European Union Aviation Safety Agency

Comment-Response Document 2018-12

Reduction of runway excursions

CRD to NPA 2018-12 — RMT.0570 — 7.10.2019

EXECUTIVE SUMMARY

This comment-response document (CRD) contains the comments received on notice of proposed amendment (NPA) 2018-12 and the individual responses provided to them by the European Union Aviation Safety Agency (EASA).

The summary in this CRD highlights the most substantial comments received and the corresponding EASA responses.

Based on these comments, EASA has made some changes to the proposed amendments to Part-26, CS-26, and CS-25.

Finally, this CRD also provides the list of preventable occurrences considered in the impact assessment (IA) of NPA 2018-12.

Action area:	Runway safety		
Affected rules:	Part-26, CS-26, CS-25		
Affected stakeholders:	Large aeroplane operators, large aeroplane manufacturers and their suppliers, Supplemental Type Certificate applicants		
Driver:	Safety	**Rulemaking group:**	No
Impact assessment:	Full	**Rulemaking Procedure:**	Standard

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Summary of the outcome of the consultation

94 unique comments were received via the CRT tool on this NPA (95 in total) made on 12 segments by the following 23 stakeholders:

Airbus, Bombardier, CAA NL, CAA UK, ERAA, Collins Aerospace Avionics, Dassault Aviation, DGAC France, EBAA, Embraer, ESDU, Eurocontrol, Garmin International, GAMA, IATA, KLM, LBA, Mitsubishi Aircraft, NHF Technical Committee, Ryanair Technical Services, Safran Nacelles, Wideroe Flyveselskap, and 1 individual.

The following stakeholders sent comments that were received shortly after the end of the NPA public consultation and were also taken into account in this CRD: Boeing (2 comments), TCCA (3 comments).

Therefore, in total, EASA took into account 99 unique comments from 25 stakeholders.

The 95 CRT comments were distributed as follows (NPA segments):

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The majority of the commentators were supportive of the EASA proposal, and some of them proposed to revise the regulatory text to improve its clarity, add missing elements into the specifications, or make corrections.

This positive feedback has been used by EASA to amend the regulatory text. This includes better consistency between the CS-26 and CS-25 specifications, while providing clear high-level objectives in Part-26, adding some missing specifications into CS-25 and CS-26 to clarify the minimum expected functions and capabilities of the ROAAS, as well as AFM elements, which clarify that an automated means of deceleration control is optional.

Some commentators raised the following comments challenging some elements of the EASA proposal:

— Regarding Part-26, point 26.205, providing a three-year timeline for the production cut-in after the entry into force of the Regulation:

Some industry stakeholders commented that three years is not enough time, and proposed five or seven years instead. The EASA rulemaking task started in 2012. After a first NPA in 2013, the rulemaking task was supported by the preparation and the publication of an international industry standard (EUROCAE ED-250) thanks to the collaborative work of members representing the majority of large aeroplane and equipment manufacturers, some pilots unions, some operators, and aviation authorities (including EASA), the standard was issued in December 2017. EASA should issue the Opinion to the European Commission on an Amendment of Part-26 in September 2019, which means that the entry into force of the corresponding Regulation should happen in the best case by the end of 2020, or in Q1 of 2021. Adding three years after the entry into force of this Regulation means that aeroplanes (newly produced) must be equipped by the end of 2023 or Q1 of 2024. EASA is aware that various ROAAS projects have been launched during the last few years, and some of them are close to completion at the time of writing this CRD. EASA considers that for such cases, the projected deadline would be adequate. However, it is also recognised that some stakeholders have not yet started to develop a new system, or adapt an existing one, that complies with the proposed rule and the corresponding EUROCAE standard.

EASA therefore agrees to change the proposed deadline in order to provide five years between the date of publication of the Opinion to the EC and the date of applicability of the production cut-in, and not less than three years between the entry into force of the Regulation and the applicability of the production cut-in. EASA considers that the publication of the Opinion is a clear and official statement to the industry stakeholders that they have to prepare to comply with the future regulation.

- The proposal to exempt from the proposed Part-26 rule aeroplanes produced in limited quantity, aeroplanes of old designs but still in production, and freighters:

Regarding old designs and aeroplanes produced in limited quantity, considering the current available information and the trend of newly produced aeroplanes registered in EASA Member States, EASA does not foresee that the presented cases could occur in practice. Furthermore, the actual date of applicability of the future Part-26 (anticipated to be early 2025 or later) will leave enough time for stakeholders to find a solution that fits their needs. Concerning the case of freighter aeroplanes, these aeroplanes share their avionics architectures and type certificates with other non-freighter aeroplanes, so the costs of equipping such aeroplanes will not require to be amortised by the freighter versions only.

— The proposal to exempt turboprop aeoplanes:

The data submitted by a commentator (source IATA) actually indicate that turboprop aeroplanes have a higher risk of a runway overrun, and a higher rate of fatal accidents, than jet aeroplanes.
The EASA impact assessment (IA) shows that turboprop aeroplanes can benefit from a ROAAS: the list of 41 preventable runway excursions (EASA MS operators only) includes 10 turboprop aeroplanes (5 accidents including 1 fatal, and 5 serious incidents). Therefore these figures do not support an exemption for turboprop aeroplanes.

- The proposal to limit the applicability of the proposed Part-26 rule to aeroplanes with MOPSCs of 20 or more and MCTOMs of 45.3t or more (i.e. aiming to exclude business aeroplanes from the rule):

In the list of 41 accidents and serious incidents (1991-2017) which may have been prevented (EASA MS operators only) by the installation of a ROAAS, 23 of the involved aeroplanes (56 %) have MCTOMs below 45.3t, and 6 of them (15 %) are typical business jets. These 6 business-jet-related occurrences include 4 accidents, 1 of them with fatalities, and 2 serious incidents. Therefore, these figures do not support an exemption for business aeroplanes as proposed.

EASA also notes the statement made by the EBAA that 'Business aviation segment aircraft also have a high likelihood to voluntarily install ROAAS and potentially ROAAS can be seen a standard for business aviation size aircraft'. This policy is very welcome and should ease the implementation of the proposed Regulation.

Finally, we would like to remind readers that the applicability of the proposed Part-26 rule is limited to CAT operations, and therefore it does not impact private operations.

The EASA responses to individual comments are provided in the following section.

Individual comments and responses

In responding to comments, a standard terminology has been applied to attest EASA's position. This terminology is as follows:

(a) **Accepted** — EASA agrees with the comment and any proposed amendment is wholly transferred to the revised text.

(b) **Partially accepted** — EASA either agrees partially with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.

(c) **Noted** — EASA acknowledges the comment, but no change to the existing text is considered necessary.

(d) **Not accepted** — The comment or proposed amendment is not shared by EASA.

(General Comments)	-

comment	*1*	comment by: *NHF Technical committee*
	NHF does not have any comments to this NPA.	
response	Noted.	

comment	*2*	comment by: *Luftfahrt-Bundesamt*
	The LBA supports the proposed amendments and has no further comments on NPA 2018-12.	
response	Noted.	

comment	*7*	comment by: *Ryanair Technical Services*
	Dear Sir/Madam, Rynair has reviewed the NPA for manadating a Runway Awareness system on all new aircraft from 2022 and supports the EASA proposal. Best regards John Clear Director of Technical Services	
response	Noted.	

comment	*8*	comment by: *ESDU, IHS Markit*
	In principle, the introduction of ROAAS is supported as it should give a safety benefit.	
response	Noted.	

comment	*9* comment by: *ESDU, IHS Markit* The NPA proposes ROAAS for large commercial aeroplanes (CS-25). Given that many overrun accidents and incidents occur with smaller jet aircraft (CS-23), it is suggested that the scope of the NPA should be expanded to all jet powered aircraft.
response	Not accepted. This rulemaking activity was initiated based on the fact that a runway excursion is a relatively frequent cause of accidents for aeroplanes involved in commercial air transport (CAT), which essentially concerns aeroplanes in the CS-25 category. EUROCAE standard ED-250 has therefore been developed for application to CS-25 aeroplanes. Although the standard application may be modified in the future to be adapted to CS-23 light jet aeroplanes, mandating the installation of a ROAAS for this category of aeroplanes is not considered to be cost-effective from a rulemaking impact assessment perspective.

comment	*11* comment by: *ESDU, IHS Markit* EUROCAE ED-250, para 1.5.2, Page 6 introduces new definitions of landing distances - PLD, RMD, TLD - that we believe are unique to this document. Whilst these are explained in Appendix C in terms of already existing definitions, it is regrettable that this proposal will introduce yet another set of terms for landing distances.
response	Noted. NPA 2018-12 was not intended to provide a consultation on the technical content of EUROCAE ED-250. But please note that these definitions were the outcome of thorough discussions in the EUROCAE working group, and they were finally considered necessary for the ROAAS system specifications.

comment	*13* comment by: *ESDU, IHS Markit* EUROCAE ED-250, Para 3.1.3.3. In defining airborne alerts no mention is made of integrating these with existing systems, for example radio-altimeters or GPWS. This is a critical aspect of crew procedures that requires careful attention.
response	Noted. NPA 2018-12 was not intended to provide a consultation on the technical content of EUROCAE ED-250. But this comment relates to aspects belonging to aircraft integration and that are not required to be addressed in the EUROCAE standard.

comment	*14* comment by: *ESDU, IHS Markit* EUROCAE ED-250, Appendix, A.1 The diagram suggests that a go-around may be initiated after touch-down. This seems to be countrary to all current thinking. It implies that there is a further decision point after the initial decision to land (taken at the 50ft threshold point or lower for autoland). Generally go-arounds post

	touchdown have not been shown to be safe and can result in high energy accidents - because of the time taken to stow reversers and spoilers and for engine thrust to develop. (Note: It is accepted that for autolandings, a decision to go around from, for example, a 15ft decision height may result in the aircraft's wheels rolling on the ground briefly).
response	Noted. NPA 2018-12 was not intended to provide a consultation on the technical content of EUROCAE ED-250. But please refer to the note provided below this figure and the following table, related to the 'transition phase' after touchdown, which states that 'each manufacturer may define the conditions for which a go-around is no longer expected (customized for each type design)'.

comment	*15* comment by: *ESDU, IHS Markit* EUROCAE ED-250, Appendix, C.1.3.1. How are airworthiness design regulatory definitions/assumptions of pilot reaction times and system delays to be integrated with a ROAAS?
response	Noted. Those two aspects are design dependent and must therefore be analysed during each certification project. Note that paragraph C.1.3.3 of ED-250 elaborates further on these aspects.

comment	*23* comment by: *KLM* · *In the worldwide international scope of the aviation industry, government initiatives should be taken worldwide where ever possible. Please amend the EASA initiative to be in close cooperation with FAA and incorporate this in the NPA.*
response	Noted. EASA agrees on the principle of harmonisation with the FAA as far as it is possible. However, on the present subject, the FAA took a different position from EASA, which is explained in the response of the FAA to the NTSB, dated 5/5/2016, concerning safety recommendation A-11-028: 'From Michael P. Huerta, Administrator (…) Industry is taking ownership and is advancing current systems to heighten awareness and effectively reduce risk that accompanies operating in and around the runway environment. Industry has proven itself sufficiently motivated to develop and apply for certification of increasingly more mature systems as they are developed, and our current rules are sufficient to allow the FAA to certify these systems without revision. For these reasons, development of new airworthiness standards requiring installation of runway excursion advisory systems is not warranted. I believe the FAA has effectively addressed this recommendation and consider our actions complete.'

comment	*30* comment by: *EUROCONTROL* EUROCONTROL supports the proposed rule change to mandate installation of ROAAS on board of new aircraft.

