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1 Executive summary

This report summarises the work done by the EASA RP3 Safety (Key) Performance Indicators development WG, laying down a proposal for S(K)PIs to be included in the 3rd Reference Period (2020-2024) of the performance scheme for air navigation services and network functions in civil aviation.

EASA launched this working group for the development of S(K)PI for RP3 in January of 2016. The group formally reported to the European Commission and closely coordinated with the Performance Review Body (PRB) in developing the proposal. The group met seven times in the year, meeting lastly on 13 October 2016.

The proposal contains three distinct elements:

- The adoption of a common SPI framework between the Performance Scheme and the EASA Safety Risk Management (SRM) process, which will allow for a clear link between the monitoring of safety areas in the Performance Scheme on the one hand and the European Plan for Aviation Safety (EPAS) & Air Traffic Management (ATM) Risk Portfolio on the other. This contains the proposal of including in the Performance Scheme Regulation a limited set of S(K)PIs while others are nested outside of the Performance Scheme in the EASA SRM process that monitors EPAS via an associated ATM Collaborative Analysis Group (CAG). It can then be argued that the full set of SPIs will capture the effects of both sets of actions, i.e., actions included in the EPAS and the effects of actions in other Key Performance Areas (KPA)s due to the implementation of the Performance Scheme. It is reasonable to expect that a single and compatible framework of indicators monitors the safety performance of the ANS system be used, with opportunities to leverage synergies and to avoid inconsistencies and incompatibilities and to avoid duplication of effort. This approach will allow for the Safety KPA and risk management of the system to be more flexible, dynamic, applicable and up-to-date. Further indicators can also be adopted by the Scheme via this mechanism and allow the Performance Scheme to benefit from the introduction of up-to-date indicators, without the need to amend the regulation. Therefore, EASA’s recommendation is to ensure that there is no duplication of activity and to allow the Performance Scheme to inherit the work conducted in producing the EPAS and Safety Risk Portfolios. The safety analysis would be done by EASA, amalgamating both sets of indicators and including the analysis in each monitoring report each year. It is understood however that no changes to the indicators that have been set within the Performance Scheme (Regulation) can occur during the reporting period.

- The proposal of a set of SPIs, after reviewing the current SPIs for RP2 and the experience during the first year of RP2, contains a combination of lagging indicators (outcome-based) and leading indicators (process-based) as the most appropriate approach to monitor safety performance. Among the lagging indicators, the areas to monitor are runway incursions (RIs), separation minima infringements (SMIs), and over deliveries as result of flow management. EASA and the group recommends that targeting lagging indicators be
avoided at the organisational or State level due to possible negative effects and consequences that such an action will have on levels of reporting. With regard to leading indicators, only an indicator to address the effectiveness of safety management is retaining proposed for retention in the Scheme, discontinuing or moving other indicators to the EASA SRM. The final proposal of S(K)PIs are summarised in the table below.

- It is proposed that the work be further elaborated in two work streams to address interdependencies between safety and other performance areas; exploration of a model to account for these interdependencies (i.e., Rasmussen’s n’s gradient approach to the interaction of competing forces in and on an organisation) and the measurement of safety energy. Both of these streams require more work in the form of a feasibility study prior to being incorporated into RP3 of the Performance Scheme. It is recognised that work on interdependencies may not be sufficiently robust until RP4 but the work must be commenced now with an eye to the future. The measures derived are suggested for collection and observation only while the calibration of a model is developed. These novel directions need to be attempted in order to begin real work in the area and the burden of reporting must be considered before moving forward with it.

- Following is a summary table of recommendations stemming from the work and discussions of the working group that reflects majority consensus. Each indicator is provided together with the suggested metric and the legal “nesting” or mechanism by which this work might be achieved. Remarks are also provided on the advisability of targeting and whether a further feasibility study should be carried out.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Metric</th>
<th>Where to place the PI</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents/Serious incidents</td>
<td>Rate of accidents/serious incidents with ATM contribution at EU level</td>
<td>EASA SRM process supporting the EPAS</td>
<td>Targeting is not advised</td>
</tr>
<tr>
<td>Runway Incursions</td>
<td>RIa: rate of RI with ATM contribution at airport level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised PI limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>RIb: rate of RI at State level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised PI limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>Rlc: rate of RI at EU level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised Limited to high severe incidents</td>
</tr>
<tr>
<td>Separation Infringements</td>
<td>SMIa: rate of SMI with ATM contribution at ANSP level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised Limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>SMIb: rate of SMI at State level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised Limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>SMIc: rate of SMI at EU level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised Limited to high severe incidents</td>
</tr>
<tr>
<td>Over deliveries</td>
<td>OvD: % of hours with aircraft rate &gt; 110% slot rate at regulated sectors</td>
<td>Performance Scheme Reg</td>
<td>Targeting is <strong>not</strong> advised</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Effectiveness of Safety Management – ANSP (Maturity)</strong></td>
<td><strong>Option 1:</strong> SoE V2.1</td>
<td>Performance Scheme Reg</td>
<td>Targeting possible. Authorities need to be involved in verification.</td>
</tr>
<tr>
<td></td>
<td><strong>Option 2:</strong> Cross domain tool</td>
<td>Performance Scheme Reg</td>
<td>Targeting possible. Duplication of activities to assess SMS. Work on further developing the tool would need to be done.</td>
</tr>
<tr>
<td></td>
<td><strong>Option 3:</strong> Cross domain tool</td>
<td>ATM/ANS Common Requirements</td>
<td>Targeting possible</td>
</tr>
<tr>
<td><strong>Effectiveness of Safety Management – NSA (Maturity)</strong></td>
<td><strong>Option 1:</strong> Discontinue the metric</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Option 2:</strong> EASA CMA (Continuous Monitoring Approach) model</td>
<td>EASA SRM process supporting the EPAS</td>
<td>Feasibility study: amend model and indicator development</td>
</tr>
<tr>
<td><strong>Rasmussen’s Gradient model</strong></td>
<td>Interdependency metrics</td>
<td>TBD</td>
<td>Feasibility study: operationalise and calibrate model, monitor metrics</td>
</tr>
<tr>
<td><strong>Safety Energy</strong></td>
<td>Interdependency metrics</td>
<td>TBD</td>
<td>Feasibility study: operationalise and calibrate model, monitor metrics. It might possibly be combined with Rasmussen’s Gradient model</td>
</tr>
</tbody>
</table>
2 Preamble

The report seeks to outline the agreed proposals for indicators put forward by the RP3 S(K)PI Working Group in order to assess safety performance during Reference Period 3 of the Performance Scheme for Air Navigation Services and Network Function. Indicators are provided to assess the safety performance of Air Navigation Service Providers (ANSP), Competent Authorities (CA) in each EASA Member State (EASA MS) and the Network Manager (NM) with reference to the ATM Performance Scheme. Wherever possible, the group has taken into account the need to reduce the burden of reporting on Member States and ANSPs. It is also expected that RP3 will make use of the European Central Repository (ECR), which shall be the primary data source for occurrence information.

RP3 is scheduled to begin on 1 January 2020 and, notwithstanding any amendments to the regulations, will run until 31st December 2024. In order to accommodate the processes of consulting with Stakeholders, preparing and publishing regulatory material, agreeing targets at FAB/national and service provider level, and preparation of national performance plans, the key safety performance indicators for RP3 were prepared through this said RP3 S(K)PI Working Group.

2.1 Legal framework

This report takes into account, as appropriate, the existing legal framework.


  In particular, but not limited to:

  (19) The performance of the air navigation services system as a whole at European level should be assessed on a regular basis, with due regard to the maintenance of a high level of safety, to check the effectiveness of the measures adopted and to propose further measures.


- Commission Implementing Decision setting the Union-wide performance targets for the air traffic management network and alert thresholds for the second reference period 2015-19 (2014/1312/EU).

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1 Commission Implementing Regulation (EU) No. 390/2013, Article 8: "The first reference period for the performance scheme shall cover the calendar years 2012 to 2014 inclusive. The second reference period shall cover the calendar years 2015 to 2019 inclusive. Subsequent reference periods shall be of five calendar years, unless otherwise provided through the amendment of this Regulation."
The report also recognises the need to amend particular parts of 390/2013 in order to address the coming challenges posed during the 3rd Reference Period 2020-2024 (RP3).

When amending the Regulation, the Commission is asked to consider the new draft EASA Basic Regulation\(^2\) to ensure a coherent approach to the management of aviation safety.

### 2.2 Targets and the management of safety risk with an SPI framework

The suggested indicators have been constructed so that any one of them may be targeted. However, targets have not been discussed nor proposed as target setting does not fall within the remit of this group. It has, however, been unanimously agreed and proposed by the group, that targets, if any, should only be placed on leading indicators. The Agency is not in favour of targeting lagging indicators at organisation or State level due to possible negative effects that such an action will have on levels of reporting (damage to reporting, safety culture, just culture running counter to the principles of Reg. 376/2014 and the improvement of the ECR data). This approach is largely supported by the RP1 Ex-Post Evaluation Study where two-thirds of the respondents are said to be opposed to targeting lagging indicators.

The management of safety risk to ATM operations should be done via the EASA SRM process in the form of an ATM safety risk portfolio that is used to identify safety issues and mitigating actions to be considered for inclusion in the EPAS. This general approach is that which EASA uses across the aviation system and it ensures a coherent and joined-up approach to aviation safety with one safety management approach being applied within EASA MS.

Further, this approach does not preclude the targeting of leading indicators and is compatible with improving safety though the identification and mitigation of safety risks within the system. It is agreed that targeting leading indicators will not adversely affect the system. EASA requests the Commission and the PRB to further consider the text of Commission’s Final Proposal for a new EASA Basic Regulation in amending Reg. (EU) 390/2013. In particular, consideration should be given to, inter alia, Articles 5 and 6, which deal with the European Aviation Safety Programme (EASP) and the EPAS.

Article 6 is worthy of particular note as it obliges EASA to develop the EPAS supported by SRPs and therefore this activity should not be duplicated by other means:

**European Plan for Aviation Safety**

1. The Agency shall develop, adopt, publish, and subsequently update at least on a yearly basis a European Plan for Aviation Safety. Based on the assessment of relevant safety information, the European Plan for Aviation Safety shall identify the main safety risks affecting the European aviation safety system and set out the necessary actions to mitigate those risks.

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2. The Agency shall document in a dedicated safety risk portfolio the safety risks referred to in paragraph 1 and monitor the implementation of related mitigation actions by the parties concerned, including, where appropriate, by setting safety performance indicators.

3. The European Plan for Aviation Safety shall specify, taking into account the objectives set out in Article 1, an acceptable level of safety performance in the Union, which the Member States, the Commission and the Agency shall jointly aim at achieving.

It is appropriate for Safety to remain a part of the ATM Performance Scheme and it will continue to serve two roles.

1. Safety as a Key Performance Area (KPA) to monitor, and

2. Safety as a control mechanism that challenges the other KPAs: Cost Efficiency, Capacity and Environment.

With reference to Article 6 (2) the Agency has already begun the process of preparing domain specific safety risk portfolios, some of which have been published during 2015 and 2016 as elements of the EASA Annual Safety Review. The Agency prepares draft risk portfolios that are then adjusted with the assistance of domain specific CAGs and the Network of Analysts (NoA) before being provided to the various Advisory Bodies as part of the EPAS planning cycle. The completed portfolios provide a list of Key Risk Areas (Outcomes) and grouped safety issues that are then used to inform the process that drives the EPAS.

It is also worth noting that Article 7 (National Aviation Safety Programme) and Article 8 (National Plan for Aviation Safety) of the new Basic Regulation complement EASA responsibilities, but at the Member State level.

The framework as explained above relies on a data-driven analysis that will identify the risks followed by an examination of that analysis by an ATM CAG. The resulting output is further considered before being used to inform the EPAS process. This approach will provide a substantial and flexible way to identify, mitigate and monitor risks in the aviation system in Europe.

EASA encourages both the Commission and the PRB to consider that duplicating these activities, i.e. identify, mitigate and monitor risks of the ANS system, may create levels of incoherence between the Performance Scheme and the EASA system and may logically increase the reporting and verification burden on all participants. It is therefore suggested that the EASA mechanism (EPAS derived from the ATM safety risk portfolio and supported by the EASA SRM process) be used by the Performance Scheme, with both risk management and acceptable levels of safety performance set by the EASA system. This ensures a coherent system approach to risk management. This would not prevent the PRB from monitoring the output and making comments. In addition, the EPAS, due to the lighter validation process when compared with the time required for a regulatory file, is better suited to the dynamic nature of safety. It is logical to argue that the EPAS will be more up-to-date and can potentially better address the actual safety problems likely to be faced by the Performance Scheme.
The EPAS is discussed further in Chapter 3 of this report.

2.3 RP1 and RP2

During RP1 and RP2 valuable work has been done in improving safety maturity (EoSM) and improving Just Culture and the application of RAT severity classification at both the ANSP and CA levels. This is evidenced by the improvements by the improvements that have been noted during RP1 and the first year of RP2. It must be noted that only EoSM and the application of RAT severity classification has been targeted in RP2. No targets were set for RP1 and Just Culture remains untargeted in RP2. It is appropriate to acknowledge that work, and to ensure that leading indicators remain part of the Performance system. Further, this area of safety activity is not formally tasked by other regulatory means. Leading indicators within the ATM system are best characterised by organisational processes that in themselves promote a safer system. They are preventative or proactive as opposed to reactive.

The EoSM indicator in its present form has not substantially evolved since the beginning of RP1. The indicator needs to be significantly changed to ensure that it is operating correctly as a leading indicator, which is aimed at improving safety performance in RP3 and potentially in further reference periods. This reformation will take into account the gains that have been achieved in RP1, RP2 and consolidate them. At the same time, work that has been done by different groups by both the ANSP and needs CA levels need to be taken into account. This work will improve the levels of harmonisation of the indicator. Safety performance as a leading indicator must look into the processes that exist within organisations and authorities that allow safety to grow beyond the minimum levels of compliance. This is an appropriate component of the performance scheme as it ensures that the system becomes proactive instead of reactive.

A closer examination of existing RP2 safety indicators can be found later in Appendix C of this report.

2.4 PRB White Paper

The working group has reviewed and taken into account the views expressed in the PRB white paper. Of the three identified risks, RIs, SMI s and Cyber Security, the group has addressed RIs and SMI s as indicators and made recommendations. Cyber Security was not addressed owing to a lack of specific expertise within the group.

Interdependencies have proved difficult for the system to address during both RP1 and RP2. The group has made progress in this area in the form of a table of suggested indicators with interdependent character. Further, the indicators have been assessed in terms of their impact on safety, the primary KPA driver behind the individual indicator and the level of interdependency. As alternative and complimentary approach, a simple Safety Energy indicator has been proposed by the group.
3 The Safety Performance Indicators Framework

3.1 Introduction

This section outlines an SPI framework for RP3 with some examples, which demonstrates the compatibility between the Single European Sky (SES) Performance Scheme and the EASA risk management process.

The SES Performance Scheme is one of the key means of achieving the SES objectives of enhancing ATM system performance standards, while contributing to sustainable development of the air transport system, single aviation market and improving the overall performance of ATM and ANS, with a view to meeting the requirements of all airspace users. However, the main instrument to manage and improve the safety of the aviation system in Europe, including ATM/ANS, is the EPAS. The EPAS is managed by EASA via the SRM process, which aims to establish a clear framework for the various safety activities that support the Plan. The Plan is the document that collates all the strategic safety actions, taking input from the analysis of data on accidents and incidents carried out within the SRM process, primarily via the ATM SRP defined by the ATM CAG. The analysis considers not only the direct accident outcomes but also the underlying factors or hidden causes behind safety occurrences. Moreover, the Plan takes a longer term view into the future and covers the 5-year period with the latest iteration being 2016-2020, and it is updated annually.

