluded that it is expected that all accidents involving commercial air traffic are reported, but that this is not the case for air traffic incidents. This implies that indicators resulting from incidents are unlikely to provide a good measure for the changes in status of safety, if the occurrences are not properly reported [NLR, 2007a]. It is therefore recommended to continuously improve incident occurrence reporting.

Reliability also depends on the normalization method used. Occurrence data can be normalized using e.g. number of flights, hours flown, passenger enplanements, and passenger miles flown. The United States use number of flights in some of their indicators. The United States, United Kingdom, and Australia use the number of flight hours as normalization method. The United States also use the number of persons on board as normalization method. It is recommended to use an appropriate method to normalize data, e.g. in case the indicator is the risk of an accident it is preferred to use number of flights for normalizing data, because the risk of accidents for an aircraft is greatest during takeoff and landing. An example of the importance of using a proper normalizing method is given in the box below.



Example of the importance of proper normalization.

The above figure contains the accident rate of airliners and commuter airplanes of a State. The first plot is normalized using per flight hour, the second using per flight. The first plot actually prompted the State to take action to improve the safety of commuter flights, since the accident risk of these flights appear to be significantly higher than for airlines. However, for both categories the vast majority of accidents took place during takeoff, initial climb, approach, and landing flight phases. Therefore, the most meaningful denominator that can be used to normalize the accident data is the number of flights. The result is shown at the bottom of the figure, which shows that the accident rate per flight for airliners and commuters are now much closer [NLR, 2007b].

Another important aspect is that the target needs to be relevant. A relevant target implies that the service provider or State can implement the appropriate measures to achieve the targets. In other words, the service provider or State must be able to draw up an action plan, that it can perform, that has a direct influence on the safety indicator, and hence on the safety target. It is therefore important to realize what the influence is of the Netherlands on aviation

regulation, and what the direct influence is of both service providers and the State on the operation.

The influence of the Netherlands on aviation regulation is limited to some unique aspects of the Dutch aviation system. Other regulations are set by EASA and ICAO. One unique aspect of the Dutch aviation system is Amsterdam Airport Schiphol, because of its special nature. An example of regulations specific to the Netherlands is regarding third party risk in the surrounding of Schiphol. A good safety indicator could therefore be related to third party risk. Non-specific Dutch safety indicators can be integrated in a future European ALoS. It was already recommended in the previous section to participate in the development of a European safety system.

The safety targets need to be drafted such that the service provider or State has a direct influence on the indicator used. In establishing the targets it is therefore needed to realize what these influences are. A service provider can for example change its operation, and inform or train their personnel. A State has influence on the aviation sector by performing inspections and audits. Enforcement actions include warnings, fines, and sanctions, e.g. withdrawal of permits/certifications. These actions must be reflected in an appropriate indicator. An example of such an indicator could be related to the number of illegal sightseeing tours in Dutch airspace. An illegal sightseeing tour is performed by an operator without Air Operator's Certificate (AOC). An AOC is mandatory for such companies according to new European regulations. The State can formulate the safety target to decrease the number of illegal flights. It can do so by e.g. fining operators without AOC, or withdrawing pilot licenses of pilot's flying for operators without AOC. A reduction in illegal flights will improve the safety level, because the operators performing illegal flights do not comply to the stringent rules of an AOC.

The United Kingdom notes in their SSP document that the establishment of an ALoS should involve close liaison between the State and service providers so that both the SSP and service providers SMS have similar ALoS [CAP 784, 2009]. Although there is indeed a need for a close liaison between the State and service providers, that does not necessarily mean they will have similar ALoS. As is indicated in the previous paragraph the safety indicators in the respective ALoS need to reflect the parameters that can be influenced by either the State or the service providers. This influence is significantly different. An operator for example can actively try to reduce unstable approaches. A safety target such as the reduction of unstable approaches therefore seems to be in place in an operator's SMS. The State, however, has less direct influence on the occurrence of unstable approaches, and should focus on performance based

oversight. In such an environment leading safety indicators are more relevant. However, there will still be a need for lagging indicators, especially in ALoSs of service providers.