	We wish they are mandated on all aircraft, but agree that this would be a very costly solution having in mind that ROAAS do not mitigate the veer-off risk
response	Noted.

comment	*38* comment by: *UK CAA* Thank you for the opportunity to comment on NPA 2018-12, Reduction of Runway Excursions. Please be advised that there are no comments from the UK Civil Aviation Authority.
response	Noted.

comment	*75* comment by: *Dassault-Aviation* **Comment:** Dassault Aviation strongly support the action to reduce the safety risk associated with runway excursions at landing, following up on our involvement in drafting the EUROCAE document ED-250 MOPS of ROAAS. The chosen option 2, introduction of a ROAAS requirement into CS-25 for new type certificates, associated with the use of CS-26 for mandating a ROAAS installation on aircraft manufactured after a certain date appears to be achieving the right cost-effectiveness balance.
response	Noted.

comment	*85* comment by: *DGAC Deputy Head of aircraft and operations rulemaking department* Please note that DGAC France has no specific technical comments on this NPA. Nevertheless, we would like to know the reason why the changes proposed by this NPA amend the CS26 and not the Regulation (EU) 965/2012 CAT and NCC annexes as is the case for TAWS or ACAS equipment?
response	Noted. Part-26 (Annex I to Regulation (EU) 2015/640)) was identified right from the beginning of this rulemaking task as the most suitable regulation because the intent was to mandate airworthiness specifications for a type of operations (CAT in this case), which is exactly the purpose of Part-26. The OPS Regulation may have been used in the absence of Part-26.

1. About this NPA p. 3-4

comment	*76* comment by: *Dassault-Aviation* **Comment:** Page 3 §1.3 , first bullet: typo on regulation number: (EU) 2015/640 and not 6406
response	Accepted. The last '6' digit was supposed to be the reference to foot note number 6.

2. In summary — why and what p. 5-6

comment *3* comment by: *Christopher Mason*

Operating with RAAS once pilots have assimilated the logic of the system, can be very beneficial to their decision making during approach and landing. It can also reduce unnecessary go arounds, which we know are inherently risky. The classic example would be the Emirates 777 in Dubai in which they encountered a tailwind on short final and went around. RAAS could and should have told them that they would still have had over a kilometre more landing distance than they needed.

The main down side is that it introduces a new and additional set of aural notifications in the cockpit, with the potential for distraction and/or misunderstanding. On balance it is positive but there the cost per aircraft currently is not commonly known to determine value.

ERA

response Noted.

comment *5* comment by: *Tim SINDALL*

The overall objective of reducing the number of runway excursions during landings may be achieved as proposed in this NPA by requiring large aeroplanes to be equipped with a design-related means to alert the crew to an impending longitudinal runway over-run, but this 'back-stop' solution should not be considered in isolation. Rather, consideration should be given also to assist crews to avoid getting themselves into such a situation in the first place by assisting them through visual guidance to execute accurate tracking in the final stages of their approach and subsequent touchdown.

To this end EASA might wish to consider developing a requirement that all instrument runways should be equipped with a full set of precision approach path indicators (PAPIs) that would comprise four boxes on each side of the runway, for many aerodromes in Europe do not currently provide a full set. Such an arrangement produces via the unlit gap between the sets of lights a visual and compelling indication of the glide path origin.

It is suggested that the full PAPI system as was initially developed at RAE Bedford should be considered complementary to the longitudinal runway alerting system and passed to the relevant officials in EASA for their consideration.

It will be noted that the full PAPI solution would be of early benefit to all large aeroplanes that would not be required to retrofit the alerting system that is the subject of this NPA as well as all other aerolanes that not being described as 'large' would not be expected to carry the alerting system.

The one, a full PAPI solution, would effectively complement the other, adoption of the propsals contained in this NPA.

response Noted.

The lack of a 'full' PAPI installation does not appear among the causal factors of runway excursions during landing. The EASA specifications for aerodrome design have transposed the relevant provisions of ICAO Annex 14 with regard to the provision of PAPI, and which already include the possibility for the provision of a second wing bar on the other side of a runway. Nevertheless, this comment has been forwarded to the EASA Aerodromes Standards and Implementation Section to be taken into consideration.

comment *16* comment by: *Wideroe Flyveselskap AS*

2.1 Why we need to change the rules - issue/rationale Page. 5

In the IATA Runway Safety Accident Analysis Report 2010-2014 is Runway Excursion defined as two types of events:

- Veer Off: A runway excursion in which an aircraft departs the side of a runway
- Overrun: A runway excursion in which an aircraft departs

Runway Safety Accident Data in the report compares frequency of Runway Excursions for Different Phases of Flight and Aircraft Propulsion

RWY Excursion type	Number of accidents - Total	Phase of flight	Jet	Number of fatal jet-accidents	Turboprops	Number of fatal turboprop accidents
Overrun	35	Landing	24	3	11	2
Veer-offs	41	Landing	19	0	22	0

The full report states that turboprops have a higher rate of runway excursions than jet aircraft. Furthermore, the data shows that turboprops are more likely to veer off the runway than to actually overrun it. Hence, a sophisticated system for predicting overruns are less likely to have an effect on turboprops and therefore the cost benefit analysis is probably lower for turboprops than for jet.

response Not accepted.
This data indicates that turboprop aeroplanes have a higher risk of a runway overrun than jet aeroplanes because the size of this fleet is significantly smaller that the jet fleet. Moreover, this data also indicates a higher rate of fatal accidents for turboprop aeroplanes vs jet aeroplanes.
Please note that the EASA IA was based on a longer time period (1991-2017), it included serious incidents, and was restricted to EASA operators.

comment *17* comment by: *Wideroe Flyveselskap AS*

2.1 Page 5.

	Question to EASA: It is referred to large aeroplanes. What is large aeroplanes in this context? Aircraft mass or aircraft category A, B, C, D and E? It could be argued that a Category B DASH-8 Q200 aircraft with a published landing distance of 400 meters probably has less overrun issues than a fast heavy jet. However, a Cat C DASH-8 Q400 has a published landing distance of 850 meters, which is comparable to an Embraer 190 jet and as such may be more prone to overrun incidents or accidents.
response	Noted. 'Large aeroplanes' in this context refers to aeroplanes that have the Certification Specifications for Large Aeroplanes 'CS-25' or equivalent in their certification basis.

comment	*18* comment by: *Wideroe Flyveselskap AS* 2.3 Page 6. Question to EASA: The short landing distance of a Cat B turboprop arise the question if ROAAS will be working on short fields and steep approach runways? Is this addressed in the certification specifications?
response	Noted. EASA does not find any technical reason why these operations could not be addressed during the certification of a ROAAS. EUROCAE ED-250 includes provisions on steep approach operations (if certified) and different runway lengths. The proposed CS 25.705 does not exclude steep approach operations.

comment	*22* comment by: *KLM* · *No rationale is given in the NPA about the costs of developing and implementing these systems. Have the proper parties (e.g. airplane and equipment manufacturers, certification bodies etc.) been consulted?*
response	Noted. Chapter 4.4.2 of the NPA, titled 'Data collection', states that 'unit costs estimated in this IA are based on information provided by aeroplane and equipment manufacturers'. For confidentiality reasons, we do not mention the names of the manufacturers.

comment	*25* comment by: *AIRBUS* Airbus suggests to change: "For the last few decades, runway excursions have been recognized …" by: "For the last few decades, runway excursions at landing have been recognized …"

	Rationale: This change will avoid any ambiguity in requesting such systems for rejected Take Off, which are rare events with even more rare longitudinal overruns. Please note that the Industry is developing voluntarily Take Off Securing / Take off Monitoring that should prevent in early phase of TO preparation or in TO initial acceleration occurrence of unsafe or marginally safe Take Off, which are more frequent than unsafe or marginally safe rejected Take Off.
response	Accepted. Note that this is mentioned in other places in the NPA. But please also note that this part of the NPA will not be re-published.

comment	*26* comment by: *AIRBUS* In §2.1., Airbus suggests to change the following: "After touch-down, the system is able to provide a timely alert to the flight crew if the measured deceleration is not sufficient to bring the airplane to a safe stop before the end of the runway." by: "After touch-down, the system is able to provide a timely alert to the flight crew if the calculated stopping point is beyond the end of the runway." **Rationale:** There is no reason to impose a design by defining the aircraft measured current deceleration as a criteria for prediction of airplane stopping point.
response	Accepted. But please note that this part of the NPA will not be re-published.

comment	*27* comment by: *AIRBUS* Airbus suggests to change: **Related safety issue** The US National Transportation Safety Board (NTSB) reported the following: 'On July 31, 2008, about 0945 central daylight time, East Coast Jets flight 81, a Hawker Beechcraft Corporation 125-800 A airplane, N818MV, crashed while attempting to go around after landing on runway 30 at Owatonna Degner Regional Airport (OWA), Owatonna, Minnesota. The two pilots and six passengers were killed, and the airplane was destroyed by impact forces.' The following safety recommendation (SR) has been addressed to the FAA by the National Transportation Safety Board (NTSB) further to the investigation of this accident: The FAA was requested to actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it become available, require that the technology be installed.'

by:

Related safety issue

NTSB Safety Recommendation A-11-028

The US National Transportation Safety Board (NTSB) reported the following:

• 'On July 31, 2008, about 0945 central daylight time, East Coast Jets flight 81, a Hawker Beechcraft Corporation 125-800 A airplane, N818MV, crashed while attempting to go around after landing on runway 30 at Owatonna Degner Regional Airport (OWA), Owatonna, Minnesota. The two pilots and six passengers were killed, and the airplane was destroyed by impact forces.'

• The following safety recommendation (SR) A-11-028 has been addressed to the FAA by the National Transportation Safety Board (NTSB) further to the investigation of this accident: The FAA was requested to actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it become available, require that the technology be installed.'

• The runway was ungrooved and wet.

• Based on information in FAA August 8, 2018, letter, NTSB notes that major airplane manufacturers such as Airbus, Boeing, Embraer, and Gulfstream have developed, certified, and are installing technology to reduce or prevent runway excursions in newly manufactured aircraft. We further note that Honeywell has developed a system that can be installed on in-service airplanes, and its Smart Runway/Smart Landing systems, or similar, are being used in a variety of in-service airplanes from a number of manufacturers. This information demonstrates that industry is voluntarily adopting the technology, which is an alternative that satisfies this recommendation. Accordingly, Safety Recommendation A-11-28 has been classified by NTSB on Sept 25th, 2018 as CLOSED--ACCEPTABLE ALTERNATE ACTION.

European Action Plan for the Prevention of Runway Excursions (EAPPRE)

• Recommendation 3.4.4. Aircraft Operator: The aircraft operator should consider equipping their aircraft fleet with technical solutions to prevent runway excursions.

• Recommendation 3.5.3 Aircraft Manufacturer: On-board real time performance monitoring and alerting systems that will assist the flight crew with the land/go-around decision and warn when more deceleration force is needed should be made widely available.