Therefore, the actions listed in the EPAS will have an effect on the safety performance of the European ATM system and, consequently, the SPIs for RP3 would certainly capture the effect of the EPAS actions. Similarly, the ATM Performance Scheme is a scheme to monitor the performance of the air navigation services and the network functions, and one of the objectives of the RP3 Safety KPA is to serve as a control mechanism for detecting adverse safety effects of actions taken by stakeholders in other KPAs. This control is effected through and evaluation of interdependent factors. It is, therefore, expected that the SPIs will capture effects of both sets of actions, i.e., actions included in the EPAS and effects of actions in other KPAs due to the implementation of the Performance Scheme, and it is reasonable to expect that a single and compatible framework of indicators monitors the safety performance of the system. By sharing the same SPI framework and definitions between the SRM and the Performance Scheme, opportunities to leverage synergies are created and inconsistencies and incompatibilities are avoided.

This section is divided into two parts. The first one gives an overview of the EPAS, SRM and the safety risk portfolios to explain how they are linked to the ATM Performance Scheme. The second one describes the SPI Framework, definitions and examples of indicators.

3.2 EPAS, Safety Risk Management Process and Safety Risk Portfolios

The EPAS is managed via the SRM process, which aims to establish a clear framework for the various safety activities that support the Plan. At the heart of the SRM process are a number of domain-specific Safety Risk Portfolios that articulate the Key Risk Areas (Outcomes) and associated Safety Issues. Consequently, a dedicated ATM Safety Risk Portfolio is currently being developed and will be monitored through a set of indicators. The Safety KPA should share elements with the formal
Performance Monitoring function within the SRM process, acting as part of this performance monitoring function.

An overview of the SRM process is provided below:

The 5 steps of the Safety Risk Management Cycle include:

1. The identification of Safety Issues that affect the European aviation system;
2. The assessment of Safety Issues, which aims at assessing the risks associated with the consequences of the Safety Issues identified in the previous phase;
3. The definition and programming of safety actions seeking to identify strategies (or mitigation actions) to address those issues whose level of risk cannot be tolerated after the assessment;
4. The implementation and follow-up of safety actions aimed at tracking the status of and report on the agreed strategies; and
5. Safety Performance aimed at reviewing identified risk areas to assess if the risks previously identified have been mitigated and compare them with safety performance indicators.

Resulting actions on the Safety Issues that are identified in the SRM process will translate into: rulemaking activities, focused oversight, research activities, safety promotion and potentially also in actions for Member States.

3.3 The SPI Framework as overarching link between the SRM Process and RP3
The SPI framework that supports the Performance Monitoring part of the SRM Process has evolved from work performed in both the Safety Management International Collaboration Group (SMICG) and the Network of Analysts (NoA). Both groups have adopted a conceptual approach to define SPIs based on tiers. The same conceptual approach was presented at the ICAO High Level Safety Conference in March/April 2010, where a framework of SPIs to monitor safety of the aviation system was described as belonging to three different “tiers”.

The 3 Tiers of SPIs monitor different aspects of the aviation safety system. The first tier monitors accidents and serious incidents that have already happened, the 2nd tier monitors also lagging indicators based on historical occurrence data, typically lower-severity incidents that are precursors and are indicative of the likelihood of accidents; and the 3rd tier consists of leading system indicators that help to monitor a number of system-based activities that underpin various aspects of safety. The 3 Tiers are broadly defined as follows:

- **Tier 1 SPIs**: Tier 1 SPIs are lagging indicators that monitor the overall safety of the ATM system, specifically in relation to the number of accidents\(^3\)/serious incidents\(^4\) and fatalities/injuries. The Tier 1 SPIs enable comparison of Safety Performance across different domains, not only ATM-related, to help prioritise resources in the aviation system. Examples of indicators in this Tier are
  - Accidents and Serious Incidents. Number of accidents and serious incidents (as per Regulation (EU) 996/2010) related to ATM grouped by severity or risk classes.
  - Fatalities and Injuries. The number of fatalities, serious injuries and minor injuries.
  - Damage Levels. The number of occurrences involving aircraft being destroyed, or suffering major or minor damage with some form of ATM contribution.

- **Tier 2 and Tier 2+ SPIs**: At the Tier 2 level, two subsets of lagging indicators are monitored. These two types of lagging indicators are designed to monitor the Safety Risk Portfolios, and have reference to the ECCAIRS taxonomy. The Tier 2 indicators monitor the Key Risk Areas (Outcomes) including both the number of occurrences and risk levels assigned to the different outcomes. The classification of Tier 2 form a taxonomy of mutually exclusive and collectively exhaustive list of outcomes. These are supported by Tier 2+ SPIs, which are typically factors present in low-severity incidents.. The Tier 2+ identifies factors or events present in the Key Risk Areas classification, which will be used to identify safety Issues.

\(^3\) Accident as defined in Regulation (EU) 996/2010

\(^4\) Serious incident is defined in Regulation (EU) 996/2010: an incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft, which in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down. A list of examples of serious incidents is set out in the Annex of the Regulation;
contained in the ATM Safety Risk Portfolio. This topology have classes that overlap with each other.

At a European level, examples of the Tier 2 SPIs are the following occurrences, classified as:

- Airborne Conflict;
- Ground Conflict;
- Aircraft upset (with some ANS contribution, such as Wake Turbulence encounters);
- Runway Incursions;
- Runway Excursions;
- Terrain Conflict.

At the Tier 2+ level, examples of indicators would be taken from the specific Safety Issues that lead to the different outcomes defined at the Tier 2 level. Whilst these would need to be fully developed in the ATM CAG, typical examples are the following:

- Separation minima infringements;
- Loss of separation in uncontrolled airspace i.e. Airprox;
- ACAS RAs;
- Aircraft deviation from ATC clearance;
- Aircraft deviation from applicable ATM regulations (e.g., ATM procedures, Airspace Infringements, ATM-related equipment carriage);
- Call sign confusion;
- ATMSpecific (Technical) occurrences (ASO), such as technical failures in C, N, S or Data processing, that affect the ability to provide safe ATM/ANS services and other network functions;
- Significant ATS sector / position overload leading to a deterioration in service provision;
- Incorrect receipt or interpretation of significant communications;
- Prologued loss of communication with an aircraft or with other ATS unit;
- Occurrences involving ATCO fatigue.

**Tier 3 and Tier 3+ SPIs:** Finally, at the Tier 3 level, there are 2 types of leading indicators that monitor the resources, abilities and system processes of the ANS and network function providers and the Member State regulators that have an impact on safety performance. This tier aims to measure properties of processes that have a relationship to the safety performance of the system. These are indicators of how far the State and its service providers are able to gather representative and good quality data or information and how effectively they manage risks to prevent accidents and serious incidents. Tier 3 SPIs refer to the organisations that provide aviation services, and Tier 3+ applies to such measures at the European or Member State Level. Examples of indicators are:

- Just Culture;
- Level of reporting;
- Effectiveness of Safety Management;
Processes linked to the human element of social technical systems (e.g., use of human factors cases in the assessment of changes, fatigue management systems and other processes related to human performance);

Indicators related to data quality (e.g., use of Automatically Detected Occurrences, data quality processes)

The safety performance of the aviation system is the result of the interaction of several components: the ATM/ANS service providers, the regulator, the other service providers (e.g. airline operators, airport operators), and external components, which can be defined as contextual factors.

The Performance Scheme is a scheme for the air navigation services and the network functions. Therefore, the set of SPIs will most likely not cover all elements having influence on the performance of the aviation system, but they will need to capture the relevant elements that are related to the provision of ATM/ANS services and network functions. The SPI framework proposed here will assist in achieving this objective, but it can also be extended in the future to incorporate additional domains and components, if required. For now, and with consideration of the scope of the current Performance Scheme, the proposed SPI framework covers those safety outputs with ATM contribution. Meaning, the performance of ANSPs and the Network Manager, the regulator of those services. Other actors and contextual factors that influence the outcomes of the ATM system are not included. The same SPI framework based on 3 Tiers depicted above can be used in this context, leveraging synergies and avoiding inconsistencies and duplications. A notional representation of the SPI framework is provided in the below figure:

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3.4 Considerations on targeting SPIs

As indicated in the preamble, the group did not address the approach that should be taken in the target setting exercise. However, the group concluded that targeting any lagging indicators, such as the maximum acceptable number of a certain type of occurrence, would undermine the reporting culture in Member States and ANSPs. Experience has shown that a direct consequence of target setting on lagging indicators (such as number of separation minima infringements or runway incursions) has a negative impact on reporting rates, which in turn compromises the overall performance of the system to be correctly measured. Therefore, the group is convinced that in the interests of an open reporting culture, it would be inappropriate to target this type of performance indicators.

In other words, Tier 1 and most of Tier 2 indicators should only be SPIs, that is without targets, to support the ongoing development of an open reporting culture and, to avoid any unintended behaviour that may restrict or jeopardise the reporting rates in Member States and ANSPs. In contrast, Tier 3 indicators are more suitable for target setting.

Another caveat when reported occurrences are targeted is that establishing the underlying rationale for any change in the reported occurrences throughout time will be more difficult due to the unpredictable impact that target setting has on reporting.

Should targets be set on lagging occurrence-based indicators, then such targets should be limited to EU-wide performance targets. This is important as the deployment and use of automatic detection
tools is not wide spread and the use, where it exists, lacks harmonised implementation and this item would be difficult to address via the Performance Scheme. For these reasons, gathering even basic information that has been collected using automatic detection tools has proved problematic during the monitoring of RP2 Year 1. In addition, any implementation would require a cost / benefit analysis.

The Agency is not in favour of targeting lagging indicators at organisation or State level due to possible negative effects that such an action will have on levels of reporting (damage to reporting, safety culture, just culture running counter to the principles of Reg. 376/2014 and the improvement of the ECR data).

Requiring a continued reduction in the rate of reported occurrences for all ANSPs may not be the most effective approach to improving safety. For example, if the rate of SMI is targeted, an ANSP may be take all efforts to genuinely reporting very low numbers of SMIs and there may be other more important safety issues that need to be addressed as a priority. The rate of reported SMIs should be considered as part of a wide package of safety performance measures that together offer greater explanatory power.

4 Proposed S(K)PIs for RP3

4.1 Introduction

The group has proposed a set of candidate indicators based on the analysis of several aspects of safety performance indicators, among which the following can be highlighted:

- How to materialise the PRB thinking for the safety KPA objectives for RP3, as stated in the guidance provided in PRB White Paper. The white paper has proposed 3 performance objectives for safety:
  1. Reduction of loss of separation incidents both horizontally and vertically by focusing on system risk. Application level: EU system wide;
  2. Elimination of Runway Incursions. Application level: local airport level;
  3. Improved management of ATM system security\(^6\) and business continuity. Application level: EU system wide
- The understanding that the objective of the Safety KPA in the Performance Scheme is to be a control mechanism that ensures any targets set on cost efficiency, capacity and environmental KPAs do not have an adverse impact on safety, and that there are other processes at the European level that aim at managing safety risks and at improving safety performance (i.e. the EPAS managed by the Safety Risk management process).

\(^6\) The group did not address this objective as the expertise required to develop indicators for this would be different.
• A review of current indicators used in RP2 and the analysis of their effectiveness based on the experience gained during RP1 and the first year of RP2 of data collection and evaluation. A summary of this analysis can be found in Appendix C.
• A potential progression of current indicators in RP2 to take into account investment from stakeholders already incurred in the scheme and build upon them.
• Anticipated changes to data collection, quality and analysis resulting from the implementation of Regulation (EU) 376/2014 on Reporting, Analysis and Follow-up of Occurrences in Civil Aviation.
• The fact that a combination of leading indicators and lagging indicators would provide a more balanced view of both the level of organisational safety performance (ensuring data quality and processes to manage risks) and a more direct measure of the safety performance.

4.2 Tier 1 indicators

No indicator is suggested in Tier 1 for inclusion in the Performance Scheme regulation. These indicators can, and will, be monitored by the SRM as part of the monitoring of the implementation of EPAS. EASA and the PRB will be able to make use of these indicators in the monitoring of the safety performance without the need to introduce indicators in the regulation.

4.3 Tier 2 indicators

In aiming to capture more direct measures of safety performance that is based on lagging indicators, the indicators in Tier 2/2+ have been redefined. The proposal is to include indicators on the following areas of risk (note that a complete analysis of runway incursions and separation minima infringements is attached in Appendixes A and B, respectively):
• Runway Incursions;
• Separation minima infringements;
• Over-deliveries of Traffic by the Network Manager; and
• ATM specific (technical) occurrences.

4.3.1 Runway Incursions

As a result of the analysis covered in Appendix A, three indicators are recommended to monitor Runway Incursions (RIs). They are as follows:

**Performance Indicator R1a:** Rate of Runway Incursions at an airport with any ATS and/or CNS contribution with a safety impact, measured as:

\[
R1a = \frac{\text{No. of RI with ATS/CNS contribution and safety impact at Airport level}}{\text{No. of movements IFR + VFR at Airport}} \times 10,000
\]

**Performance Indicator R1b:** Rate of runway incursions occurred in a State that includes the overall system wide contribution with safety impact measured as:
Performance Indicator $R_Ic$: Rate of runway incursions occurred in the EU that includes the overall system wide contribution with safety impact measured as:

$$R_Ic = \frac{\text{No. of RI overall system contribution with safety impact at EU level}}{\text{No. of movements IFR + VFR within the EU}} \times 10,000$$

4.3.1.1 Considerations

RI is defined, following ICAO, as “Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft”. This definition should be included in drafting the rule text.

The protected area should be defined as the runway strip plus the ILS sensitive CAT II/III area when reduced or low visibility procedures are in force. The vertical part of the protected area should be interpreted as having physical contact of aircraft, vehicle of person with the above defined geometry (e.g. with a landing aircraft, it needs to have the wheels touching the runway to be considered RI), except in the case of helicopters which hover taxi the surface. Concerning the incorrect presence, this should be understood as the unsafe, unauthorised or undesirable presence, or movement of an aircraft, vehicle, or pedestrian, irrespective of the causal factor (i.e. ATC, pilot, driver, technical system, etc.). This should be as much as possible a factual observation.

Amongst organisations, there are variations in the way that the RI definition is interpreted and this has also an impact on the level of reporting. To minimise this definitional issue, it is recommended that the measure be limited to incidents with significant safety impact where any differences in the interpretation of the definition are least noticeable. To assess the severity of a RI occurrence several options are possible.

Currently, the Performance Scheme (Reg (EU) 390/2013 and Comission Implementation Decision 2014/132/EU) requires ANSPs and NSAs to apply the severity classification based on the Risk Analysis Tool (RAT) methodology to the reported RI occurrences, in addition to separation minima infringements and ATM-specific occurrences (ANSPs to determine the ‘ATM-ground’ severity and NAAs to determine the ‘ATM-overall’ severity based on RAT). The Occurrence Reporting Rule (EC 376/2014) requires the development of a common European Risk Classification Scheme (ERCS) to be used by States to classify occurrences in terms of safety risk. In order to avoid creating double requirements to assess the risk of occurrences, ANSPs and States may determine whether occurrences have a safety impact using RAT ground severity methodology and the ERCS, respectively. In the case of indicator $R_Ia$, the RAT safety impacted occurrences will be those with ATM ground severity classified as A, B or C.