5.3.2 Lagging indicators

As can be read in Chapter 4 all countries studied make use of lagging indicators. They do make use of indicators that are predictive for more serious events. The use of such indicators is favourable because the most severe events are so rare that an indicator of those events is not practical. Therefore the use of causal factors instead of actual serious incidents or accidents as indicator is recommended. Such indicators are predictive, and safety targets to reduce the occurrence of such causal factors prevent accidents and (more serious) incidents from happening. Both service providers in their SMSs, and States in their SSPs can use such indicators. The focus should be on causal factors of important occurrence categories, e.g. CFIT[9], loss of control, runway excursions, runway incursions, and overruns. There are three important aspects to be considered when using causal factors:

- The causal factor should be objectively measurable;
- The data should be reliable; and
- The relative influence of the causal factor on the occurrence should be established.

In the box below an example can be found of using causal factors to determine the risk of a landing overrun for an operator. The risk index as described in the example can be used as a safety indicator in the operators' SMS.

In comparison with a service provider, e.g. an operator, a disadvantage of a State is that they have less detailed information regarding the causal factor. An operator can use flight data monitoring, a State has to use incident reports. They will therefore not be capable of using an analysis as presented in the example in the box below. The advantage of a State however, is that they have a more aggregated view. An overview of all TCAS RAs[10] that occurred in a State can be more significant than all TCAS RAs that a particular operator registers, because a TCAS RA is likely to involve aircraft from different operators.

In establishing lagging indicators for both service providers and the State it is therefore important to realize that a service provider can provide direct feedback from operational

[9] Controlled flight into terrain.
[10] Traffic Collision Avoidance System (TCAS) Resolution Advisory (RA).

observations to corrective actions, while States can assure that the system responds to slowly varying disturbances or trends [ECORYS, 2007]. Hence, it is recommended to formulate safety targets related to causal factors of high risk accidents and serious incidents by service providers, and for a more aggregated view also by the State. Other examples of causal factors that can be used as indicator by the State are: level busts, because it could be the causal factor of a mid-air collision that can involve aircraft from different operators, and runway incursions, because these can be caused by operators, ANSPs and airports and therefore an aggregate view of the State would be beneficial. Level busts are used as indicator by the CAA UK, runway incursions are used by the CAA UK, the FAA, Australia, and France.

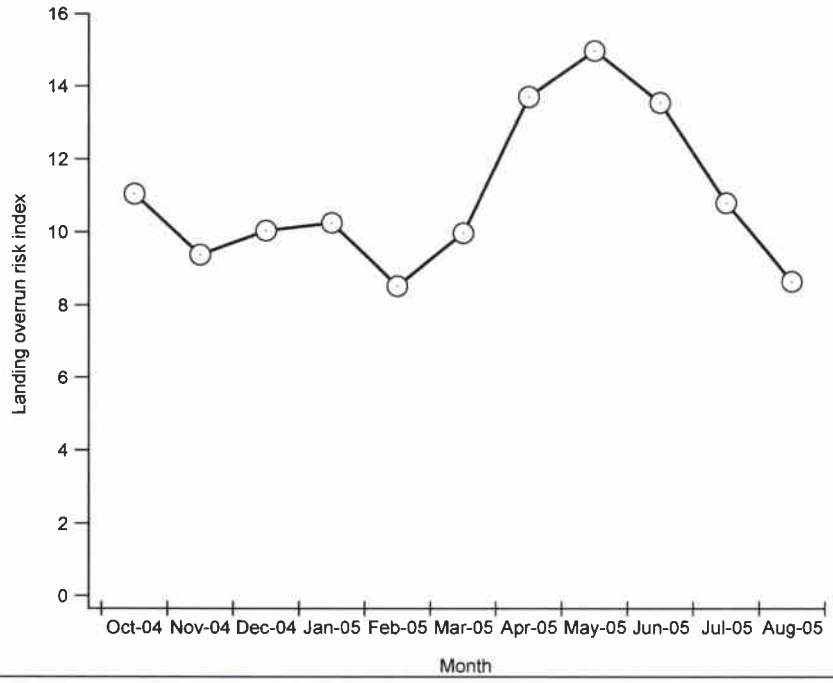
Landing overrun related risk factor	Risk Ratio
Non-precision approach*	5
Long landing	55
Excess approach speed	38
Visual approach*	5
Significant tailwind present	5
High on threshold	26
Wet/flooded runway	10
Snow/ice/slush covered runway	14

*Corrected for the correlation with other risk ratios.