• Recommendation 3.7.11 EASA: Develop rulemaking for the approval of on-board real-time crew alerting systems that make energy based assessments of predicted stopping distance versus landing distance available, and mandate the installation of such systems.

ICAO Global Runway Safety Action Plan

• Recommendation Aircraft Operators 15. Equip aircraft with runway overrun awareness and alerting systems, as appropriate.

• Recommendation Aircraft Manufacturers 2. Continue development of runway overrun awareness and alerting systems.

• Recommendation Aircraft Manufacturers 5. Continue development of stable approach and energy management monitoring and alerting systems.

IFALPA Position Paper 16POS05

• IFALPA supports the development and installation of a Runway Overrun Awareness and Alerting System (ROAAS) in all commercial transport aircraft as a means to reduce the number of longitudinal runway excursions on landing.

Commercial Aviation Safety Team (CAST)

SE 218 Overrun Awareness and Alerting Systems - Manufacturers develop and manufacturers and operators implement onboard technology to reduce or prevent landing overruns on new and existing airplane designs, as applicable and feasible.
• Output 1 - Manufacturers agree to make available onboard technology to reduce or prevent landing overruns on applicable new transport category airplane (TCA) programs launched after June 1, 2015. Applicable new TCA programs include:
◦ New type certificate programs
◦ Major derivative, amended type certificate programs involving redesign of flight deck avionics
• Output 2 - Airplane manufacturers and avionics suppliers study the feasibility of providing onboard technology to reduce or prevent landing overruns on current production and out-of-production transport category airplane (TCA) programs.
• Output 3 - Air carriers implement onboard technology, as feasible, to reduce or prevent landing overruns on existing transport category airplane (TCA) programs.

Rationale:

Airbus proposes a slight complement to NTSB SR A-11-028 extract, and addition of the appropriate up-to-date list of safety recommendations for the justification of related safety issue.

response

Noted.
The NTSB safety recommendation reference is indeed A-11-028. It was indicated in the first NPA 2013-09, but was not re-used in this second NPA, by mistake.

The different positions and recommendations mentioned in this comment are valid for the topic 'runway excursions', but are not really necessary in the paragraph being commented on ('Related safety issue'), which was intended to define the safety issue, including the relevant safety recommendations dealing with design solutions, but not the various positions of the stakeholders groups.

Please note that this part of the NPA will not be re-published.

comment *41* comment by: *EBAA*

p.5-6 2. In summary – why and not:
Related safety issues.
The accident and the following report from NTSB, referred to as a safety issue addressed in this NPA, rightly lists "*the development of technology to reduce or prevent runway excursions and, once it becomes available, require that the technology be installed (A-11-28)*" as one of the fourteen recommendations made by the NTSB to FAA in the report. However, there is no mentioning that an installed ROAAS system may have aided the PiC in the decision making to go around or not, in the Conclusions or Probable cause of the report. Furthermore, the probable cause stated in the report does not address ROAAS as such but rather address: the captains decision making, pilots' poor crew coordination and lack of cockpit discipline, fatigue, failure of FAA to require CRM and SOP training for part 135 operators, inadequate arrival landing distance assessment guidance, Part 135 weather briefings, PiC line check, etc.

	FAA elected not to follow the recommendation and have approved installed ROAAS system as a voluntary installed equipment as and not made mandatory as in any of the proposed options 1 to 3 of this NPA. Thereby allowing a discrepancy between FAA and EASA that will have an impact on EBAA members choice of state of registry should any of the option 1-3 be applicable for EASA registered business aviation aircrafts. Another issue is related to the presented options. Option 1, assumes that 18 years after mandatory implementation 50% of the fleet would have a ROAAS. The present technological developments are with such a pace that it might be realistic to expect that systems like ROAAS would already be out-dated well before the 50% or 75% (option2) by (2040 assuming a 2022 as publication date) in service is reached. The same reasoning is applicable to option 2. Therefore mandating a ROAAS as indicated in these options is really no option at all. Thus the only realistic options are either option 0 or option 3. Since option 3 is considered far too expensive and not cost effective only option 0 remains as the only viable option related to ROAAS. A system with a voluntarily installation of a ROAAS would not only be in line with the FAA, but would also be the realistic and viable option. As a consideration for EASA, it might be suggested that a voluntarily installation of a ROAAS might be stimulated with operational benefits for those aircraft operators having installed a ROAAS in their aircraft. That would speed up installing ROAAS taking into account the pace of technological developments and as such would serve safety much more effectively than in the proposed option 2. EBAA is willing to work with EASA in finding concrete incentives leading to stimulating ROAAS in (business type) aircraft.
response	Not accepted. The proposed specifications do not mandate any particular technology. But if, in the future, it appears that new systems have been developed that are able to provide equal or even better protection against runway overruns, EASA could adapt the specifications as necessary; the use of special conditions (SCs) is also possible. Regarding the suggestion to 'find incentives', EASA understands that the proposal would be to issue operational rules in order to restrict operations (e.g. ban operations on runways below a certain length, on contaminated runways, or the approach under certain degraded visibility/meteorological conditions, etc…) of aeroplanes not equipped with a ROAAS, and therefore provide an operational benefit to operators equipped with a ROAAS. This would therefore imply putting option 3 into force, as most of the operators would probably want to avoid the operational restrictions. The IA does not support this option, and EASA prefers to keep the approach of option 2.

comment	*53* comment by: *General Aviation Manufacturers Association / Hennig* **EASA Should Review Status of NTSB Safety Recommendation** EASA specifically identifies a July 31, 2008 business jet accident in the section entitled "Why we need to change the rules - issue/rationale" and one of the fourteen

	associated safety recommendations (SR) issued by the U.S. National Transportation Safety Board (NTSB). NTSB SR A-11-028 states that: "TO THE FEDERAL AVIATION ADMINISTRATION: Actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it becomes available, require that the technology be installed." GAMA notes that on September 25, 2018 (a few weeks prior to EASA's publication of NPA 2018-12), the NTSB---in response to various FAA activities driven by A-11-028---closed the safety recommendation with the classification "CLOSED--ACCEPTABLE ALTERNATE ACTION." The FAA specifically elected not to mandate technology to reduce or prevent runway excursions (i.e., ROAAS), but instead---through various activities---has promoted the development and voluntary adoption of technology with this safety capability. A review of the docket identifies a number of aeroplane models on which equipment has been installed including, per an August 8, 2018 FAA-NTSB communication, the following models and installation rates: "...Airbus had installed... on 781 aircraft with 54 operators. [...] ROPS was instealled on the following aircraft models: A320 (451); A380(I79); A350 (I02)(sic); and A330 (49). ROPS is available for retrofit and line-fit on Model A320, A330, A380 aircraft, and is included as a basic feature on the Model A350 type design. [...] Boeing: Received FAA type certification approval for their ROAAS on the Model 737NG as well as the Model 737 Max. It is available as an option. Embraer: Developing a RO AAS system, targeting entry into service in 2019. Gulfstream: In the process of integrating and certifying Honeywell's Smar Runway/Smart Landing system in conjunction with a jointly developed ROAAS into an existing product, with the intent to implement the system in future products. [...] The Honeywell Smart Runway... has been installed on--Airbus Model A300, A3I0 (sic), A320, A330 and A340 aircraft, -Boeing Model 727-200, 737-400, 737NG, 747-400, 757-200, 767-300, 777-2/300, DC-9, MD-I 0 (sic), MD-11F and MD-80 aircraft, the Tupolev TU-204, Tlyushin 96-300, and various business jets."" https://www.ntsb.gov/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-11-028 GAMA notes that this list is not exhaustive, but that the technology is also available from OEMs not cited in the FAA-NTSB communications. GAMA recommends that EASA review the analysis available in the docket as it supports our separate comments encouraging the voluntary adoption of ROAAS-capability by European operators (i.e., Option 1), because it shows that the light-touch, voluntary approach pursued by the U.S. FAA has proven effective.
response	Noted. It is true that some aeroplanes are already equipped with systems intended to protect against runway excursions, and that some other systems are being developed. Nevertheless, please note that the IA performed in the EASA NPA considers only the retroactive requirement affecting aeroplanes registered in an

EASA Member State, while we understand that the figures mentioned in this comment are on a worldwide scale. Moreover, it should be noted that the Honeywell initial version of Smart Landing (the module pertinent to runway longitudinal excursion mitigation) cannot be used to comply with the proposed CS-25 and Part-26 rules because it is not an energy-based system.

Finally, the intent of EASA is to ensure that the system will be installed and will not remain as an option. It is very difficult to estimate how many aeroplanes would be equipped in the future if there was no regulatory mandate.

comment *58* comment by: *Bombardier*

The justification to require a ROAAS does not appear to take credit for expected safety improvements in runway excursion resulting from the efforts of TALPA / FAA AC 25-32 and the corresponding EASA NPA 2016-11. The historical data that is used to project forward the assumed accident rate against which EASA is assessing the safety benefit includes data all the way back to 1991; yet Fig 1 of the report indicates at least a qualitative shift in the risk level from, say, 2009. Other safety actions and initiatives, such as TALPA, Honeywell Smart Landing TM, Collins Aerospace TLAF, have occurred during the period selected, and would be expected to significantly impact the future accident rate even with no ROAAS. The cost/benefit analysis provided by EASA NPA over-estimates the benefits provided by ROAAS because it does not account for operational improvements in the last 10years driven by TALPA and other operational changes. It is suggested that EASA rework the cost-benefit analysis to take this into account.

response Noted.
Figure 1 shows that although there was an improvement period after 2009, with very few or no accidents or serious incidents, from 2013, the trend worsened, with an increase in the number of occurrences between 2015 and 2017.

The projected accident or incident rate in the IA is based on the risk assessment as of 2018, which is then combined with an estimation of the increase in the size of the fleet in Europe. As always, it is possible that other factors will affect the actual rate of occurrences in the future, and some factors may have positive effects, while others may have negative effects. The outcome of the TALPA initiative (included by EASA in NPA 2016-11 and Opinion 02/2019) should bring a positive effect on runway excursions for which the main causal factor was linked to the actual runway contamination being either wrongly reported or not sufficiently taken into account in the landing performance assessment process. However, the IA of NPA 2018-12 gave safety benefit only to occurrences in which other causal factors were dominant, such as non-stabilised approaches, and landing too fast or too long, which could be mitigated by a ROAAS; in such cases, better reporting or the use of runway decontaminants would not prevent the runway excursions.

comment *59* comment by: *Bombardier*

"No drawbacks are expected" - Does not take into account the very real possibility of significant increase in the number of false positive annunciations, that result in go around incidents as a result of implementation and the resultant impact on ATC.