It is proposed that both, ANSPs (in coordination with aerodromes) and States will derive the absolute number of safety-impacted occurrences to calculate the rate of occurrence as defined by $R_Ia$, $R_Ib$ and $R_Ic$. The ANSPs/aerodromes provide the calculation for $R_Ia$, with the States providing that for $R_Ib$, and $R_Ic$. This approach assumes an equal weighting of each of the safety impacted occurrences. $R_Ib$ and $R_Ic$ are differentiated by the level of aggregation. However, the nature of
occurrences information used for Ria is different, as it includes a subset of all RIs: only those with Air Traffic Service or Communications, Navigations, Surveillance contribution. The indicator Ria aims at capturing those situations where the ATS/CNS services contributed directly or indirectly to the occurrence. The indicators Rlb and Rlc aim at capturing the trend at Member State level of actions of all contributors, i.e., air operators, aerodromes, and ANSPs.

Using data submitted annually through the European Central Repository (ECR) would allow the identification of these type of occurrences. Complete exposure data cannot be obtained from the Network Manager (via STATFOR), which includes mainly IFR movements but a small portion of VFR flights. However, in order to contain IFR and VFR movements at airports separately, the NM figures need to be complemented by the airports. Airport operators are obliged to provide this information in the current regulation (see Annex V, point 3.2.2 of Regulation (EU) 390/2013).

4.3.1.2 Caveats

Interpretation of measurement: Caution must be taken when interpreting the number of reported RIs. An increase in the rate of reporting, whether at aerodrome, ANSP, State or EU level, could be the result of improvements in reporting culture, new tools or a genuine degradation in safety or a combination of the above.

Benchmarking: The rate of reported RIs should not be compared between airports since it is likely that there are significant differences in reporting culture and differences in their interpretation of the RI definition. In addition, other factors such as the airport lay out and equipment or complex runway operations play a significant role in the number of RI occurrences.

The identification of runway incursions that have ATM/CNS contribution is not a straightforward exercise, and is subject to interpretations and subjective judgement.

There were two dissenting opinions in the group in proposing these indicators due to the fact that the nature of the occurrences used in the three rates are different and that the “safety impact” is estimated using two different methods, the Italian member and Eurocontrol/DPS representative did not support the use of three types of rates and suggested to use the same occurrence and method to assign severity, varying only the level of aggregation. The rest of the group did not agree with this view and decided to retain the three types of rates for the reasons stated above.

4.3.2 Separation Minima Infringements

As a result of the analysis covered in Appendix B, three indicators are recommended to monitor Separation Minima Infringements (SMIs). They are as follows:

**Performance Indicator SMIa:** Rate\(^7\) of Separation Minima Infringements with any ATS and/or CNS contribution with a safety impact at the ANSP Level, measured as:

\(^7\) Using controlled ANSP flight hours.
SMIa = \[ \frac{{\text{No. of SMI with ATS/CNS contribution and safety impact at ANSP}}}{{\text{No. of controlled flight hours by ANSP’s AoR}^8}} \times 100,000 \]

**Performance Indicator SMIb:** Rate\(^9\) of Separation Minima Infringements, which includes the overall system wide contribution, with safety impact at the State level, measured as:

\[ SMib = \frac{{\text{No. of SMI overall system contribution with safety impact at State level}}}{{\text{No. of controlled flight hours within State}}} \times 100,000 \]

**Performance Indicator SMIc:** Rate of Separation Minima Infringements, which includes the overall system wide contribution, with a safety impact at the EU Level, measured as:

\[ SMic = \frac{{\text{No. of SMI overall system contribution with safety impact at EU level}}}{{\text{No. of controlled flight hours within EU}}} \times 100,000 \]

### 4.3.2.1 Considerations

SMI is defined as “a situation in which prescribed separation minima were not maintained between aircraft”. The SMI definition outlined here is different to the definition described in Regulation (EU) 376/2014, which is not in line with industry practices. This definition should be included in the implementing rule text. The infringement of separation minima considered is between IFR/IFR controlled flights in controlled airspace. It is important to note that both horizontal and vertical separation needs to be lost to trigger an SMI.

Amongst organisations there are variations in the way the SMI definition is interpreted and this also has an impact on the level of reporting. To minimise this issue, it is recommended that the measure is limited to incidents with safety impact. ANSPs and States will determine whether occurrences have a safety impact using the Risk Analysis Tool (RAT) ground severity methodology and European Risk Classification Scheme (ERCS)\(^{10}\), respectively. In the case of indicator SMIa, the RAT safety impacted occurrences will be those with ATM ground severity classified as A, B or C. In the case of rates SMIb and SMIc, occurrences will be determined as safety impacted by the States once the ERCS is fully developed, but those bearing higher risk should be retained in the indicator.

It is proposed that at both, ANSP and State levels the absolute number of safety impacted occurrences will be counted to calculate the rate of occurrence as defined by SMIa, SMIb and SMIc. The ANSPs will perform the calculation for SMIa, and States for SMIb, and SMIc. This approach

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\(^8\) Area of Responsibility

\(^9\) using controlled flight hours within the State

\(^{10}\) Currently, the Performance Scheme (EU 390/2013) requires ANSPs to classify occurrences in terms of ATM ground safety severity in accordance with the Risk Analysis Tool (RAT) methodology. The Occurrence Reporting Rule (EC 376/2014) requires the development of a common European Risk Classification Scheme (ERCS) to enable states to classify occurrences in terms of safety risk. Furthermore, the Occurrence Reporting Rule requires that when developed the ERCS is compatible with existing risk classification schemes such as the RAT. (Overall).
assumes an equal weighting of each of the safety impacted occurrences; consideration should be made as to whether this is appropriate. Note that the only difference between SMIb and SMIc is the level of aggregation. However, the nature of occurrences is different with respect to SMIa, as it includes a subset of all SMIs; only those with Air Traffic Service or Communications, Navigations, Surveillance contribution.

Data to support these performance indicators is already mandated to be provided by ANSPs via the European Central Repository in accordance with Regulation (EU) 376/2014 or is reportable through ECCAIRS NSAs are already required to validate the data before it is submitted, so the use of the indicators should not introduce significant extra workload.

The number of controlled flight hours is considered to be a better measure of risk exposure than terminal / En-route aircraft movements. These flight hours are measured by the Network Manager (NM) as it is considered that the NM is best placed to consistently report flight hours of ANSPs across Europe. As some ANSPs provide cross-border services, the estimation of flight hours is based on two different estimations depending on the rate. The SMIa is calculated using flight hours controlled by ANSP, and SMIb and SMIc are calculated using flight hours controlled within the State and EU, respectively.

4.3.2.2 Caveats

Caution must be taken when interpreting these indicators. An increase in the rate of reporting, whether at ANSP, State or EU level, could be as a result of improvements in reporting culture, new tools or a genuine degradation in safety or a combination of the above. A further detailed investigation would be required to establish what is driving the reporting rate changes.

The rate of reported SMIs should not be compared between ANSPs since it is likely that there are significant differences in reporting culture and differences in the interpretation of the SMI definition. This may mask the underlying reasons for the differing safety performance (such as differences in organisational culture, structural properties of the system, equipment provided, staffing arrangements etc.), which would help ANSPs understand how best to improve their safety performance.

In circumstances where ANSPs provide cross border services, it will not be possible to link the data provided by the ANSP under the indicator SMIa with the data provided by the State under the indicator SMIb.

There was consensus in the group in proposing these indicators with some dissenting opinions. Due to the fact that the nature of the occurrences used in the three rates are different, the Italian member and the Eurocontrol/DPS representative did not support the use of three types of rates and suggested to use the same occurrence type, varying only the level of aggregation. The rest of the group did not agree with this view and decided to retain the three types of rates for the reasons stated above.
4.3.3 Over-delivery

As a result of the group analysis, the indicator that measures over-deliveries was proposed to be monitored. The over-delivery indicator measures the percentage of ATFM regulated hours in a given time period (e.g. a year) when the actual traffic was 10% or more above the slot rate. The following indicator recommended as follows:

\[
OvD = \frac{\text{No. of hours when traffic} \geq 110\% \text{ slot rate}}{\text{No. of ATFM regulated hours}} \times 100
\]

The final metric may be tuned and fully developed in acceptable means of compliance.

4.3.3.1 Considerations

The metric of over-delivery aims to measure the ATFM capability to protect ATC sectors and airport from excessive demand, expressed as the number of over-deliveries. Over-delivery is defined as occurrence situation when the declared rate of the ATFM regulation is exceeded by the actual number of aircraft that enter a regulated sector or airport during a particular period. It is considered that an over delivery ≤10% above the slot rate is a normal fluctuation. Thus, the over-delivery means that more aircraft than planned enter a protected ATC sector or airport (i.e. ATFM slot allocated), exceeding the regulated capacity (i.e. ATFM hourly slot rate) by more than 10% measured at the time of inserting the flow management measure in ATFM systems and during the post-analysis phase.

Over-deliveries can be seen as a precursor to ATCO overload\(^\text{11}\), and by extension potentially impact the safety performance of ATS services. ATFM regulations are used as the last resort when all other ATFM measures (e.g., level capping, rerouting) cannot ensure an adequate protection to excessive sector or airport demand. The main parameters of an ATFM regulation are the protected location or traffic flow, the regulated rate (usually expressed in number of flights in an hour), and the start and the end time. The ideal effect of an ATFM regulation is to deliver an amount of traffic at or below the regulated rate. When the traffic is much higher than the regulated rate, it is likely that an ATCO experiences an overload.

There are two parameters that, given an over-delivery, drive the probability of overloads: a) The magnitude of the over-delivery compared to the regulated rate (e.g., 10%, 20%, 30%, etc. above the hourly rate in the ATFM regulation, and b) the number of regulated hours affected by over-deliveries.

It is known that ATFM regulations cannot guarantee that the actual traffic always remains at or below the slot rate given the tolerance of the many ATFM parameters (e.g., window width of time bands, take-off window, etc.). There is always a certain fluctuation of the actual traffic around the declared hourly rate that can be accepted. The Flow Management Positions (FMPs) and ATC units are aware of this and they set ATFM regulations accordingly. It is then assumed that an over delivery

\(^{11}\) An occurrence when an air traffic controller reports that he/she has had to handle more traffic than they consider it was safe to do so.
of 10% above the slot rate is a normal fluctuation. Above such a value, the likelihood that an over delivery might be a precursor to an overload is high.

It is important to note that the number of ATFM regulated hours affected by over-deliveries >10% is counted during the post-analysis phase, and is counted for those sectors that have been regulated. Deliveries of aircraft above the declared capacity of sectors that do not set ATFM regulations are not included in the indicators. In addition, it is worth noting that an ATCO could experience an overload, because an ATFM regulation was not set. This is not measured by the indicator.

The performance objective for the Flow Management would ideally be to maintain the number of ATFM regulated hours where the over deliveries is above 10% to the lowest possible minimum. Were it possible to reduce the over-deliveries, the ATC units could gain more confidence in the protection of ATFM measurements and set the ATFM regulation less conservatively. This would have positive repercussions in capacity as the ATFM rate would approach that of the ATC sector capacity, and it would have a positive effect on ATCO productivity as it may be possible to reduce the amount of spare ATCO resources in the operational room.

The over-delivery indicator is already measured by the NM. It is part of the NM Performance Plan as an indicator of the capacity KPA, as it may be a symptom of an inappropriate utilisation of ATFM regulation, and therefore it may reduce unnecessarily sector capacity.

**4.3.3.2 Caveats**

Over-delivery could be a symptom of an inappropriate utilisation of ATFM regulations. If an ATFM regulation is introduced inappropriately (e.g., to stream the incoming traffic), the measure of over-delivery does not have an impact on safety.

Over-delivery may be associated to capacity and/or predictability.

Network Manager is not accountable for all drivers that are behind the over-delivery indicator. That means that the behaviour of the indicator is not completely attributable to NM. However, NM is an accountable entity, which not only controls a particular class of performance drivers, but also, in accordance with (EU) 677/2011 and (EU) 255/2011, has the duty to monitor all the other performance drivers and accountable entities. For example, NM is responsible for defining ATFM parameters and procedures that have an impact on the over-deliveries. NM is not, however, accountable for other drivers, such as airborne re-routing and changing flight level, which would be more attributable to ATC and airspace users. A list of drivers and accountable entities is given below:

<table>
<thead>
<tr>
<th>Performance Drivers</th>
<th>Direct accountable entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATFM standard parameters and procedures</td>
<td>NM</td>
</tr>
<tr>
<td>Adherence to ATFM departure slots</td>
<td>ATS units</td>
</tr>
<tr>
<td></td>
<td>Airport Operators</td>
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<tr>
<td></td>
<td>Airspace Users</td>
</tr>
<tr>
<td>Exempted Flights</td>
<td>States</td>
</tr>
<tr>
<td>Airborne re-routing or changing</td>
<td>ATS units</td>
</tr>
</tbody>
</table>
Data to support the performance objective regarding over-delivery is already available to NM as it is necessary to perform the ATFM function. However, the data is for all factors contributing to the over-delivery. Therefore, a great deal of analysis will be required to determine the actual NM contribution to the over-delivery, but that may not be necessary as, in the same manner as for runway incursions, not all factors are attributable to ANSPs.

### 4.3.4 ATM-specific (technical) occurrences

This type of occurrence is exclusively under the accountability of ANSPs. However, the group decided not to retain the indicator within the Performance Scheme but to potentially be monitored via the EASA SRM and EPAS.

### 4.4 Tier 3 Indicators

#### 4.4.1 Effectiveness of Safety Management - ANSP

The RP3 SKPI development WG concluded that a leading indicator that measures the effectiveness of the ANPSs’ SMS is needed. The proposal is to include the following indicator:

\[ EoSM - ANSP = \text{Effectiveness of Safety Management of ANSPs} \]

There was a great deal of discussion about the best method to measure this leading indicator for the ANSPs, as the current questionnaire used to evaluate EoS (especially that for the states) was considered not fit for purpose and is in need of enhancements as indicated by work that has been done in this area since the existing tool was authored. This indicator is proposed to be retained as:

1. It is a good leading indicator. As a leading indicator, it is believed that a proactive approach to safety will yield better results than a reactive one, given the present relatively high levels of aviation safety in EASA States.
2. It is suitable for targeting without adversely affecting the health of the safety reporting system

However, there are three proposals to approach the measurement of the indicator and are provided for the evaluation of the European Commission, among which the final approach should be selected. The first two options were agreed upon by the group, and the third one has been added by EASA after the final meeting of the group. Option 2 (use of a cross-domain tool) was rejected by the Italian member of the group if that would mean targeting this indicator, due to a perceived incompatibility with the Common Requirement regulation (Regulation (EU) 2016/1377), which enters into force on January 1 2019.
• **Option 1:** The use of CANSO Standard of Excellence (SoE) in Safety Management Systems, which is an evolved version of the current version of the EoSM questionnaire. Current version is V2.1.

• **Option 2:** The use of a cross domain SMS assessment tool nested in the Performance Scheme regulatory framework. Further elaboration of the tool would be required during the AMC/GM development to extend it beyond compliance and to include business decision making.

• **Option 3:** Discontinue the use of EoSM within the Performance Scheme regulation, but introduce the use of the cross domain SMS assessment tool nested in the Common Requirements Regulation (EU) 2016/1377, as a new AMC for the competent authorities to evaluate the implementation of SMS by ANSPs as part of their oversight obligations. EASA would use the output evaluation as part of the monitoring of safety in the Performance Scheme.

4.4.1.1 Considerations

**Option 1:** The reformed Standard of Excellence, SoE V2.1, is structured to be more objective and challenging than the current EoSM questionnaire. CANSO decided to align the EoSM questionnaire with ICAO Annex 19 in late 2013 and a new version of the questionnaire was agreed upon at the Global Safety Conference in early 2015. The current version, SoE V2.1 goes beyond Annex 19, as it includes the development of a positive and proactive safety culture, safety by design and fatigue risk management, among others. The new method has introduced changes in the weightings and to the maturity level descriptors as well. It is currently moderated by Eurocontrol. This option represents no more work for the ANSPs as they are doing it within CANSO as part of their current programmes. A new verification/moderation mechanism is required, to include Competent Authority action (e.g. a reduced group of Competent Authorities/EASA). This indicator is potentially targetable, and a potential new target would need to be reviewed in light of the characteristics of the new version. To reduce the administrative burden, ANSPs could only be required to submit the differences to their previous assessment following a first full assessment.