Example of using causal factors: landing overrun.

The table above contains the risk factors of a landing overrun. A risk factor increases the risk of a landing overrun. The risk ratio provides insight on the association of a factor on the risk in a landing overrun accident. A risk ratio of 5 means that the probability of an accident with the risk factor present is 5 times higher than without its presence. Using the risk factors and ratios one can calculate a risk index of a particular landing. The index represents the relative risk an operator has compared to a reference condition (e.g. a risk index of one, when all risk factors are absent). In the figure below an example is given of the monthly trend in the average landing overrun risk index for a particular aircraft of an operator. The risk index appears to be higher than the average during the months April, May, and June of 2005. In this example case detailed analysis of the individual landings during these months showed that this is mainly caused by an increase in the number of landings with significant tailwind, and landings which are high on the threshold. Such findings could trigger an operator to formulate measures to

minimize these conditions [NLR, 2009].



A pitfall that has been mentioned before is that data regarding causal factors is harder to obtain, especially for the State. Furthermore, it is important to properly assess the correlation between the causal factor and the actual accident or incident. This correlation is needed to determine the appropriate safety target.

Although some indicators using causal factors will be more useful at a higher aggregate level, i.e. at State level, it is expected that indicators using causal factors are most in place in the ALoS of a service provider. The service provider is more able to have a direct influence on the mitigation of the causal factors than the State. Therefore, the SSP ALoS might want to focus on the supervision of the appropriate mechanisms within the SMSs of service providers. This can be done using leading indicators.

5.3.3 Leading indicators

The need in action 41 for formulation of safety targets for the most risky activities, implies a reactive approach. As has been indicated, one of the objectives of the SSP is a shift towards a more proactive and predictive environment. This implies a shift in the type of safety indicators used. An ALoS will therefore also need to contain leading indicators.

The Eurocontrol SAFREP task force is working on the development of leading indicators [SAFREP]. The task force works on a method to be able to objectively determine the maturity level of safety frameworks, such as SMSs of service providers. The determination of the maturity level is done by scoring several aspects of the organization. Appendix B contains a list of elements that are scored to assess the maturity level of an SMS. For every element it is determined to what extend the organization has implemented it. When scoring an element, a score between 1 and 5 is used. 1 being the lowest possible level of implementation, 5 the highest. Appendix B also contains more detailed information about the score. The overall score is determined by summing the scores of all elements, and is expressed as an percentage of the maximum attainable score. A high score indicates a high maturity level, which implies a high level of implementation of the different SMS elements in the organization.

The maturity level of an SMS can be used as a leading indicator in the ALoS of both service providers and States. In the ALoS of a service provider the level of maturity of the SMS of the service provider will be used. In the ALoS of a State the mean level of maturity of the SMSs of all service providers, or a group of service providers (e.g. operators, ANSPs, airports) can be used as indicator. Safety targets could then be defined in the form of a targeted increase in (mean) maturity level.

Another possibility is to use safety culture as a leading indicator. Safety culture is an important element of safe operations. There is many research on understanding, measuring, and improving safety culture. Safety culture assessment tools can be used to establish the level of safety culture at service providers and at a State level. Safety targets can be established with the goal of an improvement of safety culture.

In addition to this, it is stressed that the safety in aviation is a matter of multiple stakeholders. SAFMAC has identified a need for a joint goal setting in the safety validation of changes. Therefore, the ALoS might need to establish a framework in which the safety targets are not only addressed per SMS per service provider, but also in a multiple stakeholder setting. An example could be measuring the maturity of the cooperation of the main ANSPs, operators, and airports. A difficulty in this approach is that many operators flying in Dutch airspace are certified by other States.