	The acceptable rate for nuisance alerts inducing go-around should be specified in the AMC; ED-250 only specifies the severity of loss of function and misleading alert.
response	Noted. This topic on the acceptable rate of nuisance alerts was discussed within the EUROCAE working group that developed ED-250, and the group decided that it was not appropriate to specify a value. Guidelines to minimise nuisance alerts is, nevertheless, part of ED-250.

comment	*61* comment by: *Bombardier* The example, an incident referred to in the "Related Safety Issue", does not demonstrate how a ROAAS system would have helped avoid the accident. A description should be added to indicate how a ROAAS system would have contributed to a reduced risk of incorrect go around maneuver by the pilot.
response	Noted. This occurrence happened outside EASA Member States and was therefore not taken into account in the IA of this NPA. — However, the NTSB investigation indicates that a ROAAS may have prevented or mitigated this accident by alerting the crew: during the approach, as ‘a landing distance assessment using Section 25.109 data would have indicated that the runway length was insufficient for landing with at least a 15-percent safety margin with an 8-knot tailwind’, which might have triggered an alert in-flight and normally led to a safe go-around; — on ground, as the required deceleration means (an air brake system) was not properly used, and therefore the deceleration performance was inadequate, which might have triggered an alert early in the landing roll phase.

comment	*62* comment by: *Bombardier* Please clarify the % split between longitudinal vs lateral runway excursions during landing, and identify how the % of longitudinal excusions is used in the economic benefit analysis re. accidents expected to be prevented by ROAAS.
response	Noted. In total, 102 accidents and serious incidents were identified between 1991 and 2017, among which 64 occurrences (27 accidents and 37 serious incidents) were considered to be runway longitudinal excursions (although in some cases there can also be some side excursion components). The projected number of accidents used for the economic benefit is based on the number of accidents (15) which could have been prevented by a ROAAS.

comment	*63* comment by: *Bombardier* The addition of real-life examples illustrating the expected behavior of the ROAAS would be helpful within the NPA to scope the capabilities and limits to consider.

	This should include examples where the ROAAS could not prevent an overrun (for example, a runway that is more slippery than reported).
response	Noted. On Page 18 of the NPA, it is stated that ROAASs could not have prevented events in which: — a mechanical failure was the major factor that contributed to the runway overrun, or — the landing was performed in weather conditions that were clearly outside the limitations of the aeroplane. These are the main factors that have been observed during the analysis of occurrences. Other factors can also contribute to decreasing the credit for a ROAAS, for instance, human factors related issues, the incorrect reporting or the incorrect use of the runway condition, specific meteorological phenomena (e.g. windshear), etc.

comment	_67_ comment by: _Safran Nacelles_ Paragraph 2.3 25.705 also requires an on-ground predictive alert or automated means of deceleration control to be installed to actively protect the aeroplane from a runway overrun. This seems beyond the overview of the proposals which is limited to alerting systems.
response	Partially accepted. The intent was not to mandate an automated means of deceleration control, but to leave it as an option for the applicant. This has been clarified in the resulting text.

comment	_77_ comment by: _Dassault-Aviation_ **Comment:** Page 5 §2.1 first paragraph, first line: style, are runway excursions "major contributors to accidents" or are they an incidents/accident type themselves, therefore contributing in a major manner to the number of accidents, or being a major proportion of the list… ?
response	Accepted. Runway excursions is a category of occurrences which represents a substantial portion of all accidents and presents a high level of risk. For instance, in the EASA Annual Safety Review 2018, runway excursions are identified as one of the two main key risk areas accumulating the highest risk score.

comment	_78_ comment by: _Dassault-Aviation_ **Comment:** Page 5 §2.1 first paragraph, 4th line: If 80% of reported runway excursions are at landing, how many of those are longitudinal excursions?
response	Noted.

In the landing occurrences reviewed, 63 % of the occurrences were classified as longitudinal excursions; therefore this represents a share of 50 % of all runway excursions.

comment	*79* comment by: *Dassault-Aviation* **Comment:** Page 6 §2.4 Second paragraph: "No drawbacks are expected". It may be that safety benefits largely outweigh the associated costs, but those supporting these costs may find it a drawback (as long as they are not immediately affected by a runway excursion incident, or avoidance of such).
response	Accepted. The cost impact is also mentioned in this section of the NPA. It may indeed be considered to be a drawback by some stakeholders.

comment	*87* comment by: *Collins Aerospace Avionics* We request that data be referenced to support the expectation that there would not be an unjustified increase in go-around rate or negative impact to safety due to false alerts. Was an OSED done prior to MOPS?
response	Noted. ED-250 contains various provisions intended to minimise false or nuisance alerts, which are potential concerns in the development of any system that triggers an alert to the flight crew. As an example, ROAAS_RECO13 provides the following: 'ROAAS Equipment should be designed so that ROAAS false alerts due to erroneous sensor inputs are minimized'. For CS-25 certification, the specifications of CS 25.1322 (Flight crew alerting) and the related AMC also apply at the aeroplane level, and should ensure that the ROAAS is developed with an acceptable level of design integrity that avoids nuisance and false alerts and provides reliable alerts to the flight crew when needed.

3. Proposed amendments and rationale in detail — 3.1. Draft regulation (Draft EASA Opinion) (Part-26) p. 7

comment	*6* comment by: *KLM* The proposed text in CS 26.205 "Compliance with Part 26.205 is demonstrated by complying with CS 25.705" suggests that the requirements for a Runway overrun awareness and alerting system, as specified in Part 26.205, are identical to the requirements for a Runway overrun awareness and alerting system as specified in CS 25.705. This is, however, not the case as Part 26.205 requires a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway whereas CS 25.705 requires a system that shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with a timely in-flight predictive alert of a longitudinal runway

	overrun risk, and an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing. In this context, could EASA please provide an explanation for the differences between the Part 26.205 and CS 25.705 requirements and rephrase the proposed text “Compliance with Part 26.205 is demonstrated by complying with CS 25.705” or the text proposed for Part 26.205 and/or CS 25.705.
response	Accepted. The intent is to provide the same specifications in Part-26/CS-26 and CS-25. The resulting text clarifies this point.

comment	*10* comment by: *ESDU, IHS Markit* The NPA proposes amending CS 26 and and CS 25 to make installation of a ROAAS mandatory for certain aircraft, but it does not propose any associated requirements to ensure consistent integration between Airworthiness, Operational Performance and Crew Procedures. The EUROCAE ED-250 addresses this to some extent, but the NPA does not include amendments to address crew procedures or operational requirements setting out the required/expected response/actions of the crew if the ROAAS gives a warning. Is it intended that ROAAS will be 'armed' prior to landing, including crew selections for runway condition, autobrake settings, NOTAMs for runway distance available etc? At what point will this be required? Where will these crew procedures be specified?
response	Accepted. The specifications of CS 25.705 have been amended and now include what is expected to be provided in the AFM, which includes flight crew procedures following an alert. It also specifies that the system shall operate during approach (from a given height above the selected runway) and landing.

comment	*28* comment by: *Garmin International* **Section 26.205 - Page -7:** Proposed 26.205 indicates that it will take effect for aeroplanes with Certificate of Airworthiness first issued on or after “[three years after the entry into force of this regulation]”. Based on the NPA 2018-12 section 4.5 impact analysis, 2022 is the presumed mandate that would replace the bracketed text. While NPA 2018-12 section 4.1 notes that “some aeroplane and equipment manufacturers have developed, or are developing, systems that provide an alert when there is a risk of a runway overrun during a landing”, there is no analysis of how many of the current production CS-25 business aeroplanes have a certified runway overrun alerting system, nor does the analysis consider the difficulty of certifying such a system. The reality is that aeroplane and equipment manufacturers must work collaboratively to certify a “real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway.” This collaboration begins with the aeroplane manufacturer performing extensive flight testing to gather the type-specific landing performance data needed to derive accurate, type-specific energy

	models that can be used in the equipment manufacturer's alerting system. Garmin provides integrated flight deck capabilities for six current production CS-25 business aeroplane models, none of which have a certified runway overrun alerting system. In Garmin's case, some of the required performance data is available in existing type-specific Takeoff and Landing Data (TOLD) functions; however, other type-specific data still must be gathered to fully support the runway overrun alerting function. Once all data is gathered, then the runway overrun alerting function must be certified, which is another significant effort for each aeroplane type. Consequently, in Garmin's view, it is unlikely that all CS-25 business aeroplanes for which Garmin provides integrated flight deck capabilities will be able to be certified by the presumed 2022 mandate. Given Garmin's experience with other aggressive European mandates for data comm and ADS-B Out, Garmin recommends either: 1. Allowing voluntary equipage for CS-25 business aeroplanes, or 2. Pushing out the required equipage date to five or seven "years after the entry into force of this regulation".
response	Partially accepted. EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the Regulation and the applicability of the production cut-in.

comment	*29* comment by: *Garmin International* **Section 26.205 - Page -7:** Proposed CS 26.205 indicates it applies to "Operators of large aeroplanes". As noted in section 2.3, this NPA proposes to amend EU Regulation 2015/640 in addition to proposing amendments to CS-25 and CS-26. EU Regulation 2015/640 Article 2 (b) defines 'large aeroplane' as "an aeroplane that has the Certification Specifications for large aeroplanes 'CS-25' or equivalent in its certification basis". Other European aviation operational mandates are defined in terms of MTOM. For example, EU Regulation No 2016/583 mandates the carriage of ACAS II (TCAS II) version 7.1 within European Union airspace by all civil aeroplanes with a MTOM exceeding 5,700 kg or authorised to carry more than 19 passengers. In such cases, some CS-23 aeroplanes are subject to the mandate since their MTOM exceeds 5,700 kg with the implication that, for the purpose of the mandate, they are "equivalent" to "large aeroplanes". NPA 2018-12 does not specifically state that CS-23 aeroplanes exceeding 5,700 kg MTOM are not intended to be subject to this mandate through special conditions, CRI, etc. If EASA were to apply this mandate to CS-23 aeroplanes, Garmin provides integrated flight deck capabilities for four current production CS-23 aeroplane models with MTOM exceeding 5,700 kg, none of which have a certified runway

	overrun alerting system. This would further add to the unlikelihood that the mandate could be met within "[three years after the entry into force of this regulation]". Garmin recommends that when promulgating the NPA 2018-12 proposed amendments, it is clarified that "large aeroplane" does not apply to CS-23 aeroplanes with MTOM exceeding 5,700 kg. This would not preclude CS-23 aeroplanes of any weight from voluntarily equipping with a runway overrun alerting function. However, in the context of voluntary equipage, some EU regulations are prescriptive; e.g., EU Regulation No 2016/583 AUR.ACAS.1005 (2) states "Aircraft … which are equipped on a voluntary basis with ACAS II shall have collision avoidance logic version 7.1." While the proposed CS 25.705 and AMC 25.705 amendments are less prescriptive, Garmin further recommends that when promulgating these amendments, it is clarified that aeroplanes that voluntarily equip with a runway overrun alerting function are free to propose other means of compliance.
response	Noted. As indicated at the beginning of this comment, the definition of 'large aeroplane' provided in Regulation (EU) 2015/640 refers to aeroplanes certified with CS-25 in their certification basis. This mandate therefore does not encompass aeroplanes certified with CS-23 in their certification basis. Voluntary certification of a system on a CS-23 aeroplane may be done using a standard different from the one required for a CS-25 aeroplane.

comment	*39* comment by: *EBAA* **p.7 3** EBAA new or amended text to the proposal in the NPA in magenta. **p.7 3. 3.1.** 26.205 Runway overrun awareness and alerting systems Operators of large aeroplanes, with an MOPSC of 20 or more and a MCTOM of 45.3 metric tons or more used in commercial air transport should ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [three years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway. MOTIVATION EBAA concludes that mandatory installing a ROAAS for business type aircraft is never cost effective.
response	Not accepted. In the list of 41 accidents and serious incidents (1991-2017) which could have been prevented or mitigated by the installation of a ROAAS, 23 of the involved aeroplanes (56 %) have MCTOMs below 45.3 tons, and 6 of them (15 %) are typical business jet aeroplanes. These 6 business-jet-related occurrences include 4 accidents, 1 of them with fatalities, and 2 serious incidents.