**Option 2:** The Cross-Domain SMS Assessment Tool has been designed to be used by the Competent Authority as a common approach to SMS assessment across different aviation domains. The tool was developed focusing on both the assessment and continual improvement of SMS within the scope of authority oversight. The tool provides an evaluation of four levels of SMS implementation: Present, Suitable, Operating, and Effective, as the level of SMS maturity increases. “Present” and “Suitable” levels would be assigned when all the required enablers of a functioning SMS are implemented by the ANSPs. In order to check that SMS processes are indeed “Operating” and/or “Effective” the SMS should be re-evaluated on a regular basis to assess how well the SMS is performing.

There is no rule that recognises and/or enforces the use of this tool. Until there are common MS requirements for Competent Authorities and common SMS regulations for organisations placing the tool at the level of IR or AMC of any EASA rule would create problems. Hence, the tool has been initially suggested as guidance material. This lacks enforcement power, and the harmonised application of the tool is not guaranteed. Further work on the tool during the AMC/GM development would be required to better ensure its correct calibration and consistent EU-wide deployment. Therefore, within option 2 it is suggested to include the use of the tool within the Performance Scheme regulation. This, however, would create specific requirements for the Competent Authority to evaluate the ANSP’s SMS nested in the Performance Scheme, in addition with their oversight
responsibilities in the Common Requirements Regulation (EU) 2016/1377, with risk of incongruities between approaches and has the potential to increase the reporting burden on States. Due to a perceived incompatibility with the certification rule, the Italian member did not support targeting this indicator. All other members supported targeting.

Option 3: The new Common Requirements (Regulation (EU) 2016/1377) mandate the service providers to have in place an SMS and to monitor its effectiveness. It also requires the competent authority to assess the SMS as part of its oversight activities to service providers. In order to reduce burden on States and the duplication of requirements during oversight of an ANSP’s SMS and within the Performance Scheme, this option is proposed as an alternative. It is proposed to nest the obligation to assess the ANPS's SMS and score the effectiveness of the SMS exclusively in the Common Requirements. The indicator would be removed from the Performance Scheme regulation, but the result of the oversight by competent authority may be used as part of the performance analysis by EASA.

4.4.1.2 Caveats

Option 1 has the limitation that the SoE is not facilitated by any competent authority, hence the SMS evaluation performed is not validated and similar to the self-evaluation that EoSM suffered in the past. To mitigate it, a group of authorities and/or EASA could be created and participate in the evaluation of the SoE.

Option 2 carries the risk of double requirements in EASA oversight regulation and Performance Scheme, increasing burden for authorities.

Option 3 would streamline the application of the cross domain tool, but it would require time to implement with the risk to not be ready for RP3.

4.4.2 EoSM-NSA

The group proposes that this indicator be discontinued in the Performance Scheme in its current form, i.e., as an EoSM questionnaire for NSAs that is managed and verified by EASA. In order to simplify the safety part of the Scheme and to reduce burden on the States. Two options are envisaged in order to measure the capability and effectiveness of a CA to perform its oversight function:

- **Option 1**: To remove this indicator from the Performance Scheme without the addition of any other element related to NSAs with respect to the monitoring of safety. In the end, the Performance Scheme is about providers of ANS services and network functions and not about competent authorities, whose performance is evaluated elsewhere (i.e., Common Requirements Regulation (EU) 2016/1377 and the EASA oversight inspections).

- **Option 2**: to use the output of the Continuous Monitoring Approach model used by EASA to schedule the standardisation visits to the Member States in the monitoring analysis, while removing the indicator from the Performance Scheme Regulation. The model would be modified to be fit for purpose, and aim to measure the confidence of EASA in the CA abilities to discharge its oversight and safety responsibilities in the ATM/ANS domain. It requires some additional work to modify the model if this approach is selected and carrying out a feasibility study is recommended. Consideration should be given to extending the oversight to include the challenges resulting from the deployment of SESAR technologies.
4.4.3 RAT severity application

It is assumed that at the end of RP2 the 100% application of RAT for occurrences with severity AA, A, B, and C will have been achieved. To capitalise on the achievements gained during RP2 and acknowledging the investment made by ANSPs in introducing and applying RAT, it is proposed that the requirement to apply RAT severity classification be maintained.

Recognising the desire of the European Commission to simplify the Performance Scheme and considering the ANSPs opinion in the group regarding their investments in applying this method and their desire to continue with its use, a compromise approach is advisable. EASA proposes that the application of RAT severity as an indicator be removed, while maintaining the use of applying RAT severity to specific occurrences in the rule as a means to identify those occurrences with safety effect, as explained in sections 4.3.1.1 and 4.3.2.1. This would retain the obligation for ANSPs to apply an harmonised method that is currently used, i.e. RAT, in the AMC associated to the indicators RI and SMI. Those indicators are restricted to those occurrences with safety effect. This would require the identification of those types of occurrences with severity A, B, and C, based on RAT. The obligation for NSAs to use RAT would be removed.

The above proposal assumes that the RAT and ERCS are two compatible methods, as foreseen in Article 7.5 of the Reg (EU) 376/2014.

4.5 Summary of proposed SPIs for RP3

The following figure summarised the proposal to monitor SPIs for RP3.
Tier 1: High severity outcomes with ATM contribution

Tier 2/2+: Occurrence-driven SPIs:
- Key Risk Areas
- Safety Issues

Tier 2: Risk Areas
Runway incursions: Rla, Rlb, Rlc

Tier 2+: Safety Issues
Separation minima infringement: SMIa, SMIb, SMIc
Over-deliveries: OvD

Tier 3/3+:
Safety management process effectiveness / other leading indicators

Tier 3:
Effectiveness of SMS: EoSM-ANSP

Tier 3+:
Standardisation-CMA model

Service Provider (ANSP/NM)

State (Regulator)

Aviation System

Accidents/Serious incidents with ATM contribution

Safety Performance Monitoring

Other SPIs (to be decided)
5 Interdependencies

5.1 Introduction

The PRB White Paper has identified the need to refocus attention on key risks, which show interdependency issues. “This is considered highly desirable from a performance perspective as change management requires identification of problem areas generated by either interdependency interaction with the Safety KPA, or problems created by technology interaction with latent, human factors or unidentified errors.” To this should be added those risks that have potential for interdependency issues or can propagate emergent risks.

In addition, the ToR of the EASA RP3 SPI WG included the analysis of interdependencies as an area to tackle within the group’s remit.

Two approaches have been investigated to address the analysis of safety interdependencies with other KPAs. The two models explored show promising prospects, but additional work is required to operationalise them and assess their feasibility to be introduced in the Performance Scheme, which would necessitate feasibility studies be undertaken. There is potential added value that this approach can yield in that the generalisability and applicability for ATM in future control periods as an indicator that offers consistency over several control periods whilst retaining explanatory power.

5.2 Theory behind the philosophy adopted in the approach to interdependencies

Safety science has evolved beyond the early approaches to safety management that are characterised by approaches such as Heinrich’s ‘Iceberg’ model. These approaches still, arguably have some value today, being suited to the nature and maturity of the industrial production processes at the time - circa 1930. The nature of safety in this case is characterised and emphasised by what today we call ‘Health and safety’ – industrial accidents. The focus of safety interventions focused on the human-being themselves and interventions strived to limit an organisations exposure to claims for liability.

Progressively, beyond the 1930s, conceptions of safety typified by Reason’s approach to safety and Turners’ ‘Man-Made disasters’ acknowledged that safety has components of system behaviour and failure. In this case the term ‘system’ has evolved to be the socio-technical system that is characteristic of post-war organisations. These conceptions of safety acknowledge that elements of the organisation that are distant from the production process can have a negative effect upon safe production.

These conceptions of safety were borne from several accidents that influenced perceptions of safety: Aberfan, Piper-Alpha, Chernobyl and Three-Mile Island for example. In these cases, the classic ways of conceiving safety were found to have limitations. Some researchers argue that the domination of hindsight in these conceptions of safety, whilst understandable, were nevertheless limiting due to their preoccupation with events that have happened and about which the precise circumstances and pre-conditions may never occur again.

Other researchers recognised that the dynamics and nature of socio-technical systems were changing. What could once be characterised as simple and non-linear systems – tractable systems where it is possible to predict a priori system behaviour and performance was changing. Socio-technical systems now demonstrated evidence of being intractable – system behaviour was less able to be predicted with confidence because of the complex tangled web of interactions between system components that defy prediction or comprehension.
Associated with tractability is the continued sustained safe performance of ATM itself. This is of itself a challenge. Fewer events of any significance lead to a change in what safety itself means. For example, how does a frequency count of SMIs inform how safe, or unsafe a system is? Such metrics may say something about proximal factors of an event, but the distal influences—the systemic or systems thinking views—are kept— at a distance. Thus, dysfunctional and incomplete narratives of events are generated and the focus is disproportionately directed towards system components or elements producing the productive function and not on how the system supports and influences effective system performance and the productive function.

The nature of future changes to the ATM system are entirely consistent with intractable systems. A consequence of this will be the creation of additional and new complexity in the ATM system and emergent properties that defy a priori knowledge of system behaviour. For example, the four key performance areas produce competing demands and induce tensions for resources that influence how a system behaves as well the effectiveness or availability of buffers.

These changes in system properties pose challenges for risk management. Several approaches to these challenges have evolved. The EASA RP3 SPI WG principally explored two potential approaches as the most promising ways to assess KPA interdependencies and build future RP3 metrics in support of it:

- Rasmussen’s approach on Risk Management in a Dynamic Society (Rasmussen, 1997): Rasmussen’s gradient approach to organizational risk management and control.

5.3 Rasmussen – Risk Management in a Dynamic Society: Model of gradients

“The propagation of an accidental course of events is shaped by the activity of people which either can trigger an accidental flow of events or divert a normal flow.” (Rasmussen, 1997)

Rasmussen was amongst the first to explore risk management in the context of large scale socio-technical systems. Beginning with complex technical systems and using control and systems engineering to design control and safety systems for hazardous process systems.

It emerged that the scope of the system that needed to be considered was greater than the industrial process itself. Moreover, it became apparent that a broad view, a top down system view, provided the means to explore the system of interest. Why? Because of the reality of the adage that a ‘system is more than the sum of its parts.’

Rasmussen’s work evolved and became one that adopted a multidisciplinary approach as it was recognised that control of safe operation involved many actors beyond the immediate process activity and included numerous actors outside the social-technical system of the organisation such as those with a societal interest in safe operation.

Fundamentally, Rasmussen’s work is to do with the control of safe operations. With a particular focus on how effective controls can be. For what is called ‘stable systems’ these control mechanisms can be effective.

However, the nature of the socio-technical systems that were then emerging and today are quite typical, is different. The world is not stable, it is dynamic, messy and complex. Where complex refers to the system...
property ‘that consist of a large number of elements, that interact dynamically, and that are non-linear and the level of interaction is fairly rich i.e. growing continuously’ (Cilliers, 2000).

One of the sources of complexity is the nature or a modern business practise. This was one of the disciplines that Rasmussen drew upon in the derivation of a functional model of socio-technical system behaviour. This model assumes that any work system will have a natural migration of the systems behaviours towards some boundary of acceptable behaviour. Acceptable behaviour can be defined as economic, safety production, whatever an organisation emphasises for its production work system. The boundary itself is not a static boundary but dynamic. An example of the model can be found in figure 1.

![Figure 1: Rasmussen’s model of gradients and migration towards the acceptable boundary (Rasmussen, 1997)](image)

Migration towards the boundary of acceptable performance reduces the buffers of the work system. These allow room in the production process to cope with perturbations. Frequently resource led, any change in these can lead to operating in the error margin and operating ever closer to the acceptable performance boundary. In so doing, the work system can be vulnerable to shocks or surprises that lead it to operate beyond the acceptable performance boundary.

The factors that may lead a work system in a socio-technical system to migrate will not necessarily be found in conventional safety metrics. For example, violations of procedures in this model it is argued have little immediate effect. The migration towards the acceptable performance boundary is likely to be over time. Thus as cost effectiveness measures are introduced, these lead to adoptions of normal work that fulfil the cost-effectiveness goals and hence a migration towards the boundary.

In these circumstances migration to the boundary will not be found in indicators of safety at the human level – SMIs etc. It is to other non-safety processes that migration can be found. The gradual changes and adoptions in everyday work of numerous actors in the socio-technical system.
It is argued in this paper that Rasmussen’s approach is one that has potential in exploring the interdependence and consequent effects on the ATM system and that this can be achieved at the EU, State and ANSP level. This concept is explored in more detail in sections 5.3.1 and 5.3.2.

5.3.1 Transforming Theory into Practice

The remainder of this section examines the way of translating the Rasmussen’s gradient model into practical measures that can be used to assess the impact of cost, capacity and environmental pressures on safety and the consequent effects on the ATM system.

Appendix D provides an analysis of the three interdependency areas described in the PRB White Paper. It provides an interpretation of those interdependencies in plain English and proposes possible measures related to them. The resulting list of metrics (see table in Appendix D) was found unmanageable, so each of the identified measures in the interdependency areas was weighted according to the following criteria:

- Ease of collection
- Objectivity
- The relationship with Safe Production

The metrics that resulted with the highest ranking are presented in the table below and later have been allocated to the most appropriate of the three principal drivers from the Rasmussen’s model of gradients to analyse interdependencies. The three principal drivers from the Rasmussen’s model of gradients are as follows:

- Gradient towards least effort
- Management pressure towards efficiency
- Campaigns for safety culture

<table>
<thead>
<tr>
<th>Measure</th>
<th>Gradient towards least effort</th>
<th>Management pressure towards efficiency</th>
<th>Safety Gradient Counter Pressures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviations from traffic flows in the NOP</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Number/% of a/c in sector above the declared capacity</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Number/% of spare staff available in the roster</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross competency / validations</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of cost of overtime (% hrs worked extra vs % hrs worked normal of ATCOs)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonality of traffic</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sickness rates</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Regulation breaches related to fatigue (e.g., more hrs working than allowed)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATCO time on sector</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Temporary Operating Instructions</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
The model will enable organisations to determine if the negative gradients towards least effort and efficiency are balanced by campaigns for safety culture.

5.3.2 Proposal for analysis of safety interdependencies using the Rasmussen’s model of gradients

In summary, the group has provided a plain English interpretation of the PRB interdependency focus areas. Measures for each of these focus areas have been identified and weighted according to their relevance and ease of collection. The measures with the highest weighting have been categorised in to the three principal drivers from the Rasmussen’s model of gradients, represented in the following figure.

It is clear that further work is required to develop the application of the model. The work should focus on operationalising the model and calibrating it with real data. The group’s proposal is to launch a feasibility study that explores and evaluates these aspects, aiming at providing a model to the PRB to evaluate interdependencies. It proposes that this philosophy can be used to determine an organisation’s operating point, how close it is operating to the safety boundary and in what direction it is likely to move in the future (thus providing a predictive element to the model). This would be determined by monitoring each of the measures that comprise the three principal drivers to establish their relative strength both now and into the future.
the future. Then, determining the organisational pressure to move towards the safety boundary which would be based on the net strength of “management pressures towards efficiency” and the “gradient of least effort” drivers versus the “safety counter gradient pressures”. The practical application in the Performance Scheme should be further evaluated in a feasibility study before implementation, but the approach is promising to seriously address the interdependencies with safety.