It is recommended to define leading safety indicators. These indicators can make use maturity levels of SMSs or safety culture at service providers or State level, or the maturity of the cooperation between specific service providers. As is mentioned in section 2.5, Eurocontrol

assumes there is a relationship between lagging and leading indicators. Improved performance in a leading indicator will drive better performance in the lagging indicator. In the ideal case achieving the leading safety targets, will also result in the achievement of lagging safety targets. In other words, it is assumed that an improvement of for example SMS maturity will decrease the occurrence of accidents and serious incidents. This assumption is also an important pitfall, because it will be difficult to quantify the correlation between an improvement in maturity level and an improvement in safety level. It is therefore difficult to establish meaningful safety targets. One could establish a baseline, and thereafter use a certain increase in maturity level per year as target. That safety target does not give any quantitative assurance of an increase in safety, however.

5.3.4 Process of establishing an ALoS

The establishment of an ALoS needs to be a continuous process. This report has indicated what the qualities are of a proper safety indicator and target. It also gave some examples of indicators that can be used in the ALoS of a service provider and State. However, the actual safety indicators and targets need to be established after careful consideration of the safety critical areas that need to be monitored. The process of establishing an ALoS should consist of the following steps:

- Safety critical areas must be defined, on both the service provider's level and the State level. It should be determined what the interdependencies are, to establish what areas can be addressed in a joint effort of several service providers. Furthermore, it should be established what can be done in a European approach.
- After the safety critical areas are determined, it should be established which lagging indicators capture these areas at the level of the service providers. It should be established which lagging indicators can be used on the more aggregated level of the State. Finally, it should be determined which leading indicators can be used in support of the lagging indicators.
- If the safety indicators are established on a high-level the technicalities should be determined, e.g. which normalization method, and which reporting system to use.
- If the safety indicators are determined, the safety targets can be defined with a realistic time constraint. Some time will be needed to establish a proper baseline to base the target on. Action plans can be drawn up to be able to achieve the targets set.
- The last step is the practical implementation. The data needed for the indicators must be made available and if needed studied. A proper time period must be established to achieve the targets set. However, the targets should not be too rigid, if other areas turn out to be more critical, new indicators and targets should be established. It is thereby noted that

France intends to produce future versions of their action plan, incorporating changes due to identified problems arising from the implementation of regulations [SAP, 2009]. Also Belgium expects that their action plan will be arranged for a period of 5 years, but will be evaluated, adapted, and published every year [Belgium, 2009].

It is finally recommended to take a cautious approach in setting safety targets in an ALoS. This is reflected by the SAFREP task force [SAFREP]. The task force notes that if targets are set too early in the process, or if they are unduly correlated with other performance indicators, the whole process may be threatened. The United Kingdom also notes that to establish ALoSs for service providers in a systematic manner will require safety policies, safety metrics and monitoring methods to be agreed for the different aviation sectors. The United Kingdom assumes that it will not be an easy task because the ALoS will need to commensurate with the complexity of individual service providers specific operations and the resources available [CAP 784, 2009].

5.4 Conclusion

It is recommended to start to describe the Dutch aviation safety system, and identify how it fits into the ICAO framework of an SSP. This also allows to clearly identify which parts of an SSP are still missing, and need to be developed. The focus should be on important aspects of the Dutch aviation system, e.g. the complex operation at Schiphol, the interaction with Eurocontrol, and the small dense airspace. In line with France, Belgium, and the United Kingdom it is recommend to contribute to a strategic plan for improving air safety in Europe. To do so the appropriate European bodies need to be approached and joined.

It is recommended to establish targets that are concrete, measurable, acceptable, and relevant. Targets need to contain a time constraint. Targets should also be reliable. The reliability depends on the source and quality of data used for the indicator. It is therefore recommended to continuously improve incident occurrence reporting. It is also recommended to use a proper method to normalize data.

In establishing safety indicators and targets it is needed to determine the influence of service providers and the State. The influence of the Netherlands on aviation regulations is limited to some unique aspect of the aviation system. One such aspect is Schiphol. A good safety indicator could therefore be related to third party risk in the surrounding of Schiphol. A service provider has a direct influence on the operation, while a State has influence on the sector by performing inspections and audits, and by enforcement action. A State could therefore

formulate for example a target to decrease the number of illegal flights, by fining operators without AOC.