Based on these figures, EASA does not agree to exclude business jets from the scope of the proposed Part-26 rule. But please note that the proposed applicability is limited to commercial air transport operations.

comment 48 comment by: *General Aviation Manufacturers Association / Hennig*

Definition of Large Aeroplane for Purpose of ROAAS

EASA proposes to limit the applicability of the Runway Overrun Awareness and Alerting System (ROAAS) retrofit requirement to large aeroplanes (CS-26.205).

GAMA interprets this definition of "large aeroplane" to be based on the definition in Regulation (EU) 2015/640:

"'large aeroplane' shall mean an aeroplane that has the Certification Specifications for large aeroplanes 'CS-25' or equivalent in its certification basis."

GAMA requests that EASA confirm that the agency intends to limit the applicability only to aeroplanes that are subject to CS-25 and that all CS-23 aeroplanes, including those with a certificated take-off mass of 8.618 kg (19,000 lbs) and a passenger seating configuration of 19 or less, are exempted from the proposed applicability.

Any installation of ROAAS or similar aircraft capability by operators of CS-23 aeroplanes should occur on a voluntary basis.

response Accepted.
The scope of the proposal does not include CS-23 aeroplanes.

comment 49 comment by: *General Aviation Manufacturers Association / Hennig*

Continued Voluntary Equipage for Business Jets

Equipping business jets with ROAAS and similar capabilities is currently occurring on a voluntary basis. GAMA questions whether EASA's proposed way forward (Option 2) is appropriate and encourages EASA to revisit Option 1.

GAMA noted in comments to NPA 2013-09 (August 12, 2013; comment number 142) that the agency had underestimated the complexity of applying the equipment mandate to... in-production aeroplanes.

EASA stated in NPA 2013-09 that 20 transport category aeroplanes currently in production would be impacted by the mandate (NPA at 18). NPA 2018-12 seems to use a similar number of 20 large aeroplanes for its analysis ("...if 20 type are available on the market in a given year..." NPA at 4.5).

Currently, there are 25 different CS-25 aeroplane models in production in the business jet industry alone. The air transport (i.e., Airbus, Boeing, Bombardier, and Embraer) in-production models used by scheduled airlines adds many more models to that number.

	Including in-production business jet in the CS-26 mandate, as proposed in Option 2, would significantly increase the cost of the mandate as the complete list of models currently in production does not seem to have been part of EASA's Regulatory Impact Analysis (RIA). GAMA recommends that EASA limit the CS-26 applicability. Further to GAMA comments in 2013, GAMA recommends that the agency consider narrowing the applicabilty of the CS-26 regulation for ROAAS equipment to aeroplanes with a passenger seat configuration of 20 passenger seats (see, NPA 2013-09, comment 142). GAMA strongly supports the continued voluntary equipage for in-production and existing fleet business jets with ROAAS capability as has been exemplified by manufacturers across GAMA's membership. Note 1: GAMA, as discussed further in comment 53, recommends that EASA review the U.S. Federal Aviation Administration's (FAA) response to recommendation A-11-018-031 and the NTSB's acceptance of the voluntary adoption of runway overrun protection systems as justification for the continued voluntary adoption of ROAAS technology by business jet manufacturers for in-production aeroplanes and as retrofit into the existing fleet. Note 2: Historically, EASA (and prior to that Joint Aviation Authority) differentiated business jets by a 45,500 kg or 45,360 kg mass threshold. As noted in separate rulemaking activities conducted by the agency (e.g., RMT.0695), a shift from mass to passengers seats threshold is appropriate. If EASA accepts GAMA's recommendation for voluntary adoption of ROAAS by business jet operators, GAMA recommends that the agency use passenger-seat configuration to identify business jets.
response	Not accepted. The quoted statement of Section 4.5 of the NPA ("(...)*e.g., if 20 types are available on the market in a given year*(...)"), is provided as an example to illustrate the calculation of the share of each type within the total annual new deliveries. This information is relevant to calculate how fast the share of new types is going to increase in the total fleet. As of 2018, data from Ascend shows that aeroplanes from 22 different type certificates in the CS-25 category have been sold and registered in EASA Member States for commercial air transport (CAT) operations. This includes 11 type certificates in the business jet category. In the list of 41 accidents and serious incidents (1991-2017) which could have been prevented or mitigated by the installation of a ROAAS, 23 of the aeroplanes involved (56 %) have MCTOMs below 45.3 tons, and 6 of them (15 %) are typical business jets. These 6 business-jet-related occurrences include 4 accidents, 1 of them with fatalities, and 2 serious incidents. Based on these figures, EASA does not agree to exclude business jets from the scope of the proposed Part-26 rule. But please note that the proposed applicability is limited to commercial air transport (CAT) operations.

comment	*50* comment by: *General Aviation Manufacturers Association / Hennig*

	Proposed Three Year Timeline for CS-26 GAMA separately has stated its support for voluntary equippage with ROAAS for business jets (see, comment 49) and support for Option 1. If EASA elects to proceed with Option 2, however, GAMA reminds the agency of our comments to NPA 2013-09 about a three year timeline, and our preference for a five year timeline based on our experience with aircraft upgrades: "...the typical timeframe from making application for new type certification to the granting of a type certificate is five years. The agency, however, through this rulemaking seems to propose that an aeroplane manufacturer that has already locked in final design (such as, through the setting of a certification basis for the project) will have to make changes to their design mid-stream. This will have a negative impact on existing project currently undergoing type certification or validation with the agency. GAMA recommends that for new type, the agency establish a minimum of a five-years in consideration of typical timelines for type certification for new type aeroplanes in the transport category. Similarly, it is GAMA's experience that the proposed 3-year timeframe for the implementation of the NPA requirements is inadequate for in-production aeroplanes based on the time needed for the development, certification, changes to production, and management by each manufacturer of numerous production lines." If EASA proceeds with Option 2, GAMA recommends that 26.205 provide a minimum of five years after the regulation enters into force (as opposed to three years after the entry into force of the regulation as propsed) for its applicability to aircraft that are issued with a new individual Certificate of Airworthiness.
response	Partially accepted. EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the regulation and the applicability of the production cut-in.

comment	*52* comment by: *General Aviation Manufacturers Association / Hennig* **Specify Required Capabilities and Not Means by Which They May be Provided** The proposed regulation should specify the required capability and not the means by which that capability may be provided. GAMA recommends that 26.205 be reworded to identify the key points of the intended functionality. One possible alternative rewording to provided a clearer capability in the regulation would be that the aircraft "...is equipped with a system that calculates a predicted landing stopping point in real-time, both in flight and on-ground, and alerts the flight crew when the predicted landing stopping point exceeds the end of the runway."
response	Partially accepted. The Part-26 text has been amended to provide the high-level objectives to be met by a ROAAS, and the CS 25.705 / CS 26.205 text has been amended to more clearly specify the ROAAS functions.

comment	*56*	comment by: *Bombardier*
	3 years seem insufficient for vendors to develop new equipment, and then for aircraft OEMs to certify installation. Adequate time needs to be provided for the following 1. TSO to be published 2. Equipment manfufacturers to develop solution and get TSO approval 3. Definition/guidance on certification requirement to be published (AMC) 4. Aircraft OEM to develop and certify installation Bombardier is therefore suggesting at least 5 years.	
response	Partially accepted. EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the Regulation and the applicability of the production cut-in. EASA proposed to create ETSO-2C158 for ROAAS in NPA 2019-06, dated 22.5.2019. The proposed ETSO requires compliance with the EUROCAE ED-250 standard. Regarding CS-25 guidance and acceptable means of compliance, EASA considers that the EUROCAE ED-250 standard, in addition to other CS-25 provisions, allows new projects to be certified; the CRI process can also be used to agree on project-specific issues. At this stage, EASA does not wish to issue prescriptive elements in the AMC.	

comment	*69*	comment by: *Safran Nacelles*
	The ROAAS systems intend to focus on the landing braking phases, i.e. calculation of landing distance compared to LDA. Safran think that such system could also be relevant in case of rejected take-off, i.e. calculation compared to ASDA to reduce pilot's reaction time and improve decisions during a rejected take-off.	
response	Noted. Although the statement of this comment may be valid, it is not intended to mandate such a function to be used for the take-off phase. The EASA proposal is based on an identified safety issue, which is the risk of a runway longitudinal excursion during landing.	

comment	*71*	comment by: *Embraer S.A.*
	Embraer understands that three years is an inadequate amount of time to develop the ROAAS for multiple aircraft models. **Rationale:** Since the ROAAS is a real-time flight crew alerting system that makes energy-based calculations of the predicted landing stopping point, this is a system that must be customized by the aircraft OEM for each aircraft type and model. The ROAAS is not a "COTS" system that is easily installed in the aircraft without customization, whatsoever.	

	The installation of the ROAAS will have to take into account the specific aircraft's characteristics. Flight tests and studies will have to be carried out in order to minimize the nuisance alerts rate to an acceptable level. Airbus' published certification rate for matured ROPS in different aircraft models shows a 1 ROPS/year (see Eurocontrol's Hindsight Figure 2, page 84 at https://www.eurocontrol.int/sites/default/files/publication/Hindsight/hindsight-22.pdf). Furthermore, technical feasibility is not covered by the analysis. Old aircraft that are still being delivered may not have a feasible solution to implement ROAAS. Five years, instead of three, seem to be the correct amount of time necessary to carry out all the activities for all the applicable aircraft types and models. **Suggestion:** To change the text from: *"Operators of large aeroplanes used in commercial air transport shall ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [three years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway."* To: *"Operators of large aeroplanes used in commercial air transport shall ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [five~~three~~ years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway."*
response	Partially accepted. EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the Regulation and the applicability of the production cut-in.

comment	*74* comment by: *Embraer S.A.* EASA proposes to limit the applicability of the Runway overrun awareness and alerting system (ROAAS) retrofit requirement to large aeroplanes (CS-26.205). Therefore, Embraer understands, based on definition of large aeroplane in Regulation (EU) 2015/640, that all CS-23 aeroplanes are exempted from the proposed applicability, including those with a certificated take-off mass of 8.618 kg (19,000 lbs) and a passenger seating configuration of 19 or less. We suggest to make the applicability of the rule more clear, limiting it only to CS-25 aeroplanes, stating that the installation of ROAAS by operators of CS-23 aeroplanes should occur on a voluntary basis.
response	Noted.

	As indicated at the beginning of this comment, the definition of 'large aeroplane' provided in Regulation (EU) 2015/640 refers to aeroplanes certified with CS-25 in their certification basis. This mandate therefore does not encompass aeroplanes certified with CS-23 in their certification basis. Voluntary certification of a system on a CS-23 aeroplane may be performed using a standard different from the one required for a CS-25 aeroplane.

comment	*86* comment by: *Collins Aerospace Avionics* The proposed 3 year timeline (post entry into force of this regulation appears too short for industry to achieve.
response	Accepted. EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the regulation and the applicability of the production cut-in.