5.4 Q4-Balance Framework and Safety Energy

It is clear from the approach to safety within ATM activities in Europe that organisations expend resources on safety as an activity. It is valuable to understand the manner of the distribution of resources in order to understand the decision making behind it and what trade-offs are accepted between safety and productive output. Safety energy seeks to understand this relationship within the context of organisational resource allocation. In allocating finite resources within an organisation there is an economy – safety trade-off. This involves balancing resources to satisfy the organisation’s goals for investment, to sustain operations, increase efficiency, and sustain or maintain safety performance. The fundamental trade-off in these investment decisions is between short-term gain and long-term goals. One method to explore this is that of safety energy as proposed by Woods et al (2015). Safety energy is a notion that aims at qualifying the resources the organisation is devoting to safety and at assessing its capability to be proactive in safety management based on the proportion of resources devoted to this activity. In order to assess that, Woods et al. use a framework laid down in the next paragraph.

Woods proposes a four-quadrant model as a framework to explore economy – safety trade-offs. It is designed to allow an organisation to map various metrics employed and that define economy and safety in terms of the reactive and proactive resultants. Woods describes the Q4 framework as, “The resulting visualisation provides the means to develop and utilise a balanced portfolio of metrics that assesses the state of and interactions across all of the performance dimensions critical to modern systems and organisations.”

![Figure 2. The Q4-Balance Framework. Panel A (left) shows that performance metrics fall into a space defined by two dimensions: reactive proactive (x axis); economy safety (y axis). As a result, metrics are grouped into four quadrants (quadrant 1 = reactive-economic; quadrant 2 = proactive-economic; quadrant 3 = reactive safety; quadrant 4 = proactive safety). Panel B (right) shows how specific performance metrics used by specific organisations can be plotted as a position in this space to assess the distribution across the quadrants. In our illustration, the indicators represented might be the ones used by services such as quality (squares) and safety (triangles) departments. Such representation can reveal patterns of imbalance that hinder organizations as they confront trade-offs in risks and uncertainties.](image-url)
The quadrant model helps to explain decision making that is already occurring within organisations. It further assists us in understanding the consequences and outcomes stemming from those decisions in a structured manner. In particular, the model provides the means to track organisational decision making and its influence on safety over time.

Quadrant 1: Reactive Economic is characterised by indicators such as previous years’ turnover, earnings before interest and taxes (EBIT), marginal yield.

Quadrant 2: Investment in equipment and technology (e.g. SESAR technologies), investment in training of human resources and numbers of staff as a factor of production, including the provision of overtime (manpower planning), financial preparedness, market growth linked with forecast traffic volumes, strategies to deal with regulatory requirements on the business plan.

Quadrant 3: Reactive safety that charts the safety performance of an organisation in the previous business year and within a defined historical context. The areas of chief interest in this quadrant include technical failures, over deliveries of traffic into an airspace, delay statistics and causation, the efficacy of safety interventions as previously forecast during business planning (Q2) and whether they actually occurred. This quadrant effectively provides the accounting oversight of the activities that were forecast in Q2. In short, that which is revealed in the form of inconsistencies between Q2 and Q3 hints at areas that require further investigation and analysis. Within the context of safety, the exploration of the delta helps to focus the attention on the buffers and the abilities of the system to adapt and respond to cascading effects, unintended consequences and perturbations, and the ability to anticipate bottlenecks ahead of time along with preparation for events that will impose stress on the network itself. E.g. Large events, such as the European Cup Final, that increase demand for services and the stresses on those services. Another good example is the effect on traffic as a result of an extreme weather event. The Q1 –Q3 together impute the total economic value of the activity (TEV), which also includes the economic risk or pricing risk.

Quadrant 4 embodies that which is unknown and is expressed through the operation’s ability to respond as required and where the level of preparedness of the organisation is measured. Q4 is concerned with the buffers existing within an organisation. That is the available spare resources of any sort that can be called on in times of need, which will assist an organisation in escalating activities when the operation is under stress. Indicators might be the availability of these resources, the changes in strategies in deploying resources, and consequences upon adjacent agencies that may be affected by the strategies that are used.

The 4Q-framework provides a representation to identify imbalances and misalignments in the metrics risk portfolios used by ANSPs when conflicts arise between economic and safety goals, and between proactiveness vs reactiveness. Even if the use of the indicators shown by the 4Q-balance diagram shows a balanced distribution of indicators, imbalances created by the attention given to the indicators may also create imbalance, thereby shifting the centre of gravity of the portfolio, as described by Woods et al.

There are two ways that may be worth exploring:

1. On the one side, to use the 4Q-balance framework at the European level and assess the balance of the portfolio of indicators used by the Performance Scheme by the PRB/EC to support their decision making or option selection. The notion of balancing the portfolio of indicators could be a powerful technique for the Performance Scheme; and,

2. On the other hand, to promote the use of the 4Q-balance framework by the ANSPs in order to identify imbalances in their portfolio’s indicators that drive their own decision-making. The aim is for organisations to use a balanced set of indicators as a good practice, which may become a leading indicator that promotes ANSPs to ensure decision making is taken based on a balanced portfolio with their own indicators.
In addition, another concept to explore that emerge from the Q4 balanced framework is the notion of safety energy. “Safety energy aims at qualifying the resources the organisation is devoting to safety-oriented indicators, and at assessing its capability to be proactive in safety management” (Woods et al, 2015). This is covered in the following section.

5.4.1 Safety Energy Indicators

The measure provides the means to ascertain the actual cost of Safety energy to the organisation in realising **safe productive output** (SPO), where output is expressed as the trade-off between increasing safety and efficiency of SMS against the control of operating costs. There is a trade-off between the opportunity cost of operating safely and that of operating efficiently with respect to the other considered key performance areas [ETTO principle – Efficiency Thoroughness Trade-off]

There is a need to understand the cost of safety against the provision of safe productive output, which will conform to the rules of SMS and Safety policy. SPO should be understood at an individual organisational level for ANSP, CA and NM.. The process of SMS and the cost of maintaining existing levels [EoSM level D for ANSP, C for Competent Authority] of safety maturity (post RP2) can be expressed as a relationship with Safety related to CAPEX during a given period (safety investment). e.g. A negative change or delta in this relationship could indicate an area of concern and one that should be investigated, as previously explained by Q4 of the model. It is recognised that some organisations are more complex than others.

Following a period of collection and observation, this indicator could be made suitable for targeting during RP4. Preparations must be made during RP2 with a view to RP4 so that the advances achieved in RP2 may drive performance in RP4. The indicator is suitable as an indicator during RP3, to enable data collection and observation of the indicator. Suggesting targets in this area during RP3 will logically only add cost pressures and organisational pressures to organisations, if pursued. There is a need to consolidate the gains made during RP2 in Safety and allow for the collection of valuable data that will drive performance gains and the analysis of interdependencies in RP4.

The nature of proactive (leading) indicators helps us to identify the subtle influences in the relationships between those factors and help us to understand and describe a particular manifestation of safety behaviour within the system. These indicators help to inform us about the future rather than examining the future through a lens of the past and trying to understand the reasons behind the event – it is disconnected from causality.

“Today’s organisations operate in an increasingly complex environment as organisations adapt to meet increased pressures for efficiency and productivity in a changing technological environmental and competitive world by maintaining or improving its record of safety” (ACARE 2012).

This increase in complexity requires new metrics that allow organisations to identify when brittleness is increasing and evaluate cost-effective sources of resilience (Hollnagel et al., 2006). Reactive safety approaches can look at specific risk factors one or a few at a time. Proactive measures, especially given the increasing complexity of systems, help identify emergent phenomena and multifactor patterns that can contribute to new risks (Herrera, 2012).

The measure is to ascertain the actual cost of Safety energy to the organisation in realising **safe productive output**, where output is expressed as the trade-off between increasing safety and efficiency of SMS against the control of operating costs. [ETTO principle – Efficiency Thoroughness Trade-off]
There is a need to understand the cost of safety enablers and safety interventions against the provision of safe productive output. SPO should be understood at an individual organisational level for ANSP, Competent Authorities and the Network Manager. The process of SMS and the cost of maintaining existing levels [D for ANSP, C for Competent Authority] of safety maturity (post RP2) can be expressed as a relationship with Safety related to CAPEX during a given period (safety investment). As previously discussed in relation to Q4, a negative change in this relationship could indicate an area of concern and one that should be investigated. It is recognised that some organisations are more complex than others and is also affected by the organisation’s maturity, business model and operational characteristics.

5.4.2 Proposed Safety Energy indicators

Candidate metrics within Quadrant 4 to assess Safety Energy within an ANSP, a Competent Authority and the Network Manager are as follows:

**The ANSP shall report:**
- Safety Energy expressed as a Percentage of annual operating budget planned
- Safety Energy expressed as a Percentage of annual operating budget actual
- Delta between planned and actual (current reporting year)
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget planned
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget actual
- Delta between planned and actual (historical)

**The Competent Authority shall report:**
- Safety Energy expressed as a Percentage of annual operating budget planned
- Safety Energy expressed as a Percentage of annual operating budget actual
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget planned
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget actual

**The Network Manager shall report:**
- Safety Energy expressed as a Percentage of annual operating budget planned
- Safety Energy expressed as a Percentage of annual operating budget actual
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget planned
- Historical 5 year average (n-1 to n-5) as a Percentage of annual operating budget actual

The Safety Energy metrics might be possibly combined with the Rasmussen’s Gradient model in an attempt to address the interdependencies with safety, but this aspect should be further evaluated in a feasibility study.

5.4.3 Data required for the indicator

It is assumed that all organisations publish an annual operating report based on International Financial Reporting Standards. It is further assumed that the information should normally appear in these reports, albeit differently labelled. Given those assumptions, the provision of such reports from each organisation should satisfy the data requirements. Consideration should be given as to the practicability of augmenting data obtained from operating reports with information gathered through the established process of oversight as conducted by the CA and EASA.
6 Summary of proposals for RP3

Following adjustment in order to address Commission expectations, PRB discussion, and to accommodate an agreement within the group in relation to the metrics, this section summarises the final proposal to the European Commission on how to address safety performance in RP3. It is worth noting that most elements related to performance indicators have been discussed within the group, but final adjustments to pull together the complete approach has not been addressed in the group’s discussions.

Much of the RP3 proposal can be seen in the diagram below, which shows how the various elements are linked: Performance Scheme Regulation mandated indicators, EPAS & ATM Risk Portfolio indicators. The actions taken in the EPAS will have an effect on the safety performance of the European ATM system and, consequently, the SPIs for RP3 would certainly capture this effect. Similarly, the ATM Performance Scheme, as a control mechanism to counterbalance adverse safety effects of actions taken in other KPAs, will capture these effects. It is, therefore, expected that the SPIs will capture effects of both set of actions, i.e., actions included in the EPAS and effects of actions in other KPAS due to the implementation of the Performance Scheme. It is reasonable to expect that a single and compatible framework of indicators monitor the safety performance of the ANS system be used, whereby opportunities to leverage synergies are created and inconsistencies and incompatibilities are avoided.

In short, the approach is to select a subset of safety performance indicators to be sited in the Performance Scheme regulation, but retain the management of others (i.e., definition, measurement and analysis) in the EASA Safety Risk Management (SRM) process that monitors and informs the EPAS via an associated ATM collaborative analysis group. The safety assessment would be done by EASA, amalgamating both sets of indicators. The work done by the EASA RP3 WG in addressing safety interdependencies with other performance areas and the measurement of safety energy requires more work prior to be incorporated to RP3. But it is desirable that this can be included within RP3 as a pilot indicator and as a means to calibrate the metric. The measures derived are suggested for collection and observation only, while the calibration of a model is developed. A feasibility study should be devoted to that aim. These novel directions need to be attempted in order to begin real work in the area and the burden of reporting must be considered before moving forward with it.

The Agency believes that a combination of lagging indicators (outcome-based) and leading indicators (process-based) is the appropriate approach to monitor safety performance.
The Agency is not in favour of targeting lagging indicators at organisation or State level due to possible negative effects that such an action will have on levels of reporting (damage to reporting, safety culture, just culture running counter to the principles of Reg. 376/2014 and the improvement of the ECR data).

At the request of the PRB and the Commission, the EASA RP3 SPI WG has elaborated indicators covering RIs and SMIs. The group has decided to propose an indicator close to the NM to measure over deliveries. Their placement within the tiered approach is shown in the diagram.

Output from the combined processes of the EPAS and the ATM Safety Risk Portfolio could be used directly by the Performance Scheme. This will allow for the Safety KPA and risk management of the system to be more dynamic, applicable and up-to-date. This would alleviate the dangers of naming indicators directly in the Performance Regulation. This setting of indicators artificially sets safety performance priorities many years ahead of the reference period. This priority setting will almost certainly be incoherent with the priorities that will be set, at least on an annual basis, via the EPAS. Incoherence in the system is undesirable and would create conflicting allocations of resources and potential safety conflicts.

EASA’s recommendation would be to ensure that there is no duplication of activity and to allow the Performance Scheme to inherit the output of the EPAS and Safety Risk Portfolios.

Further indicators can also be adopted by the Scheme via this mechanism and allow the Performance Scheme to benefit from the introduction of up-to-date indicators, without the need to amend the regulation.

The following table summarises the indicators proposed, where to nest them, options to consider and decisions regarding discarding or retaining current indicators together with remarks.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Indicator</th>
<th>Metric</th>
<th>Where to place the PI</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accidents/Serious incidents</td>
<td>Rate of accidents/serious incidents with ATM</td>
<td>EASA SRM process supporting the</td>
<td>Targeting is not advised</td>
</tr>
<tr>
<td></td>
<td>Contribution</td>
<td>EPAS</td>
<td>Targeting</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------</td>
<td>-----</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Runway Incursions</td>
<td>RIa: rate of RI with ATM contribution at airport level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>RIb: rate of RI at State level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rlc: rate of RI at EU level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
<td></td>
</tr>
<tr>
<td>2+</td>
<td>Separation Minima Infringement</td>
<td>SMIa: rate of SMI with ATM contribution at ANSP level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
</tr>
<tr>
<td></td>
<td>SMib: rate of SMI at State level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMic: rate of SMI at EU level</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised. PI limited to high severe incidents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OvD: % of hours with aircraft rate &gt; 110% slot rate at regulated sectors</td>
<td>Performance Scheme Reg</td>
<td>Targeting is not advised</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Effectiveness of Safety Management – ANSP (Maturity)</td>
<td>Option 1: SoEV2.1</td>
<td>Performance Scheme Reg</td>
<td>Targeting possible. Authorities need to be involved in verification.</td>
</tr>
<tr>
<td></td>
<td>Option 2: Cross domain tool</td>
<td>Performance Scheme Reg</td>
<td>Targeting possible. Duplication of activities to assess SMS. Work on further developing the tool would need to be done.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 3: Cross domain tool</td>
<td>ATM/ANS Common Requirements</td>
<td>Targeting possible</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>Effectiveness of Safety Management – NSA (Maturity)</td>
<td>Option 1: Discontinue the metric</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 2: EASA CMA (Continuous Monitoring Approach) model</td>
<td>EASA SRM process supporting the EPAS</td>
<td>Feasibility study: amend model and indicator development</td>
<td></td>
</tr>
<tr>
<td>3/3+</td>
<td>Rasmussen’s Gradient model</td>
<td>Interdependency metrics</td>
<td>TBD</td>
<td>Feasibility study: operationalise and calibrate model, monitor metrics. It might</td>
</tr>
<tr>
<td></td>
<td>Safety Energy</td>
<td>Interdependency metrics</td>
<td>TBD</td>
<td>Feasibility study: operationalise and calibrate model, monitor metrics... It might</td>
</tr>
</tbody>
</table>
possibly be combined with Rasmussen's Gradient model
# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACARE</td>
<td>Advisory Council for Aviation Research and Innovation in Europe</td>
</tr>
<tr>
<td>ADR</td>
<td>Aerodrome</td>
</tr>
<tr>
<td>AMC</td>
<td>Acceptable means of compliance</td>
</tr>
<tr>
<td>ANS</td>
<td>Air Navigation Services</td>
</tr>
<tr>
<td>ANSP</td>
<td>Air Navigation Services provider</td>
</tr>
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<td>AoR</td>
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9 Appendix A – Runway Incursions

9.1 Introduction
This Appendix has been prepared to outline proposals for safety indicators for Reference Period 3 (RP3) of the Single European Sky (SES) Performance Scheme to address the monitoring of Runway Incursions. The PRB has determined that the elimination of runway incursions (RIs) at local level is one of its major concerns and a safety objective for RP3 [1], and therefore, urged the RP3 development WG to develop SPIs that help monitor this objective. At the 4th meeting of the RP3 development WG held on 15th-16th of June 2016, the group agreed to propose SPIs that will first address the PRB concerns expressed in [1], before developing a more comprehensive set of safety indicators. This paper is the result and action of that meeting with regard to indicators related to RI. A first version was elaborated and reviewed by the group at the 5th and 6th meeting held on 19-20 July and 20-21-22 September, respectively. It was agreed that a final set of three indicators be outlined in Section 9.3. Another paper is being developed with regards the other objective, a reduction of loss of separation at EU level. Both of which will be merged and form part of the final product of the WG.