It is recommended to use causal factors instead of actual serious incidents and accidents as indicators in both the ALoS of service providers and the State. The focus should be on causal factors of important occurrence categories, e.g. CFIT, loss of control, runway incursions, runway excursions, and overruns. The data used for the indicators should be objectively measurable and reliable. The relative influence of the causal factor on the occurrence should be established. The needed data might be harder to obtain, especially for the State. Indicators using causal factors are therefore more appropriate for the use in ALoSs of service providers. The State can use these indicators when a more aggregate view is wanted, for example the number of TCAS RAs, level busts, and runway incursions. However, instead of using lagging indicators (i.e. measuring events) the SSP AloS might want to focus on the supervision of appropriate mechanisms within the SMSs of service providers, using leading indicators.

The objective of an SSP to shift towards an performance based environment implies a shift in the type of safety indicators used. It is therefore recommended to define leading safety indicators. These indicators can make use maturity levels of SMSs or safety culture at service providers or State level, or the maturity of the cooperation between specific service providers. It is assumed that improved performance in a leading indicator will drive better performance in the lagging indicator. This assumption is also an important pitfall, because it will be difficult to quantify the correlation between an improvement in maturity level and an improvement in safety level. It is therefore difficult to establish meaningful safety targets.

The establishment of an ALoS needs to be a continuous process. First the safety critical areas need to be defined, than it can be determined which lagging and leading indicators are to be used to cover these areas. A baseline needs to be established to base the safety targets on, and action plans need to be defined. After the implementation of the ALoS it needs to be monitored if new indicators and targets are needed to cover new or underexposed safety areas.

It is recommended to take a cautious approach in setting safety targets in an ALoS. In case targets are set too early in the process, or if they are unduly correlated with other performance indicators, the whole process may be threatened.

6 Conclusions and recommendations

6.1 Conclusions

New ICAO standards place a responsibility on ICAO Contracting States to have a State Safety Programme (SSP). The objectives of an SSP are:

- An SSP is a prerequisite for the implementation of a Safety Management System (SMS) by service providers.
- An SSP is to be established in order to achieve an Acceptable Level of Safety (ALoS).
- An SSP enables a shift towards a more performance based environment where regulations are used as safety risk controls.
- An SSP is needed to get ahead of safety risks through the development of safety management capabilities within the State, rather than waiting for accidents, incidents or events of non-compliance.
- An SSP enables a State to adapt to changes and continuously improve safety in the air transport system.

The most mature implementation of an SSP is that of the CAA UK. The United Kingdom has not, at this time, agreed on acceptable levels of safety applicable to service providers. The United Kingdom is adopting a phased approach to SMS implementation and will establish ALoSs in conjunction with the service providers over the next 3 years as they implement their SMSs.

The approach of the United States has been somewhat different. Instead of SSP they chose to use the term (internal) SMS. Several organizations within the FAA will develop an internal SMS. The combination of those SMSs form the US SSP.

Australia is in the process of developing an SSP. It is intended that a first version will be completed and publicly available in November 2009. The approach is similar to that taken by the United Kingdom.

France has developed, as part of the SSP, a strategic action plan for improving safety in 2009 - 2013. One of the objectives of the action plan is the actual development of a complete SSP.

Belgium has made a document describing the development of their SSP. The focus is on the organization of the Directorate-General, the responsibilities of several actors, and the internal

and external communication and dissemination of safety information. Many effort will be put in the development of a strategic action plan, which will cover safety assurance and promotion.

Some aspects of the SSP are already covered by European regulations. The United Kingdom, France, and Belgium all consider the Safety Assessment of Foreign Aircraft programme (SAFA) as part of an SSP. Belgium, France, and the United Kingdom suggest European cooperation to come to an European Safety Programme.

The countries studied make use of safety indicators and targets, and have specified action plans to improve safety. These can become part of a future acceptable level of safety (ALoS). Not all countries are specific in the formulation of their targets. Quantitative values and time constraints are sometimes missing. All indicators used are related to the reduction of accidents, serious incidents, and other occurrences, i.e. lagging indicators. All countries do use indicators of occurrences that can be the precursor of more serious events, and are therefore predictive. No country uses leading indicators yet, which use comprehensive analysis of the organizations involved. The United Kingdom does recognize the need of those indicators in their SSP.