Boeing comment 1:
THE PROPOSED TEXT STATES:
"26.205 Runway overrun awareness and alerting systems
Operators of large aeroplanes used in commercial air transport shall ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [three years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway."
REQUESTED CHANGE:
"~~26.205 Runway overrun awareness and alerting systems~~
~~Operators of large aeroplanes used in commercial air transport shall ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [three years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway~~."
JUSTIFICATION:
Boeing is in support of Option 1. Option 1 states:
Option 1: Amend CS-25 to provide high-level requirements for the installation of a ROAAS on every aircraft of all new designs, making reference to ED-250 as an acceptable means of compliance.
We think equipping future new type certificated models with ROAAS will provide significant fleet coverage consistent with the cost-benefit discussion in NPA 2018-12.
Thus, we think CS 26.205 should be deleted.
We are not in support of Options 2 or 3. We think the cost to implement options 2 and 3 outweighs the safety benefits.
Option 2 implements Option 1 and mandates ROAAS to be installed in every large (type certificated) manufactured airplane after certain date (in-production requirement).
Option 3 implements Options 1 and 2, and mandates ROAAS to be installed in every in-service large airplane (in-production and retrofit requirement).
However, if EASA decides to implement option 2 as concluded in section 4.6.1, Boeing proposes that the timeline for equipage with a ROAAS be extended to 6 years from the time the mandate goes in force. Adequate time must be allowed for product development and certification and the establishment of a supply chain. The 3 years proposed by the NPA does not allow for these considerations.
"26.205 Runway overrun awareness and alerting systems

Operators of large aeroplanes used in commercial air transport shall ensure that each of these aeroplanes, when first issued with an individual Certificate of Airworthiness on or after [~~three~~ **six** years after the entry into force of this regulation], is equipped with a real-time flight crew alerting system that makes (in-flight and on-ground) energy-based calculations of the predicted landing stopping point in comparison with the end of the runway."
In addition, Boeing recommends that automatic exemptions be allowed when circumstances make implementation impractical due to complexity and/or when the benefits of such a system are reduced for that model. See more details in our second comment.

Response:
Not accepted.
The IA concludes that option 2 is more cost effective.
Nevertheless, EASA agrees to provide more time, i.e. five years after the publication of the EASA Opinion, and not less than three years between the entry into force of the regulation and the applicability of the production cut-in.

3. Proposed amendments and rationale in detail — 3.2. Draft decision (amending CS-26)	p. 7-8

comment	*80*	comment by: *Dassault-Aviation*
	Text: Page 8 §3.3 C25.705 (b) : "or an automated means of deceleration control". **Comment:** This option is not part of the definition of a ROAAS which is an alerting system. However, this option may be considered and mentioned as an alternative solution for the ground phase, with adequate design and adequate crew information. **Proposition:** It is strongly suggested to rephrase the paragraph	
response	Partially accepted. The intent was not to mandate an automated means of deceleration control, but to leave it as an option for the applicant. This has been clarified in the resulting text.	

3. Proposed amendments and rationale in detail — 3.3. Draft decision (amending CS-25)	p. 8-9

comment	*12*	comment by: *ESDU, IHS Markit*
	The AMC allows compliance by reference to EUROCAE ED-250. It is noted that ED-250 includes statements of a mandatory nature - "shall", "must" etc. Should it be clarified (or is there a general published EASA interpretation) that where mandatory text appears in document referenced by AMC they are only 'mandatory' if the applicant chooses to comply by that method?	
response	Noted. Terms like 'shall' and 'must' used in a standard referenced by EASA in an AMC or in GM do not have the status of rules, and applicants can always propose changes regarding the way in which they wish to demonstrate compliance with an EASA rule.	

This is inherent to the definition of AMC or GM and it is not deemed necessary to repeat this statement each time EASA refers to a standard.

Note: Definitions for AMCs and GM are provided in EASA Management Board Decision 18-2015 ('Rulemaking Procedure').

comment *31* comment by: *AIRBUS*

CS 25.705 Runway overrun awareness and alerting systems (See AMC 25.705)

Airbus proposes to change:

A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft
The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with: (a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and (b) an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing.

By:

A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall make below a given altitude/height above airfield down to some taxi speed or condition the prediction of the landing stopping point and comparison with the end of the runway to provide the flight crew with:
(a) in-flight a timely and unambiguous predictive alert of a longitudinal runway overrun risk, and
(b) on-ground a timely and unambiguous predictive alert of a longitudinal runway overrun risk, or automated means of deceleration control for longitudinal runway overrun protection during landing roll,
(c) valid for at least normal dry and wet runways, for normal landing configurations without aircraft system failures degrading deceleration capability.
(d) The intended crew response to alerts and the domain of demonstration for ROAAS should be included in AFM.

Rationale / Justification:

Airbus position is that the intent of a new system and minimum AFM content must be defined at CS25 level. This includes RWY conditions and aircraft condition coverage objectives and the domain of demonstration for ROAAS.

response Partially accepted.
The CS 25.705 text has been amended to take these recommendations into account. The resulting text should meet the intent of this comment, although with different wording.

comment *32* comment by: *AIRBUS*

Airbus would request that EASA leaves some flexibility in the CS-25 regarding the availability of ROAAS at TC either through an exemption process until 1 year after TC of the model or of Certification of a major modification (new or modified brakes, new or modified engines…) affecting landing performances, or to permit the ROAAS to be installed but inactive until the final performance model can be installed.

Airbus suggests to define a time frame for ROAAS implementation after the aircraft TC. This might be higlighted somewhere else (part 26, part-CAT…).

Justification:

Airbus agrees with the safety objectives of this NPA and has directly seen the benefit that a ROAAS can bring in the goal to reduce runway excursions.
However, Airbus would also like to make EASA aware of the difficulty involved in certifying systems that depend on approved aircraft performance models (case of Runway Overrun Awareness and Alerting System as described in ED-250 at Landing or of Take-Off Securing/Monitoring) for new aircraft and derivatives which affect aircraft performance models e.g. new or modified brakes, new or modified engines. During testing and certification, the final aircraft model may not be available until shortly before certification, after which the onboard software may already be frozen. As a result, the performance model for ROAAS availability for implementation in ROAAS for the aircraft certification might not fulfill certification requirements.
Implementation of ROAAS based on preliminary aircraft performance models may result in nuisance alerts which induces a risk of loss of confidence in the system from over-conservative alerts, with potential negative pilot training.
Due to the usual low number of deliveries during the first year after initial certification, the risk of occurrence of a runway overrun is very low.

response Not accepted.

Applicants should anticipate the need to have a mature and approved aircraft performance model and take this constraint into account in their development and certification schedule.

comment *33* comment by: *AIRBUS*

In AMC 25.705, Airbus suggests to change:

In showing compliance with CS25.705, the applicant may take account of EUROCAE document ED-250, "Minimum Operational Performance Standard for a Runway Overrun Awareness and Alerting System".

By:

In showing compliance with CS25.705, the applicant may take account of EUROCAE document ED-250, "Minimum Operational Performance Standard for a Runway Overrun Awareness and Alerting System", or an existing means of compliance already agreed with the Agency.

Justification:

	Airbus has already developed and certified ROOAS on most of the fleet according to an EASA CRI. It is therefore requested to explicitly authorize the use of another means of compliance already agreed with the Agency, to not unduly penalize Manufacturers who voluntarily adopt the technology in advance to regulation application.
response	Partially accepted. By nature, the content of an AMC is not mandatory, and applicants always have the option of proposing an alternative equivalent means of compliance. There is no need to repeat that in the AMC. Note: 'AMC' is defined in EASA Management Board Decision 18-2015 ('Rulemaking Procedure').

comment	_34_ comment by: _AIRBUS_ In AMC 25.705, Airbus suggests to add: ROAAS mandate may not cover specific operations (ex: Steep Approaches, Operations on Wet PFC/Grooved or skid-resistant surfaces with a specific performance credit). **Justification**: The implementation of this function associated to these specific operations may be more complex. In addition, operational exposure to these specific operations is relatively low, with some operational restrictions often applied (e.g. on meteorological conditions, pilot experience, or existence and use of strong enough auto-brake), and, there has been no documented overrun accident on a Wet PFC/Grooved RWY operated with a specific performance credit or on airports using steep approaches.
response	Partially accepted. The proposed CS 25.705 has been updated to clarify the minimum requirements to be fulfilled by a ROAAS. It does not mandate the accommodation of steep approach operations or of grooved/PFC runways, but requires at a minimum dry and wet runways to be accommodated, in line with ED-250. EUROCAE ED-250 includes provisions on steep approaches (if certified). It is up to the applicant to identify the operational conditions and limitations of the ROAAS and indicate them in the AFM. This has also been added in the revised CS 25.705.

comment	_35_ comment by: _AIRBUS_ In AMC 25.705, Airbus suggests to add:

	ROAAS may not be available for different causes as failure impacting proper functioning or due to airport database unavailability. This should be covered through MMEL. **Justification**: The implementation of such a function should not prevent a/c operation due to ROAAS failure or airport database unavailability.
response	Noted. A ROAAS, like any other installed system, equipment or function, is a potential candidate MMEL item. The applicant should therefore prepare an application and appropriate justifications in line with the Part-21 provisions related to operational suitability data (OSD).

comment	*40* comment by: *EBAA* **p.8-9 3. 3.3.** CS 25.705 Runway overrun awareness and alerting systems (See AMC 25.705) A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft with an MOPSC of 20 or more and a MCTOM of 45.3 metric tons. A runway overrun awareness and alerting system (ROAAS) may be installed on aircraft with an MOPSC of 19 or less and a MCTOM below 45.3 metric tons~~.~~ The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with: (a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and (b) an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing. MOTIVATION: EBAA concludes that mandatory installing a ROAAS for business type aircraft is never cost effective. EBAA suggests EASA to consider also not mandating a ROAAS for the other types of large aircraft. EBAA Comment: EBAA is using the current cut off MCTOM of 45.3 metric tons in the proposed text as this is used in CS25. When CS25 is updated to be in line with the newly updated ICAO certification MCTOW in connection with and MOPSC of 19 or less EBAA expects the proposed MCTOW for ROAAS to be changed as well.
response	Not accepted. Please refer to the response to comment 39.

comment	*51* comment by: *General Aviation Manufacturers Association / Hennig* **Refrain for Specifying Means by which Objectives is Achieved and Ensure Industry Can Continue Innovation** EASA proposes a specific energy-based approach as the means by which the desired objective is accomplished (i.e., identifying the predicted landing stopping point). At

	the same time, the Certification Specification---as currently written---may also be inconsistent with the proposed Part 26 regulation. GAMA remains concerned that an unclear definition of the system would limit industry innovation and potentially nullify investment already made by industry including impacting existing installed equipment in the fleet. This likely would also contradict EASA's stated objective of NPA 2018-12 to "...put emphasis on the safety objectives... while providing more flexibility in terms of design solutions" (4.1). EASA should consider the following changes to the Certification Specification: <u>Issue 1:</u> 26.205 identifies a requirement for "real-time" alerting of the flight crew. CS 25.705 (which is used to show compliance with CS 26.205), however, does not reference a "real-time" requirement. EASA can achieve alignment between CS 25.705 and 26.205 and also provide improved clarity about the objective of the regulation through the following alternative: "The system shall make real-time calculations of the predicted landing stopping point...". <u>Issue 2:</u> CS 25.705(a) uses several indeterminate terms that could cause confusion such as "timely" and "overrun risk". To improve clarity, EASA should reword 25.705(a) to "...an in-flight alert when the predicted landing stopping point exceeds the end of the runway, with sufficient timeliness that a go-around may be safely performed." <u>Issue 3:</u> CS 25.705(b) is unnecessarily vague. To improve clarity about the requirement, EASA should reword 25.705(b) to "...an on-ground alert or automatic activation of deceleration means when the predicted landing stopping point exceeds the end of the runway, such that a runway overrun is prevented or minimized."
response	<u>Issue 1:</u> Accepted. The Part 26.205 text has been amended to provide the high-level objective. Then CS 25.705 and CS 26.205 have been revised to better specify how the system must be designed. It includes the requirement for a real-time calculation and (if needed) alert(s). <u>Issue 2:</u> Not accepted. It is not intended to specify only warning types of alerts that require a go-around. The system can also trigger awareness types of alerts, especially during approach, so pilots can adjust the aircraft parameters when immediate pilot action is not required. <u>Issue 3:</u> Accepted: CS 25.705 has been amended to convey the proposed clarifications, although with different wording.

comment	*57* comment by: *Bombardier* It is expected that guidance material will be published by EASA early enough to allow for installation approval.