9.2 Analysis
The EASA RP3 SKPI WG has analysed the PRB White Paper Safety Performance Objective related to runway incursions, stated as follows [1]:

**Elimination of Runway Incursions at local level.**

The EASA RP3 SKPI WG has evaluated the objective, and propose a set of indicators that would help monitoring the materialisation of this aspiration, with the following observations:

- The objective is a noble vision, however to be more realistic it should be restated using the word “reduction” instead of “elimination”. It is accepted that a reduction in the number of RIs at an airport is desirable. However, there are concerns that the objective may lead to the setting of targets on the maximum number of RIs. Experience has shown that a direct consequence of targeting lagging indicators is a negative impact on the level of reporting. As an alternative it is proposed that the objective could be rephrased to “no increase in normalised absolute number of RI”, i.e., no increase of RI rate;
- The PRB white paper aspiration is to eliminate the RI at airport level. It is, however, advisable to monitor the trend of RI occurrences at different levels: airport, State and EU levels, to capture various elements that contributes to the RIs. Different factors can be capture at these three levels, as laid down in the next section.
- There is a need to recognise that ANSPs are not the only party involved in these occurrences – airports, airlines and, ground handling and State (e.g. airport design), are also involved. The WG is of the opinion that ANSPs generate and contribute only a small percentage of the total number of RIs, and that pilots, vehicles, and pedestrians cause higher proportions of RIs. However, ANSPs play an essential role in the recovery from a RI. Monitoring the number of RIs is not a direct measure of the ANSP safety performance, but of the safety performance of the system as a whole. Thus, a system view including all parties should be included when proposing corrective measures to achieve the above objective;
- Pilot behaviour and vehicle driver’s behaviour have a significant impact on the number of RI (e.g. different flight deck workload, crew-coordination, level of experience), and therefore the number of RI is not completely under managerial control of the ANSPs. In many situations these are the contributory factors that play a role in many RIs, without the contribution of ATS
• Airport type/layout is another contributing factor to the number of RI, i.e. large and complex airports have more “exposure” to RI than small and simple airports, so the likelihood of having RI at the former is higher;

• One major issue in capturing RI occurrences is understanding what an RI is. The definition of RI depends on the scenarios considered. The approach could consider the most critical scenarios, and group RIs in each category: e.g., Landing without clearance, crossing a stop bar without clearance and not stopping, or RI with a conflict requiring an avoiding action. However, this would add complexity to the estimation or RI and this approach was not carried forward;

• Potentially the indicator could capture the variation in the number/rate of RI between successive years (by airport movement, including IFR and VFR) at State and EU Level. This is the option that has been carried out later;

• A measure of the number of successful runway operations without incursions could be an alternative way of expressing the indicator, but this approach was not explored and not carried forward;

• The number of IFR and VFR runway movements can be captured by ANSPs and airport operators and both should be used as exposure data

9.3 Proposed SPIs for monitoring RI and associated performance objectives

The use of leading indicators is a longer term action, and their monitoring should not be restricted to one Reference Period. The group has decided to focus on lagging indicators, with the possibility to add more generic leading indicators in the final document resulting from the WG task. Given the analysis in sections 2 and 3, the EASA RP3 SKPI WG proposes the following indicators related to RI:

• Indicator 1:
\[ R_{IA} = \frac{\text{# of RI with ATS/CNS contriobution and safety impact at Airport level}}{\text{# of movements (IFR + VFR) at Airport}} \times 10,000 \]

• Indicator 2:
\[ R_{IB} = \frac{\text{# of RI overall contriobution and safety impact at State level}}{\text{# of movements (IFR + VFR) within the State}} \times 10,000 \]

• Indicator 3:
\[ R_{IC} = \frac{\text{# of RI overall system contribution with safety impact at EU level}}{\text{# of movements (IFR + VFR) within the EU}} \times 10,000 \]

9.4 Further Guidance

The following material provides further guidance as to how the three indicators should be implemented.

• **Definition of Runway incursions**

The understanding of RI should be common and free from any interpretation, which may jeopardise sharing safety lessons learned, causal and contributory factors in RIs. Some sources have identified these variations in interpretation of the commonly accepted ICAO definition [2].

It is proposed to use the definition accepted in ICAO and EU regulations. ICAO definition of runway incursion, which is also transposed into the EASA GM1 SKPI General in Annex to ED Decision 2014/035/R:
Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

This definition should be included in the implementing rule text. With respect to the protected area, the following is proposed [2] should be defined as the runway strip and the ILS sensitive CAT II/III area when reduced or low visibility procedures are in force. The vertical part of the protected area should be interpreted as having physical contact of aircraft, vehicle of person with the above defined geometry (e.g. with a landing aircraft, it needs to have the wheels touching the runway to be considered RI), except in the case of helicopters which hover taxi the surface.

Concerning incorrect presence, the following is proposed [2]: This should be understood as the unsafe, unauthorised or undesirable presence, or movement of an aircraft, vehicle, or pedestrian, irrespective of the causal factor (i.e. ATC, pilot, driver, technical system, etc.). This should be as much as possible a factual observation, but not always there is a clear cut.

- Monitoring the Rate

It is recommended that, for all three indicators, the rate monitored is calculated per 10K movements. These include the departures and arrivals at airports in the Member State that are included in the Performance Scheme (i.e. those airports within the scope of Performance Scheme). The rate of RI should be monitored during the reference period RP3 to identify any significant variation, with the aspiration to reduce the rate at the end of the period.

- ATM/CNS contribution vs overall

Indicator 1 includes those runway incursions for which the ANSP has a contribution. This may include ATS and/or CNS contribution dependent on the ANSP scope. This indicator aims at capturing those situations where the ATS/CNS services contributed directly or indirectly to the occurrence. Recognising the major role of ATS provision in recovering from a RI, it is intended to monitor the situations under the influence of the provider of ATS/CNS services at airport. Using data submitted annually through the European Central Repository [ECR] would allow the identification of these type of occurrences. The aggregation of this indicator is at airport level. This indicator may be complemented with two additional rates of RI with ATM contribution but aggregated at State and EU levels. The group is not proposing to add additional rates as the number of indicators would increase excessively and would make the analysis too complicated.

Indicator 2 includes all types of runway incursions, independent of ATS and/or CNS contribution. This indicator aims at capturing the trend at Member State level of actions of all contributors, i.e., air operators, aerodromes, and ANSPs. Using data submitted annually through the European Central Repository [ECR] would allow the identification of these type of occurrences. The aggregation of this indicator is at Member State level.

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12 Formed by the protected area on either side of the runway centre line and from the respective runway ends as required by ICAO and CS ADR.

13 Note that there may be situations where the RI would have resulted in a less risky situation than otherwise, due to some actions of the people involved. E.g. a situation with an a/c on short final that the ATCO cannot contact to give the clearance to land due to high R/T workload, and the pilot, based on being the flight number one to land and that the runway is clear of traffic, decides to land.
Indicator 3 differs from Indicator 2 on the level of aggregation. It results from the aggregation of all occurrences in the EU.

Indicator 2 and 3 would help monitor the trend of all types of RI, in line with the PRB white paper objective of eliminating all RI at local level.

- Safety Impact: Focussing on occurrences with significant safety impact

It should be recognised that amongst organisations there are variations in the way in which the RI definition is interpreted. If the definition varies slightly between Member States, and assuming a consistent local implementation by airports/ANPs, it should not pose an insurmountable problem, as the main objective of the indicator should be used to monitor trends in each State, or airport/ANSP, and not to benchmark Member States/ANSP. Moreover, and to minimise this issue, it is recommended that the measure is limited to incidents with significant safety impact where any differences in the definition interpretation are least noticeable.

In order to identify the occurrences with safety impact to monitor trends, and because there is no a single method to measure the risk of a RI occurrence, any approach used should capture those with severity A, B, and C as per the severity classification scheme for RIs from ICAO [3].

Several options are possible to capture the risk of a RI occurrence, and therefore, to classify any occurrence as one with a safety effect. Currently, the Performance Scheme (EU 390/2013) requires ANSPs to classify occurrences in terms of safety severity in accordance with the Risk Analysis Tool (RAT) methodology. The Occurrence Reporting Rule (EC 376/2014) requires the development of a common European Risk Classification Scheme (ERCS) to be used by States to classify occurrences in terms of safety risk. In order to avoid creating double requirements to assess occurrences, it is therefore proposed that ANSPs and States will determine whether occurrences have a safety impact using RAT ground severity methodology and the ERCS, respectively.

It is therefore proposed that ANSPs (in coordination with the aerodrome) determines whether occurrences have a safety impact using RAT ground severity methodology, and the RAT safety impacted occurrences will be classified as A, B or C. The States will use the ERCS (currently under development) and although it is not currently clear how occurrences will be determined as safety impacted by the States, it is expected that the classes rated A, B, and C according to ICAO will be linked to the ERCS classification.

It should be noted that the two schemes provide different surrogates of risk. The severity dimension of the risk, is approximated by the RAT methodology, a post investigation tool, based on identified contributing/contextual factors, with the actual outcome of the occurrence, whereas ERCS serves a different purpose, assessing the severity of the most credible outcome of the occurrence, including the number of fatalities/injuries. The probability dimension of the risk is also measured differently.

It is proposed that both ANSP and States will count the absolute number of safety impacted occurrences to calculate the rate of occurrence as defined by indicators 1, 2, and 3. This approach assumes an equal weighting of each of all safety impacted occurrences, consideration should be made as to whether this is appropriate.

- Data requirements to measure these indicators

Data to support the measurement of these indicators are already mandated to be provided by service providers/aerodromes via the ECR in accordance with Regulation (EU) 376/2014. The exposure data, i.e., airport movements, are already mandated by Regulation (EU) 390/2013. NSAs
are already required to validate the data before it is submitted, so the use of the proposed performance indicators should not introduce extra workload to the stakeholders.

Exposure data can be obtained from the Network Manager (via STATFOR), which includes mainly IFR movements and a small portion of VFR flights. However, in order to contain IFR and VFR movements at airports separately, the NM figures need to be complemented by the airports. Airport operators are obliged to provide this information in the current regulation (see Annex V, point 3.2.2 of Regulation (EU) 390/2013). Although the data are intended for monitoring other KPAs, they could be used for safety performance too.

9.5 Limitations of the Proposed Performance Indicators

In the absence of automated detection of RIs, there are a number of limitations with the proposed measures. These are summarised as follows:

- **Interpretation of measurement:** Caution must be taken when interpreting the number of reported RIs. An increase in the rate of reporting, whether at aerodrome, ANSP, State or EU level, could be as a result of improvements in reporting culture, new tools or a genuine degradation in safety or a combination of the above. It is not possible to conclude the reason for changes in the rate of reporting of RIs without detailed investigation to establish what is driving the reporting rate changes.

- **Target setting:** The setting of targets on the rate of reported RIs will make establishing the underlying rationale for any changes more difficult due to the unpredictable impact target setting has on reporting culture.

- **Benchmarking:** The rate of reported RIs should not be compared between airports since it is likely that there are significant differences in reporting culture and differences in their interpretation of the RI definition. In addition, other factors such as the airport lay out plays a significant role in the number of RI occurrences. This may mask the underlying reasons for the differing safety performance (such as differences in organisational culture, structural properties of the system, equipment provided, staffing arrangements, complexity of RWY operations, complex airport lay out etc.), which would help aerodromes and ANSPs understand how best to improve their safety performance.

- **Overall Safety Performance Impact:** Requiring a continued reduction in the rate of reported RIs for all ANSPs may not be the most effective approach to improving safety. An ANSP may be genuinely reporting very low numbers of RIs and there may be other more important safety issues that need to be addressed more urgently. The rate of reported RIs is therefore not an effective measure of safety operation in and of itself. It should be considered as part of a wide package of safety performance measures that together offer greater explanatory power.

- **The identification of runway incursions that have ATM/CNS contribution is not a straight forward exercise, and is subject to interpretations and subjective judgement.**

9.6 Targets

Although some organisations are defining targets for some lagging indicators, such as the number of RIs (e.g. FAA [5]), it is our opinion that within the context of the Performance Scheme and its nuances, setting targets to this type of indicators will create negative effects on organisational reporting culture that may offset any positive effect of target setting. For example, it may discourage reporting of occurrences, unless there is a mandated detection tools to identify RI, or it may create issues when different definitions/interpretations are applied to the events that are reported as RIs. Therefore, the recommendation of this group, in the interests of an open reporting culture, is that it would be inappropriate to target these lagging indicators. This aligns with our understanding that the objective of
this safety KPA is to be that of a control mechanism ensuring that any targets set on cost, capacity and environmental KPAs do not have an adverse impact on safety.

The EASA RP3 SKPI WG therefore believes a suitable compromise would be to aspire to a reduction in the rate of RI as monitored with time (not more than 5 years) at airport/ANSP and State, and EU-wide levels. This would have the additional benefit of being independent of any variances in the way these events are reported or defined between the airports, ANSPs and States, which are known to exist.

9.7 References

10 Appendix B – Separation Minima Infringements Discussion

10.1 Analysis

The EASA RP3 SKPI WG has analysed the PRB White Paper Safety Performance Objective related to loss of separation, stated as follows:

Reduction of loss of separation incidents both horizontally and vertically by focusing on system risk. Application level: EU system wide.

The EASA RP3 SKPI WG has evaluated the objective, and propose a set of indicators that would help monitoring the materialisation of this aspiration, with the following observations:

- “Reduction”

It is accepted that a reduction in the number of losses of separation at the EU level is desirable. The WG remains concerned, however, that the objective may lead to the setting of targets on the maximum acceptable number of separation incidents. Experience has shown that a direct consequence of target setting on lagging indicators (such as number of occurrences) has a negative impact on reporting processes and rates. Therefore, we strongly believe that in the interests of an open reporting culture, it would be inappropriate to target this performance indicator. This aligns with our understanding that the objective of this safety KPA is to be that of a control mechanism ensuring that any targets set on cost, capacity and environmental KPAs do not have an adverse impact on safety.

Furthermore, requiring a continued reduction in the rate of reporting SMIs may not be the most effective approach to improving safety. Some ANSPs are genuinely reporting very low numbers of SMIs. There may be other more important safety issues that need to be addressed, which would yield more safety benefit over and above SMIs.