The establishment of an ALoS needs to be a continuous process. First the safety critical areas need to be defined, than it can be determined which lagging and leading indicators are to be used to cover these areas. A baseline needs to be established to base the safety targets on, and action plans need to be defined. After the implementation of the ALoS it needs to be monitored if new indicators and targets are needed to cover new or underexposed safety areas.

6.2 Recommendations

6.2.1 State Safety Programme

- It is recommended to start to describe the Dutch aviation safety system, and identify how it fits into the ICAO framework of an SSP. This also allows to clearly identify which parts of an SSP are still missing, and need to be developed. The focus should be on important aspects of the Dutch aviation system, e.g. the complex operation at Schiphol, the interaction with Eurocontrol, and the small dense airspace.

- In line with France, Belgium, and the United Kingdom it is recommended to contribute to a strategic plan for improving air safety in Europe. To do so the appropriate European bodies need to be approached and joined.
- It is recommended to formulate the high-level safety objectives which are part of the first component of the SSP framework (State safety policy and objectives) as goals that have to be achieved, instead of actions that have to be done.

6.2.2 Acceptable Level of Safety

- It is recommended that the ALoS contain concrete and measurable safety targets. This is reflected in action plan 41 of the "Luchtvaartnota".
- Safety targets need to contain a time constraint. The time constraint is needed to assure accountability if a target is not met. The time period used should be long enough to increase the statistical certainty of the calculated trends.
- A safety target needs to be acceptable for the State and service providers, and general public. For example, an accident with a foreign operator in the Netherlands should be reflected in one of the performance indicators, even if nor the State nor one of the Dutch service providers is responsible for the accident.
- Safety indicators need to be reliable. The reliability depends on the source of data used for the indicator. A safety indicator is only as good as the quality of the source data on which it is based. It is therefore recommended to continuously improve incident occurrence reporting.
- The safety indicators and targets need to be normalized using an appropriate normalization method.
- Safety indicators need to be relevant. The indicators need to reflect the parameters that can be influenced by either the State or the service providers. It is therefore important to assess the influence service providers and the State have on the aviation system. The influence of the Netherlands on aviation regulations is limited to some unique aspect of the aviation system. One such aspect is Schiphol. A good safety indicator could therefore be related to third party risk in the surrounding of Schiphol. A service provider has a direct influence on the operation, while a State has influence on the sector by performing inspections, and audits, and by enforcement action. A State could therefore formulate for example a target to decrease the number of illegal flights, by fining operators without AOC.
- It is recommended to formulate safety targets related to causal factors of high risk accidents and serious incidents. Such indicators are predictive, and targets to reduce the occurrence of such causal factors prevent accidents and incidents from happening. The focus should be on causal factors of important occurrence categories, e.g. CFIT, loss of control, runway incursions, runway excursions, and overruns. The data used for the

indicators should be objectively measurable and reliable. The relative influence of the causal factor on the occurrence should be established. The needed data might be hard to obtain, especially for the State. Indicators using causal factors are therefore more appropriate for the use in ALoSs of service providers. The State can use these indicators when a more aggregate view is wanted, for example the number of TCAS RAs, level busts, and runway incursions. However, instead of using lagging indicators (i.e. measuring events) the SSP AloS might want to focus on the supervision of appropriate mechanism within the SMSs of service providers, using leading indicators.

- It is recommended to define leading safety indicators. These indicators can make use maturity levels of SMSs or safety culture at service providers or State level, or the maturity of the cooperation between specific service providers. It is assumed that improved performance in a leading indicator will drive better performance in the lagging indicator. This assumption is also an important pitfall, because it will be difficult to quantify the correlation between an improvement in maturity level and an improvement in safety level. It therefore might prove difficult to establish meaningful safety targets.
- It is recommended to take a cautious approach in setting safety targets in an ALoS. If targets are set too early in the process, or if they are unduly correlated with other performance indicators, the whole process may be threatened.

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Appendix A SSP Deliverables and Milestones

An SSP consist of four components:

1. State safety policy and objectives;
2. State safety risk management;
3. State safety assurance; and
4. State safety promotion.