	1. The AMC should provide guidance on the number of approaches and landings to be conducted during the flight test campaign, the aircraft configurations, the runwway types, the level of runway contamination, the environmental conditions. 2. The AMC should also provide safety targets for loss of function or misleading indication (i.e. nuissance alert) at the installed system level. 3. AMC should be available in time to allow for the aircraft certification process to take place prior to the system being required on new CofAs
response	Noted. The topics mentioned in this comments are addressed in EUROCAE Document ED-250. EASA considers that the EUROCAE ED-250 standard, in addition to other CS-25 provisions, allows new projects to be certified; the CRI process can also be used to agree on project-specific issues. At this stage, EASA does not wish to issue prescriptive elements in the AMC.

comment	*64* comment by: *Bombardier* CS25-705(b) uses the term "overrun protection". This seems contradicts the intent of the design which is "reduce risk of overrun" per EUROCAE ED-250. There is ambiguity regarding the use of the word "protection" in item (b). It seems to imply that the rule requires a protective system which is clearly not the intention with a ROAAS which only alerts and does not protect. The wording of the rule should be improved to clarify that a ROAAS system that only provides an alert, and NOT protection, is fully compliant. Bombardier suggests rewording of the rule to: (b) an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun warning or protection during landing.
response	Partially accepted. The text has been amended to clearly state that adding an automated means of deceleration control is an option of the applicant. The term ‘protection’ has been replaced by ‘prevents or minimises’.

comment	*65* comment by: *Bombardier* The regulation should not be restrictive by stating "energy-based calculations". The reference to the energy state should be part of the objectives of the regulation and defined in the acceptable means of compliance (as already described in EUROCAE ED-250). For example, : "A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft to mitigate the risk of overruns due to excess aircraft energy. The system shall make calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with: (a) ..."
response	Not accepted.

It is a key specification to ensure that a ROAAS makes calculations based on the energy state of the aeroplane, in order to ensure reliable and tailored alerts. This is also clearly part of the ED-250 standard.

comment *68* comment by: *Safran Nacelles*

For the thrust reverser to be taken into account in the calculations of the ROOAS for landing and accelerate-stop distance on dry and wet runways, shall the probability of failure to provide the recommended level of reverse thrust not be greated than 1 per 1000 selections (as required in AMC 25.109(f) 7. ?

response Noted.
The ROAAS is a safety net type of system, and it is not foreseen that such a system should drive the reliability of the thrust reverser, which itself is already addressed by other paragraphs of CS-25.

comment *70* comment by: *Safran Nacelles*

CS 25.705 (b) requires an on-ground predictive alert or automated means of deceleration control to be installed. If an on-ground predictive alert is indeed installed, could an automated mean of deceleration control be installed while considered as an external system from the ROOAS, with more flexibility in terms of design and certification ?

response Partially accepted.
CS 25.705(b) does not mandate an automated means of deceleration control, but leaves this as an option for the applicant. This has been further clarified in the resulting text.

This function, when provided by the applicant, may be part of the ROAAS, although the ROAAS may have an interface with other system(s) in order to perform the related action(s) (e.g. selecting maximum wheel braking) included in the function.

comment *72* comment by: *Embraer S.A.*

Embraer suggests that the reference to "an automated means of deceleration control" should be deleted.

Rationale:

An automated means of deceleration control is a different system from the ROAAS (although the former requires the latter, in order for it to perform) and is not the subject of EUROCAE ED-250 (Minimum Operational Performance Standard for a Runway Overrun Awareness and Alerting System).
Therefore, we suggest to delete the reference to "an automated means of deceleration control", since this system goes beyond the ROAAS. We believe that this option should be allowed only if an equivalent standard to EUROCAE ED-250 is available, in order to maintain the safety level of the proposed rule.
Furthermore, there are no requirements or AMC for it in either NPA 2018-12 or ED-250.

	Suggestion: To change the text from: *"A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with:* *(a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and* *(b) an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing."* To: *"A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with:* *(a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and* *(b) an on-ground predictive alert~~, or an automated means of deceleration control,~~ for longitudinal runway overrun protection during landing."*
response	Not accepted. At the option of the applicant, an automated means of deceleration control may be included in a ROAAS (such a ROAAS already exists). This has been clarified in the resulting text of CS 25.705. Note that ED-250 also envisages this possibility, e.g. refer to Section 3.1.1, point ROAAS_REC02, bullet 'Possible automated means of deceleration control'.

comment	*73* comment by: *Embraer S.A.* Embraer suggests removing the term "energy-based calculations" from the requirement. **Rationale:** Embraer understands "energy-based calculations" as the most effective method for a system that is intended to minimize overruns accidents and incidents, and we also participated of the elaboration of ED-250 which defines ROAAS as energy-based system, although this term is not used. However, the ED-250 is more susceptible for future revisions, which may affect its scope to include some future methodology, not available nowadays. In this scenario, to avoid requirement revision and improve robustness, Embraer suggests removing the term "energy-based calculations" from the rule. **Suggestion:** To change the text from:

	"A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with: *(a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and* *(b) an on-ground predictive alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing."* To: *"A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall ~~make energy-based calculations of the predicted~~ predict landing stopping point in comparison with the end of the runway, and provide the flight crew with:* *(a) a timely in-flight predictive alert of a longitudinal runway overrun risk, and* *(b) an on-ground predictive alert~~, or an automated means of deceleration control,~~ for longitudinal runway overrun protection during landing."*
response	Not accepted. It is a key specification to ensure that a ROAAS makes calculations based on the energy state of the aeroplane, in order to ensure reliable and tailored alerts. This is also clearly part of the ED-250 standard.

comment	*83* comment by: *MITSUBISHI AIRCRAFT CORPORATION* AMC 25.705 Runway overrun awareness and alerting systems [Comment/Reason for Change] Clarification of ROAAS safety requirements. The requirements and Acceptable Method of Compliance (AMC) do not directly define the safety requirements (reliability, integrity, severity, etc.) for the proposed alerting system. Since Aircraft OEMs may not have thorough data to justify the level of safety for the proposed alerting system in the viewpoint such as; severity of the failure condition that the proposed alerting system would result in (loss of alert capability, erroneous alert, loss of deceleration augmentation, etc.) or required reliability or integrity for the system. It is considered more appropriate for Authority to define the above guideline in AMC based on the accedent occurrence data, rather than each Aircraft OEM to research the accident data and justify the system safety considerations. This guideline would reduce the amount of work for the Authorities to review and determine the adequacy of the safety assessment made by the OEM, as well as the amount of work for OEMs to make research and justify the safety criteria to the Authorities. These considerarions are defined on some other AMC, or AC from FAA such as AMC25-11 for Electronic Display System or AC 25-23 for Terrain Awareness and Warning System. Example: AMC25-11 for Electronic Display System or AC 25-23 for Terrain Awareness and Warning System defines the guideline for the system safety considerations.

	[Change Proposal] AMC 25.705 should clarify the criteria for System Safety Assessment in the similar way as AMC 25-11 and AC 25-23.
response	Noted. As for any system installed on aeroplanes, CS 25.1309 and the related AMC apply for the system safety assessment. Note that, nevertheless, ED-250 mentions basic failure condition classifications that may be considered at the equipment level.

comment	*84* comment by: *MITSUBISHI AIRCRAFT CORPORATION* CS 25.705 Runway overrun awareness and alerting systems [Comment/Reason for Change] Clarification of the Alert Level These requirements do not define the Alert Level. Aircraft OEMs have come through and experienced many tough discussions with the authorities to define the alert level. The condition should be Warning Alert because immediate awareness and actions become necessary per CS 25.1322 requirement. We request to define the alert level in the regulatory requirements, the same as 25.703. By doing so, the time needed to discuss the alert level through the certification process can be reduced. Example : 25.703 defines the alert level for takeoff warning system. A takeoff <u>warning</u> system must be installed and must meet the following requirements: (a) The system must provide to the pilots an aural <u>warning</u> that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff: (b) The <u>warning</u> required by paragraph (a) of this section must continue until - [Change Proposal] CS 25.705 Runway overrun awareness and alerting systems(See AMC 25.705) A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft. The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with: (a) a timely in-flight predictive <u>Warning</u> alert of a longitudinal runway overrun risk, and (b) an on-ground predictive <u>Warning</u> alert, or an automated means of deceleration control, for longitudinal runway overrun protection during landing.
response	Not accepted.

	Alerts generated by the system must comply with CS 25.1322, which defines the different levels of alert. The ROAAS may be able to generate different levels of alerts, e.g. cautions and warnings, depending on the timing of the alerts and the expected action from the flight crew.

comment	*88* comment by: *Collins Aerospace Avionics* Justification is not provided of why new technologies or runway condition reporting methods are not required to prevent false alerts or lack of alerts? (or meet the availability expectations?)
response	Noted. The comment is not fully understood. Regarding the reporting and usage of runway contaminants, EASA is working on amending OPS, CS-25, and aerodrome regulations to implement the outcome of the TALPA initiative. But the ROAAS is only required to be operational with dry and wet runways. It is an option for the applicant to accommodate contaminated runways.

comment	*89* comment by: *Collins Aerospace Avionics* The NPA does not provide data supporting effectiveness of on-ground predictive alerting.
response	Noted. The comment is not understood. The risk of a runway excursion must also be considered after touch down, and therefore an alert on-ground is required as well. This is in line with the content of ED-250. For example, an approach may be performed in a normal way with a predicted stopping point within the available landing distance, but conditions may appear just before or after touch down that lead to an increase in the landing distance and the need to alert the flight crew of a risk of a runway overrun. There have been occurrences with this scenario.