The EASA RP3 SKPI WG therefore believes a suitable compromise would be to aspire to a reduction in the rate\(^\text{14}\) of losses of separation as monitored with time (not more than 5 years) at the ANSP and State levels, focusing the analysis efforts to monitor of the trend of the number of SMI and detects negative effects of the targeting process in other KPAS. This would have the additional benefit of being independent of any variances in the way these events are reported or defined between the ANSPs and States, which are known to exist.

- “Loss of Separation Incidents”

It is proposed that the term Separation Minima Infringement (SMI) is used instead of the term Loss of Separation Incidents and that the existing SMI\(^\text{15}\) definition between IFR/VFRs controlled flights in controlled airspace is used to define this indicator.

It is acknowledged that the efficacy of the indicator could be improved by use of automated recording systems which capture a greater and more consistent number of events than manual reporting. If this is to be pursued, it is recommended that the

\(^{14}\) See section 7.1 below

\(^{15}\) A situation in which prescribed separation minima were not maintained between aircraft. Definition Source Eurocontrol (2000) [ESARR 2, Edition 1.1] and EASA (2014) [Annex to ED Decision 2014/035/R].
requirement is mandated through an Implementing Rule rather than through the Performance Scheme.

It should be recognised that amongst organisations there are some important variations in the way the SMI definition is interpreted. To minimise this issue it is recommended that the measure is limited to incidents with safety impact\(^\text{16}\) (see section 7.3 below) where any differences in the definition interpretation are least pronounced.

- **“Separation geometry”**

It is important to note that both horizontal and vertical separation needs to be lost to trigger a SMI, rather than either a horizontal or vertical loss as might be implied by the PRB White paper. The proposed definition conforms to ICAO and Industry practices.

- **“Focussing on System Risk”**

There is no reliable means of measuring ‘system risk’ in relation to SMI. Within the scope of the Performance Scheme (EC 390/2013) it is therefore proposed that ‘System Risk’ is defined as follows:

  - For ANSPs, the contribution to the overall system risk should be assessed by monitoring the trend in the rate of SMI with an Air Traffic Service [ATS] or Communications, Navigations, Surveillance [CNS] contribution to the occurrence with safety impact over time, which is considered to be an adequate surrogate for ‘system risk’.

  - Similarly, for States, ‘system risk’ should be assessed by monitoring the trend in the rate of SMI, which include the overall system wide contribution with safety impact over time.

- **Application Level: “EU System Wide”**

Consistent with the Indicators for RP2, an application level of EU system wide means that a safety indicator of this type would be aggregated at the European level. In the event of a potential target setting for this lagging indicator, it should not be set at different level than EU. This will cover SMI between aircraft in En-Route, Terminal and Airport Control Zone [CTR] airspace\(^\text{17}\).

Reporting arrangements for ANSPs providing services outside of their principal place of operations (cross border service provision) will be agreed with the relevant member states.

\(^{16}\) Safety impact of a certain occurrence will be determined using the severity or the risk associated to the occurrence.

\(^{17}\) This would include SVFR, OAT flights provided they are flying under IFR rules and under the control of the ANSP concerned. Note that some ANSPs provide OAT services from a separate unit and estimating the number of these flights may be difficult.
10.2 Proposed SPIs for monitoring SMI and associated performance objectives

Given the analysis in section 2, the EASA RP3 SKPI WG proposes the following indicators to be monitored:

**Performance Indicator 1a:** Rate of Separation Minima Infringements with any ATS and/or CNS contribution with a safety impact at the ANSP Level [using controlled ANSP flight hours].

**Performance Indicator 1b:** Rate of Separation Minima Infringements, which includes the overall system wide contribution, with safety impact at the state level\(^\text{18}\) [using controlled flight hours within the state].

**Performance Indicator 1c:** Rate of Separation Minima Infringements, which includes the overall system wide contribution, with a safety impact at the EU Level [using controlled flight hours aggregated at EU level].

In all cases the trend over the full reference period should be analysed using data submitted annually through the European Central Repository (ECR).

**Application level:** EU system wide.

10.3 Further Guidance

The following material provides further guidance as to how the three performance objectives should be implemented.

- **“Rate”**

  It is recommended that for **Performance Indicator 1a** rate of Separation Minima Infringements (with an ATS and CNS contribution) with a safety impact at the ANSP Level is calculated per 100K IFR Flight Hours as measured by the Network Manager\(^\text{19}\).

  It is recommended that for **Performance Indicator 1b** rate of Separation Minima Infringements, which includes the overall system wide contribution, with safety impact at the state level is calculated per 100K IFR Flight Hours for the state measured by the Network Manager. Note that the number of SMIs included in this metric include all SMIs, regardless the fact that have or not ATS/CNS contribution.

  It is recommended that for **Performance Indicator 1c** rate of Separation Minima Infringements, which includes the overall system wide contribution, with a safety impact at the EU Level is calculated per 100K IFR Flight Hours and determined by aggregating the state level reports in the ECR.

  The number of Flight hours is considered to be a better measure of risk exposure than terminal / En-route aircraft movements. It may be possible to use alternative denominators such as a “flight hours to movement” ratio, a complexity measure or a

\(^{18}\) The application at the local state level, rather than the FAB level is recommended

\(^{19}\) The Network Manager is best placed to consistently report flight hours of ANSPs across Europe.
density measure although specialist analysis would be required to determine the suitability of these denominators.

Due to the fact that the natures of the occurrences used in the three rates are different (Indicator 1a includes only a subset of all SMIs, which are those with ATM/CNS contribution, while Indicators 1b and 1c includes all types of SMIs regardless the contributory factors), the Italian member did not support the use of three types of rates and suggested to vary the level of aggregation between indicators. The rest of the group did not agree with this view and decided to retain the three types of rates for the reasons stated above.

- **Separation Minima Infringements**

  It is proposed to use the Definition described in · · · above: A situation in which prescribed separation minima were not maintained between aircraft.\(^{20}\)

- **“Safety Impact”**

  Currently, the Performance Scheme (EU 390/2013) requires ANSPs to classify occurrences in terms of safety severity in accordance with the Risk Analysis Tool (RAT) methodology. The Occurrence Reporting Rule (EC 376/2014) requires the development of a common European Risk Classification Scheme (ERCS) to enable states to classify occurrences in terms of safety risk. Furthermore, the Occurrence Reporting Rule requires that when developed the ERCS is compatible with existing risk classification schemes such as the RAT.

  It is therefore proposed that ANSPs and states will determine whether occurrences have a safety impact using RAT ground severity methodology and ERCS, respectively. In the case of the RAT safety impacted occurrences will be those classified as A, B or C. It is not currently clear how occurrences will be determined as safety impacted by the States, it is expected this will become clear once the ERCS is fully developed. Such maturity is currently envisaged circa 2020, which coincides with the beginning of RP3.

  It is proposed that both ANSP and States will count the absolute number of safety impacted occurrences to calculate the rate of occurrence as defined by performance objective 1a, 1b and 1c. The ANSP will do it for 1a, and States for 1b, and 1c. This approach assumes an equal weighting of each of all safety impacted occurrences, consideration should be made as to whether this is appropriate.

  It should be noted that the two schemes provide different perspectives on risk. The RAT methodology is used post investigation, based on identified contributing/contextual factors, and assesses the risk of the occurrence based on the outcomes of the occurrence, systemic issues and the probability of reoccurrence, whereas ERCS approximates the risk of an occurrence assessing the highest probable/potential consequence (of an accident in terms of the number of fatalities/injuries) and to the potential effectiveness of the remaining barriers.

\(^{20}\) **Note:** The SMI definition outlined in this document is different to the definition described in EU 376/2014 which is not in line with industry practices and in contradiction with definitions in Eurocontrol (2000) [ESARR 2, Edition 1.1] and EASA (2014) [Annex to ED Decision 2014/035/R].
10.4 Measurement of the Performance Objective

Data to support these performance indicators is already mandated to be provided by service providers via the European Central Repository in accordance with EU 376/2014. NSAs are already required to validate the data before it is submitted, so the use of the Performance Indicator should not introduce significant extra workload.

10.5 Applicability to ANSPs, NSAs and the NM

The measures can be determined directly by the ANSP and the NSA. Application to the NM is not possible. It is therefore recommended that alternative measures are derived to assess the safety performance of the NM.

10.6 Summary of the Limitations of the Proposed Performance Objectives

In the absence of automated detection of SMIs, there are a number of limitations with the proposed measures. These are summarised as follows:

- Caution must be taken when interpreting the number of reported SMIs. An increase in the rate of reporting, whether at ANSP, State or EU level, could be as a result of improvements in reporting culture, new tools or a genuine degradation in safety or a combination of the above. It is not possible to conclude the reason for changes in the rate of reporting of SMIs without detailed investigation to establish what is driving the reporting rate changes.

- The setting of targets on the rate of reported SMIs will make establishing the underlying rationale for any changes more difficult due to the unpredictable impact target setting has on reporting culture.

- The rates of SMI reported by ANSPs should not be compared or used for benchmarking since it is likely that there are significant differences in reporting culture and differences between ANSPs on the interpretation of the SMI definition. This may mask the underlying reasons for the differing safety performance (such as differences in organisational culture, structural properties of the system, equipment provided, staffing arrangements etc.) which would help ANSPs understand how best to improve their safety performance.

- Requiring a continued reduction in the rate of reported SMIs for all ANSPs may not be the most effective approach to improving safety. An ANSP may be genuinely reporting very low numbers of SMIs and there may be other more important safety issues that need to be addressed more urgently. The rate of reported SMIs is therefore not an effective measure of safety operation in and of itself. It should be considered as part of a wide package of safety performance measures that together offer greater explanatory power.

- In circumstances where ANSPs provide cross border services, it will not be possible to correlate the data provided by the ANSP under performance objective 1a with the data provided by the state under performance objective 1b.

10.7 Conclusion

The EASA RP3 SKPI WG has re-worded and broken down PRB Performance Objective One into three separate performance indicators and associated objectives. These objectives, when supplemented by other measures which are currently under development, will form a suitable
set of safety performance measures for RP3 that meet the aims of the PRB, EASA and the Industry. The group proposes how these objectives should be measured but strongly recommends that they should not be targeted to avoid a negative impact on organisational reporting culture.
11 Appendix C – Evaluation summary of current SPI in RP2

<table>
<thead>
<tr>
<th>RP2 Indicator</th>
<th>Recommendation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>JC</td>
<td>Discontinue it</td>
<td>As 376/2014 addresses. In its current form, the JC indicator used does not fit for purpose (JC requires long periods of time to be implemented and evaluated, and the questionnaire is questioned as to a measure the level of JC. Issues with judiciary system). Some metric related to reporting culture to secure the high reporting levels in ANSPs. Just Culture is now included within Reg. (EU) 376/2014 and should perhaps form part of an oversight package under 376. Within RP1 and RP2, Just Culture has been difficult to assess and advance within the framework of a harmonised approach. Just Culture is also subject to Member State laws and differing judicial systems. The indicator in its current form is not fit for purpose as it only demands the existence of Just Culture without the means to monitor and measure it. Suitable components related to reporting culture might be transferred into a reformed EoSM indicator.</td>
</tr>
<tr>
<td>EOSM-ANSP</td>
<td>Keep it but in a modify form</td>
<td>Three options: Option 1: SoE V2.1. The reformed Standard of Excellence is structured to be more objective and challenging than the current questionnaire. The current target would need to be reviewed in light of this. This option represents no more work for the ANSPs as they are doing as part of their current programmes. A new verification/moderation mechanism is required, which may or may not include Competent Authority action. Option 2: The Cross-Domain SMS Assessment Tool. This tool is currently only recommended as Guidance Material. It has been designed to be used the Competent Authority regardless of the aviation domain. There is no rule that recognises and or enforces the use of this tool. Due to a perceived incompatibility with the certification rule, the Italian member did not support targeting this indicator. All other members supported targeting.</td>
</tr>
<tr>
<td>EOSM-CA</td>
<td>Discontinue it or keep the indicator in modified form (see options).</td>
<td>Not suitable in its current form. Opt1. Discontinue the indicator and allow oversight to examine authorities on compliance evidence as opposed to the further maturity of a recognised compliant state. Opt2. Use the output of EASA model (somehow needs modification of the model). It measures the confidence of CA to discharge its responsibility. It requires some additional work to modify it. To be checked if this is feasible.</td>
</tr>
<tr>
<td>RP2 Indicator</td>
<td>Recommendation</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RAT severity applicability (%)-ANSP</td>
<td>Keep the indicator</td>
<td>ANSPs do apply this methodology already and at the end of RP2 the target is for them to apply to 100% of occurrences of category A-A, A, B, C. ANSPs of the group are in favour to keep this as indicator (for SMI, RI, ATM-s).</td>
</tr>
<tr>
<td>RAT severity applicability (%)-CA</td>
<td>Discontinue it</td>
<td>In order to avoid burden of using two methods and assuming ERCS will be mandated by Reg (EU) 376/2014, this SPI should be discontinued. The indicator would be replaced by the use of ERCS, but mandated by other regulation (an Implementing Regulation of Reg (EU) 376/2014, and not included in the Performance Scheme.</td>
</tr>
<tr>
<td>Automatic recording tools - SMI</td>
<td>Discontinue it</td>
<td>Reporting figures identified by the tool is counterproductive as discourage ANSP to use it. This should be as a requirement in other EASA regulations (e.g., part-AUR, Common Requirements).</td>
</tr>
<tr>
<td>Automatic recording tools - RI</td>
<td>Discontinue it</td>
<td>A tool to identify all possible forms of IR is difficult, if possible at all.</td>
</tr>
<tr>
<td>Level of reporting</td>
<td>Discontinue it</td>
<td>Not suitable in its current form</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Link this to reporting culture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some kind of modifications is needed.</td>
</tr>
<tr>
<td>Number of SMI</td>
<td>Discontinue it</td>
<td>Substitute by current proposal of 3 rates of SMI. Number of movements needs to be accompanied with the rates It can be complemented with the measure outside Perf Scheme (risk portfolio)</td>
</tr>
<tr>
<td>Number of RI</td>
<td>Discontinue it</td>
<td>Substitute by current proposal of 3 rates of RI It can be complemented with the measure outside Perf Scheme (risk portfolio)</td>
</tr>
<tr>
<td>Number of AIs</td>
<td>Discontinue it</td>
<td>Not to monitor in the Performance Scheme, but potentially as part of the ATM risk portfolio. It is very much linked to the VFR flights than IFR. There are issues to capture the exposure data.</td>
</tr>
<tr>
<td>Number of ATM-s</td>
<td>This indicator should be monitored via EPAS in a modified form</td>
<td>ANSPs think is not very useful in the Performance Scheme in its current form. These occurrences will be in the ECR and can be monitored outside Perf Scheme in the ATM risk portfolio, if needed. However, it is a type of occurrence with relevance to safety performance of the ANSPs, more importantly in the next years when new technologies will be implemented, specially form SESAR.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option 1: monitor the number of occurrences but only those occurrences more severe (i.e., AA, A, B). Option 2: rate of ATM-specific occurrences. Special attention should be given to the units for normalisation of the rate (operating hours of the relevant ATS units, IFR flight hours)</td>
</tr>
</tbody>
</table>
12 Appendix D – Analysis of Interdependencies and prioritisation of suitable interdependency metrics

The PRB White Paper has identified the need to refocus attention on key risks which show interdependency issues. The PRB White paper outlines that for the Safety KPA interdependencies exist in the following ways:

- Safety adds cost to the system to address identified threats;
- Safety restricts capacity development beyond minima thresholds;
- Regulation due to overload restricts capacity and causes delays;
- Safety KPA and Environmental KPA issues interact in terminal areas particularly on noise issues.