	Deliverables	Milestones
1	• State safety legislative framework promulgated. • State safety responsibilities and accountabilities established, documented and published. • State safety and enforcement policies signed by the Accountable Executive. • State safety and enforcement policies distributed within the aviation organizations of the State and among • service providers under oversight. • Independent accident and incident investigation process in place. • SSP organizational structure in place.	• Accountable Executive identified. • Proposed safety policy drafted. • Lines of safety responsibility and accountability established. • Proposed SSP organizational structure approved. • Budget for SSP processes approved.
2	• SMS regulations promulgated. • Guidance material on implementation of SMS distributed to service providers. • First annual review of the agreed safety performance of service providers completed.	• Draft proposal of SMS regulations distributed to service providers for review. • Draft proposal of SMS guidance material distributed to service providers for review. • Training of State technical personnel in hazard identification and safety risk management completed. • Procedure for agreement on the safety performance of service providers completed.

	Deliverables	Milestones
3	• State mandatory and confidential hazard reporting system in place. • First annual review of the safety policy and objectives conducted. • First annual review of the enforcement policy conducted. • ALoS established.	• Data storage and processing of hazards and safety risks at the State level. • Information on hazards and safety risks at both the aggregate State level and the individual service provider's level collected.
4	• First cycle of generic safety training for staff completed. • Training programme on key components of an SSP and an SMS for technical and support staff completed. • Guidance material on SMS distributed to service providers, including small operators. • First cycle of training for service providers on implementation of SMS completed. • Means to communicate safety-related information, internally and externally, established.	• Minimum knowledge and experience requirements for technical personnel performing safety oversight • functions established. • Guidance material on SMS developed and published. • Training programmes on SMS for State aviation organizations and service providers developed. • State newsletter and bulletins developed.

Appendix B SMS Maturity Level

The Eurocontrol Safety Maturity Framework Measurement scores the following components and elements [SAFREP]:

Component	Element
1. Safety Management Plan	1.1 Safety Policy
	1.2 Non-punitive Safety Reporting Policy
	1.3 Roles, Responsibilities and Employee Involvement
	1.4 Communication
	1.5 Safety Planning, Objectives and Goals
	1.6 Performance Measurement
	1.7 Management Review
2. Documentation	2.1 Identification and Maintenance of Applicable Regulations
	2.2 SMS Documentation
	2.3 Records Management
3. Safety Oversight	3.1 Reactive Processes
	3.2 Proactive Processes
	3.3 Investigation and Analyses
	3.4 Risk Management
4. Training	4.1 Training, Awareness and Competence
5. Quality Assurance	5.1 Operational Quality Assurance
6. Emergency Preparedness	6.1 Emergency preparedness and response

When building the scoring, the following bottom-up approach is followed [SAFREP]:

- A score of (1) shows that the system is considered to be not documented and not implemented.
- A score of (2) is indicates partially implementation but not effective. In other words, the organization does not have all of the criteria required for an award level of (3).
- A score of (3) is considered when the organization has met the minimum acceptable standard of assessment. As such, to be considered as having an acceptable level, all required elements have to be rated as per the criteria at an award level of (3). The score of (3) in all criteria reflects only the minimum requirements for compliance to ESARRs. Any additional requirements and Best Practices (BP) in the guideline protocol represent bonus

points in addition to the (3) award level (i.e. the respective ANSP is expected to pass the certification process of his regulator).

- A score of (4) is an indication of exceeding the minimum acceptable standard of assessment. To receive this award level, the element is considered to meet all of (3) plus some aspects of (5).
- A score of (5) is considered to meet all of the criteria for an award level of (4) plus all of the additional requirements listed under the criteria for that element. To achieve an award level of (5), an organization would have to meet the regulatory requirements as well as demonstrate industry best practices at a very high level.

Appendix C Abbreviations

ALoS	Acceptable Level of Safety
AOC	Air Operator's Certificate
DEGAS	Dutch Expert Group Aviation Safety
EASA	European Aviation Safety Agency
ICAO	International Civil Aviation Organization
SAFA	Safety Assessment of Foreign Aircraft
SMS	Safety Management System
SSP	State Safety Programme
TCAS	Traffic Collision Avoidance System