This Appendix examines the meaning of each of the interdependencies and proposes possible options for measurement of those interdependencies to model the impact of cost, capacity and environmental pressures on safety. The EASA RP3 SKPI WG then reviewed each of the measurement options terms of their suitability for inclusion in the Rasmussen gradient model as part of a RP3 safety performance monitoring.

12.1 Safety adds cost to the system to address identified threats

12.1.1 Analysis

The EASA RP3 SKPI WG has analysed each of the words, key phrases and intent of the interdependency as follows:

“Safety adds cost”

Examples of cost drivers that impact safety are:

- Fewer Resources has a direct impact on the ability to provide a safe service. In this example, ‘resources’ includes people, money and materials;
- Opportunity cost – the ability of organisations to spend money in different ways to improve performance [financial, environment, capacity, safety etc.]. This is exacerbated as the evaluation of the return on investment for safety is difficult to quantify, which can result in a reluctance to make investments;
- The cost of poor safety performance is not fully appreciated until after an occurrence or incident has occurred;
- We believe that the best philosophy [from Economic Theory] is output maximisation at constant input [the Google mantra of getting the best value for investment]. We need to ensure the interdependency measures drive ANSPs in this direction;
- Targets on cost can drive input minimisation for constant output, or trying to achieve the same level of performance whilst reducing costs.

“System”

In the context of this interdependency, the system and its components under consideration are:

- The European ATM network;
- National ATM networks;
- Flows of traffic;
- Free movement of people for the most economically viable cost;
• Prevention of market failure due to insufficient ATM capacity;
• Access to the ATM system to new aircraft operators.

“Identified Threats”
Examples of threats identified to safety performance are:
• Increasing complexity;
• Negative consequences of changes to the system [change management];
• Negative consequences from introducing new technology [automation];
• Demands of safety not respected [failure to follow the SMS];
• Reactive identification of threats via lagging indicators;
• Proactive identification or threats via leading indicators.

12.1.2 Interpretation of the PRB ‘Objectives’ for this interdependency area
The EASA RP3 SKPI WG has used this analysis to help interpret the PRBs objective for the interdependency area:
• Cost pressures reduce the ability to manage safety performance;
• Cost pressures reduce the ability to manage system threats;
• Measuring the value of the ‘safety buffer’.

12.1.3 Possible Measures
The following list outlines possible performance measures relevant to this interdependency area:
• Numbers of spare staff available in the roster;
• Traffic complexity
• ATCO Cross competency / validations;
• Cost of overtime;
• Staff related delay;
• Number of overloads;
• Number of voluntary reports of excessive traffic levels;
• Sickness rates due to fatigue;
• Measurement of fatigue – automatic fatigue recognition system;
• Sector opening times vs published opening times;
• Staff running out of ‘hours’;
• Average time on sector;
• Time to complete Investigation reports / reports;
• ‘Quality’ of AIP publications – measured by the number of changes;
• Quality / Number of NOTAMS;
• Duration of NOTAMS [until further notice];
• Increasing sickness on night duty resulting in more night-time closures;
• Number of ‘reversions’ or withdrawals of engineering changes;
• Number of work-arounds in the system;
• Number of problem reports / open problem reports.

12.2 Safety restricts capacity development beyond minima thresholds.

The EASA RP3 SKPI WG has analysed each of the words and key phrases of the interdependency as follows:
“Safety restrict capacity development”

Various interpretations of capacity development were considered by the group:

- Airline required route capacity to achieve scheduling and destination requirements [noting that the cost of capacity to the ANSP is the same regardless of the time of day/year];
- Green capacity – for minimum environmental impact;
- Least cost capacity – noting that the shortest route may not be the cheapest for the airline;
- Best capacity [most punctual] for aircraft operators;
- Cheapest capacity, for instance Flights in Class G and E airspace which may be cheaper but not necessarily as safe;
- Route capacity designed to match aircraft capability;
- Regulatory constrained capacity;
- Military constrained capacity.

For all of the above the group noted that the costs of assuring safe capacity increases may be prohibitive [cost of demonstrating environmental benefits has been huge].

“Beyond minima thresholds”

The term ‘minima thresholds’ is not clear in this context, but has been interpreted as:

- Separation minima thresholds;
- Sector capacity thresholds [as a maximum safe threshold];
- Runway capacity [as a maximum safe threshold];
- Regulatory control thresholds expressed as Rules of the air, ATC Rules, ICAO SARPS etc.;
- Regulation thresholds due to Weather leading to reduced capacity;
- Minimum Staffing levels thresholds as constraint to capacity [with a close relationship to cost and rules].

12.2.1 Interpretation of the PRB ‘Objectives’ for the interdependency area:

The EASA RP3 SKPI WG has used this analysis to help interpret the PRBs objective for the interdependency area:

- Safety constraints restrict Capacity Development;
- Safety constraints restrict economic gain;
- Safety constrains the use of available capacity;
- Safety buffers restrict capacity development;
- Safety regulation restricts capacity [for instance the separation standard permits one aircraft in a 5nm x 1000’ while technological advances might safety permit more than one aircraft]. This is an example of ‘regulatory lag’ where technology advances quicker than the rules.

The group believe that given this interpretation of the interdependency area, the notion that ‘Safety restricts capacity development beyond minima thresholds’ is a positive control, and we should be looking for measures where this control is breached. The measures should measure how capacity can be increased without compromising safe production.

12.2.2 Possible Measures

The following list outlines possible performance measure relevant to this interdependency:

- Use of ASMT to measure the drift in aircraft average separation
- Increased use of automation - a different role for the Human {as an enabler measure}
- Predictability of the traffic flows - deviations from planned trajectory [filed vs actual]
• Stability of the network - variations in peaks of traffic
• Better coverage and tactical control in Oceanic areas to improve delivery to domestic centres { as an enabler measure}
• CDM at European Level {as an enabler measure} for better use of airspace
• 4D conflict free Trajectory {as an enabler measure} requires a different concept of safe separation
• Over-Delivery of traffic
• Numbers of spare staff available in the roster
• Cross competency / validations
• Cost of overtime
• Staff related delay
• Number of overloads
• Number of voluntary reports of excessive traffic levels
• Sickness rates due to fatigue
• Measurement of fatigue – manually or using an automatic fatigue recognition system
• Sector opening times vs published opening times
• Staff running out of ‘hours’
• Average time on sector
• Quality and volume of AIP / NOTAM publications and other Briefing materials to facilitate safety
• Increase in training requirements for complex change to increase capacity
• Increasing sickness on night duty resulting in more night-time closures
• Number of ‘reversions’ or withdrawals of engineering changes
• Number of work-aroounds in the system

12.3 Regulations due to overloads restricts capacity and causes delays
The EASA RP3 SKPI WG has analysed each of the words and key phrases of the interdependency as follows:

“Regulations”
The term ‘Regulations’ is interpreted as ATFM regulations, either at airspace sectors or airports.

“Overloads”
Overloads relate to a sector or an airport. Here a sector or airport overload is a precursor of ATCO workload and a lead indicator of an impact on safety.

“Restricts capacity”
Capacity restriction relates to a sector or an airport. There is a relationship between safety, AFTM delays and capacity, but quantification will be difficult.

“Delay”
Delay is believed to specifically mean ATFM delay.
12.3.1 Interpretation of the PRB ‘Objectives’ for the interdependency area:
The EASA RP3 SKPI WG has used this analysis to help interpret the PRBs objective for the interdependency area:


Within this context, a target setting to ATFM delay will drive down the ATM regulations that are requested by providers, which in turn is likely to increase overload situations, increasing workload and stretching the safety boundary that will result in a degradation of safety, described logically as:

Target ATFM delay → push ATFM regulations↓ → overloads ↑ → workload ↑ → stretches safety boundaries → safety degradation

Reading the wording of the interdependency statement in the opposite direction makes it clear that this is another positive control. The measures should test how delays can be reduced without compromising safe production:

Safety as positive control → protects overloads → imposes ATFM Regulation → creates ATFM delays

12.3.2 Possible Measures
The following list outlines possible performance measures relevant to this interdependency area:

- Number of FTEs devoted to running SMS
- Plans of number of ATCOs available + productivity and sectorisation + declared capacity defines available capacity
- Declared capacity is done differently in ANSPs
- Number of sectors with overload without ATFM regulations
- Number of Intruders (not expected flights)
- ATFM regulations in neighbouring ACC/sectors to ACC above targeted ATFM delays (or “bad delay performers”)
- Overtime work hours by ATCOs in peak season

12.4 Identifying Suitable Interdependency Measures
Each of the measures identified in the interdependency areas above has been weighted according to the following criteria and are shown in the table below:

- Ease of collection
- Objectivity
- The relationship with Safe Production

The measures with the highest ranking have been allocated to the most appropriate of the three principal drivers from the Rasmussen model of gradients shown below.

- Gradient towards least effort
- Management pressure towards efficiency
- Campaigns for safety culture
<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ASMT to measure the drift in aircraft separation</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>1.Capacity 2.Environment</td>
<td></td>
<td>Enabler to do additional analysis and improve understanding of sector operations. Not to identify SMI</td>
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<td>Increased use of automation - a different role for the Human (as an enabling measure)</td>
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<td>1</td>
<td>1</td>
<td>5</td>
<td>Cost</td>
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<td>Deviations from traffic flows in the NOP</td>
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<td>3</td>
<td>1</td>
<td>7</td>
<td>1.Capacity 2.Cost-efficiency</td>
<td>Efficiency</td>
<td>Link with over-delivery.</td>
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<td>Stability of the network - variations in peaks of traffic</td>
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<td></td>
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<td>Link to deviations of traffic flow NOP/over-delivery</td>
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<td>3</td>
<td>2</td>
<td>7</td>
<td>Capacity Cost</td>
<td>Efficiency</td>
<td>Need to define clearly the terms (e.g. declared capacity)</td>
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<tr>
<td>Number/% of spare staff available in the roster</td>
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<td>3</td>
<td>3</td>
<td>8</td>
<td>Cost Capacity</td>
<td>Least Effort</td>
<td>Roster plan submitted to CA (stable in each season)</td>
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<tr>
<td>Cross competency / validations</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>Cost Capacity</td>
<td>Least Effort</td>
<td>If you have the tool</td>
</tr>
<tr>
<td>% of cost of overtime (% hrs worked extra vs % hrs worked normal of ATCOs)</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>Cost Capacity</td>
<td>Least Effort</td>
<td>ACE contains metrics of extra hrs (see page) Possibly more useful in hrs than cost</td>
</tr>
<tr>
<td>Seasonality of traffic</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>Cost Capacity</td>
<td>Efficiency</td>
<td></td>
</tr>
<tr>
<td>Staff related delay</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>Capacity</td>
<td></td>
<td>Cause category in the ATFM</td>
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<tr>
<td></td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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</tr>
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<td>Number of overloads</td>
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<td>2</td>
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<td></td>
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<td>Number of sickness rates</td>
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<td>7</td>
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<td>Number of open positions</td>
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<td>3</td>
<td>1</td>
<td>6</td>
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<tr>
<td>Regulation breaches related to fatigue (e.g., more hrs working than allowed)</td>
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<td>3</td>
<td>1</td>
<td>7</td>
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<td></td>
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<tr>
<td>ATCO time on sector</td>
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<td>3</td>
<td>3</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in training requirements for complex change to increase capacity sickness on night duty</td>
<td></td>
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<td></td>
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<tr>
<td>Number of ‘reversions’ or withdrawals of engineering changes</td>
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<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Number of Temporary Operating Instructions</td>
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<td>3</td>
<td>2</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of FTEs devoted to running SMS</td>
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<td>2</td>
<td>3</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Plans of number of ATCOs available + n/a</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Be aware of difference between overload vs over-delivery**

More difficult with manual operation.

More potential in combination with traffic complexity/density.

Increasing sickness on night duty resulting in more night-time closures. It can be taken from previous metric.

TOI increases complexity.

Need guidance to estimate the minimum.
<table>
<thead>
<tr>
<th>Productivity and sectorisation + declared capacity defines available capacity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>Number of sectors with over-deliveries without ATFM regulations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>Capacity</td>
</tr>
<tr>
<td>Number of Intruders (not expected flights)</td>
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<tr>
<td>ATFM regulations in neighbouring ACC/sectors to ACC above targeted ATFM delays (or “bad delay performers”)</td>
<td>n/a</td>
<td></td>
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<tr>
<td>Overtime work hours by ATCOs in peak season</td>
<td>n/a</td>
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<td>Assets depreciation/CAPEX</td>
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<td>3</td>
<td>1</td>
<td>7</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Hours of industrial action</td>
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<td>3</td>
<td>1</td>
<td>7</td>
<td>Least Effort</td>
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<td>Traffic complexity</td>
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<td>2</td>
<td>3</td>
<td>8</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Percentage of ANSP Budget spent on Safety</td>
<td>3</td>
<td>2</td>
<td>3</td>
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</tbody>
</table>

Subset of over deliveries. ANSP has the information

Subset in peak seasons

Over long period of years, but for short periods of time

Linked to discontent of staff

As measured by PRU
## Appendix E – Membership of the EASA RP3 S(K)PI Working Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Job Title</th>
<th>Group Membership</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>Roger DILLON</td>
<td>CANSO</td>
<td>Head of External Safety</td>
<td></td>
<td>Co-Chair</td>
</tr>
<tr>
<td>Eric DE CAUSEMACKER</td>
<td>Belgian CAA</td>
<td>ATM Performance Expert</td>
<td></td>
<td>Co-Chair</td>
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<tr>
<td>Ross INWOOD</td>
<td>EASA</td>
<td>Safety &amp; Performance Technical Assistant</td>
<td></td>
<td>Secretary</td>
</tr>
<tr>
<td>José-Luis GARCIA CHICO</td>
<td>EASA</td>
<td>Safety Analysis Officer</td>
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<td>Member</td>
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<tr>
<td>Isabel Clara BARBERO</td>
<td>EASA</td>
<td>ATM/ANS Regulations Officer</td>
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<td>Member</td>
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<tr>
<td>Katie CUSSEN</td>
<td>Irish Aviation Authority</td>
<td>Safety Analyst</td>
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<tr>
<td>Franscisco BERNAL</td>
<td>AESA</td>
<td>ATM/ANS Regulations Officer</td>
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<tr>
<td>21 John THOMSON</td>
<td>UK CAA</td>
<td>Intelligence Services Delivery Manager</td>
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<tr>
<td>Sam ESPIG</td>
<td>NATS UK</td>
<td>Head of Safety Strategy Development</td>
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<tr>
<td>Hervé FORESTIER</td>
<td>DSNA</td>
<td>Head of Performance Assurance Division</td>
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<td>Heino KUSTER</td>
<td>DFS</td>
<td>Head of Safety Policy &amp; Performance</td>
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<td>21 Rob LEGG</td>
<td>EASYJET</td>
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<td>Tamara PEJOVIC</td>
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<td>Razvan ULARESCU</td>
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<tr>
<td>Anthony SMOKER</td>
<td>IFATCA</td>
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<td>21 Tom LAURSEN</td>
<td>IFATCA</td>
<td>Executive Vice-president Europe</td>
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<td>Member</td>
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<tr>
<td>Luca FALESSI</td>
<td>ENAC</td>
<td>Head of ATM Regulation Unit</td>
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<td>Mervyn OLIVER</td>
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<td>Safety Quality &amp; Security Manager</td>
<td>Expert</td>
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<td>Antero LAHTINEN</td>
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<td>EASA</td>
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<td>Advisor</td>
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<tr>
<td>Rolf TUCHHARDT</td>
<td>European Commission – DG MOVE</td>
<td>Policy Officer</td>
<td></td>
<td>Advisor</td>
</tr>
</tbody>
</table>

21 Nominated - no attendance recorded