<u>TCCA Comment 1:</u>
Comment summary
The proposed requirement is too prescriptive. Asking for an in-flight predictive alert and an on-ground predictive alert or an automated means of deceleration may be a solution, but not the only one.
In addition, the analyses provided in Section 4 do not provide enough details on what could be the contribution of an in-flight alert vs. an on-ground alert vs. an automated deceleration.
The proposed requirement should be more a Performance Based Objective rather than a prescriptive requirement.
Suggested resolution
Transport Canada proposes the following text for; “CS 25.705 Runway overrun awareness and alerting systems” (See AMC 25.705)
A runway overrun awareness and alerting system (ROAAS) must be installed on each aircraft.
The system shall make energy-based calculations of the predicted landing stopping point in comparison with the end of the runway, and provide the flight crew with a timely predictive alert of a longitudinal runway overrun risk, enabling the crew to perform a Go-Around with sufficient safety margin.
Response:

Not accepted.
A ROAAS is also expected to provide alerts during the on-ground phase.

There have been occurrences in which a normal approach was performed, but during the landing roll, for instance, insufficient deceleration was applied, which led to an overrun. A ROAAS alert on ground can therefore be beneficial to prevent or mitigate such a scenario.

<u>TCCA Comment 2:</u>
Comment summary
The technology is to have two modes of operation Runway Overrun Awareness and Alerting system (ROASS): “In Air” and “On Ground.
Discussion
For the **In Air** operation, where the ROASS may determine that there is insufficient runway length for the reported conditions, a go-around may be elected by the flight crew. Section 4.5.1 of the NPA considers that for equipment performing its intended function “an unjustified increase in the go-around rate is not expected.” However, the NPA does not elaborate on this conclusion. The subject of risk associated with go-around was the subject of another recent EASA NPA 2017-06 that highlighted the risk of loss of control or flight path during go-around.
For **On Ground** operation of the ROASS, there are two scenarios that could result from a ROASS indication of insufficient runway: increase the rate of deceleration somehow to stop within the remaining distance; or, initiate a take-off within the remaining runway distance. Either of these scenarios would require training and landing procedures would need to be in place to deal with these eventualities; the NPA acknowledges this in from a cost perspective in Section 4.5.4.2 (Other Costs), but does not elaborate on recommended training or procedures. For the Land and Go scenario, there does not appear to be a discussion in the NPA of the risks involved with accomplishing a high workload task including an aircraft reconfiguration for take-off from a low energy state; this would seem to be a relevant aspect of the risk impact analysis.
Response:
Noted.
ED-250 contains various provisions intended to minimise false or nuisance alerts, which are potential concerns in the development of any system that triggers an alert to the flight crew. For example, ROAAS_RECO13 states the following: ‘ROAAS Equipment should be designed so that ROAAS false alerts due to erroneous sensor inputs are minimized’.

For CS-25 certification, the specifications of CS 25.1322 (Flight crew alerting) and the related AMC also apply at the aeroplane level, and should ensure that the ROAAS is developed with an acceptable level of design integrity that avoids nuisance and false alerts and provides reliable alerts to the flight crew when needed. Therefore, it is not expected that the installation of a ROAAS will lead to an ‘unjustified increase of the go-around rate’.

Concerning the on-ground alert, as reflected in ED-250, the ROAAS is a safety net and it is not expected that the alerts will require the flight crew to conduct a go-around due to the associated hazard. The current flight crew training should remain applicable for the decision of initiating a take-off after touch down.
ED-250, Section 3.1.6.3, states the following:
’ROAAS_REQ45. The following message shall not be used for the On-Ground warning:
• "GO-AROUND".
(Or any such reference to a go-around procedure).’

<u>TCCA Comment 3:</u>
Comment Summary

How is the runway surface condition accounted for in the determination of landing distance requirement from this NPA?
Discussion
While it is acknowledged that runway surface condition is a required input to the system for the determination of runway distance required, there is considerable variation of actual conditions with respect to the condition reported in NOTAM's. For On Ground operation of the system, the deceleration experienced may be variable with the actual runway surface condition at that point.
Transport Canada did not have representation on WG 101, so we do not have in depth knowledge of the efficacy of available ROAAS systems and perhaps ED-250 MOPS addresses this question.
Response:
Noted.
CS 25.705 has been amended to clarify the minimum runway conditions which must be accommodated by the ROAAS, i.e. dry and wet runway conditions. The accommodation of contaminated runway conditions is an option for the applicant.

4. Impact assessment (IA) — 4.1. What is the issue	p. 10-13

comment	*42* comment by: *EBAA* **p.10-13 4.1. What is the issue** NPA Text: Runway excursions have led to one fatal accident in CAT aeroplane operations involving airlines/cargo operations over the past decade, and a runway excursion is ranked as N°1 in the European Risk Classification Scheme (ERCS), according to the EASA Annual Safety Review for 2018. Furthermore, runway excursions accounted for 30 % of the non-fatal accidents over the same period and for the same population. EBAA Comment: The one fatal accident was not business aviation type of operations but rather airlines/cargo operation as outlined in the EASA text. The term runway excursions cover more than runway overruns during landing. The term includes runway take off overruns and veer-offs as well. According data, available to EBAA, from 2015-2018 the veer-offs cover more than 50% of the runway excursions, whilst overruns account for just 30%. Runway overruns also includes both take-off and landing overruns. The risk of take-off overruns is almost 3 times higher than landing overruns. ROAAS does not prevent take-off overruns or any form of veer offs and thus is the text related to "runway excursions" in general incorrect, which leads to incorrect conclusions related to the cost effectiveness of a ROAAS. Another misleading statement is related to the number of casualties and injuries. Page 13 indicates that the likelihood of runway excursions is improbable. It does not specify what the likelihood is of landing overruns and thus is this statement not relevant for the NPA. Secondly are systems addressing successfully the severity not taken into account in other to reduce the risk.
response	Not accepted. During the period 1991-2017, for EASA Member States operators, there were 4 accidents and 2 serious incidents involving business jets that were deemed as preventable with a ROAAS. This includes 1 fatal accident and 1 accident with injuries.

	2 accidents resulted in the aeroplane being destroyed, while 2 other accidents resulted in substantial damages. The NPA is focused on runway overruns during landing as they represent around 80 %of the occurrences. Runway overruns during take-off represent a very small portion of the occurrences i.e. around 5 %. Regarding the statement mentioned on page 13, we do not agree with this comment; please refer to the title of Table 1: 'Future expected <u>landing</u> overrun fatalities and injuries of European operators in a regulatory no change scenario (Option 0)'.

comment	*54* comment by: *General Aviation Manufacturers Association / Hennig* **<u>Review of Safety Data and Traffic</u>** EASA states in section 4.1, paragraph three, that the "number of occurrences of runway excursions during landings has increased in line with the growth in traffic. As aviation traffic is expected to continue to grow worldwide as well as in Europe, the number of runway excursions can also be expected to increase further." The data shown in 4.1.1., however, discusses accidents and incidents and both peaked approximately 20 and 12 years ago respectively. The data for 2013 through 2017 show significantly lower levels of occurences than the early part of the current century. GAMA recommends that EASA review the statement in section 4.1 against historical traffic levels among EASA MS.
response	Noted. We agree that the increase in runway overruns during landing does not actually follow the growth of the traffic. There has been an upward trend in the number of runway overruns since 2015. Please note that the IA has assumed an average of 0.7 fatalities per accident, which is based on all the relevant accidents between 1991 and 2017.

comment	*90* comment by: *Collins Aerospace Avionics* The data provided in this section (Figure 1) does not seem to support the assertions.
response	Not accepted. Please refer to the EASA Annual Safety review 2018, Section 2.3, Safety Risk Portfolio for Large Aeroplanes (CAT-Airlines and NCC-Business), which includes the following conclusion from the analysis of available data: 'From these two representations, it can be concluded that the key risk areas accumulating higher risk score, based on the occurrence data used, are Runway Excursion and Aircraft Upset. They concern a high number of higher risk occurrences and aggregating the highest risk score.'

comment	*91* comment by: *Collins Aerospace Avionics*

	The analysis shown in Table 1 does not take into account the potential beneficial impact of training or procedural mitigations to overrun accidents. These statistics assume nothing more can be done in training or use of alternative certified equipment to prevent expansion of the problem. We recommend inclusion of narrative regarding training considerations.
response	Noted. Flight crew training related action is indeed not part of this rulemaking task, therefore no credit is taken for any potential future related action. The EPAS 2019-2023 does not identify any specific action in this area.

comment	*95* comment by: *IATA* Technological solutions at the aircraft level need to be supported by improvements in other areas - to ensure for example that the adequate runway braking action is identified and the appropriate information is provided to the crews for the runway braking conditions for optimum decisions based on objective elements.
response	Accepted. A ROAAS is one of the elements in a chain contributing to the reduction in the risk of runway excursions. This is recognised in the European Action Plan for the Prevention of Runway Excursions (EAPPRE) and in the European Plan for Aviation Safety (EPAS) 2019-2023. The EPAS 2019-2023 contains other actions that will contribute to mitigating the risk of a runway excursion (see Chapters 3.1.2, 5.1.1 and 5.2.2).

4. Impact assessment (IA) — 4.2. What we want to achieve — objectives p. 13

comment	*43* comment by: *EBAA* **p.13 4.2. What we want to achieve - objectives** The statement "The objective of this proposal is to improve safety by mitigating the risk of runway excursions" is incorrect. It should read: The objective of this proposal is to improve safety by reducing the likelihood of landing overruns.
response	Partially accepted. The RMT is indeed focused on <u>longitudinal</u> runway excursions.

4. Impact assessment (IA) — 4.3. How it could be achieved — options p. 14

comment	*19* comment by: *Wideroe Flyveselskap AS* 4.3 page 14. Widerøe is supporting option 2. However, ROAAS should not be a requirement for Cat A and Cat B turboprop aircrafts below a certain landing mass, i.e. 20000kg.
response	Not accepted. This category of aeroplanes supports a non-negligible share of the number of occurrences. The review of occurrences identified 6 accidents and 4 serious incidents which could have been prevented by a ROAAS (1991-2017).

comment	*44* comment by: *EBAA* **p.14 4.3. How should it be achieved - options** A performance-based option, where operators get adequate (operational) benefits if ROAAS would be installed on voluntarily basis is not included
response	Please refer to the response to comment 41.

comment	*66* comment by: *Bombardier* Will there be an exemption process for part 25 aircraft still in production where a ROAAS system is not possible without a significant avionics upgrade? Some types have been in production a long time and are reaching the end of the production cycle, and have exhausted their avionics growth capability in terms of additional functionality for visual, aural alerts. The number of future aircraft of these types, would make the non-recurring cost of installing and certifying a ROAAS prohibitive, when considering the number of future aircraft sold with this system
response	Noted. Considering the current available information and trend on newly produced aeroplanes registered in EASA Member States, EASA does not foresee that such an issue could occur in practice. Furthermore, the actual date of applicability of the future Part-26 rule (anticipated to be early 2025 or later) will leave enough time for stakeholders to find a solution that fits their needs.

4. Impact assessment (IA) — 4.5. What are the impacts p. 15-23

comment	*21* comment by: *KLM* · *"It is assumed that the use of ROAAS equipment can help to significantly reduce the number of accidents and fatalities/injuries if the equipment is installed and performing its intended function. Therefore an unjustified increase in the go-around rate is not expected." And, page 6, item 2.4: "No drawbacks are expected". This describes the ideal world. In reality, every system has its drawbacks, one of them being false or undesired warnings, incorrect flight crew response to warnings, the risk of unnecessary go-arounds, etc. All possible drawbacks should be assessed in the NPA.*
response	Noted. ED-250 contains various provisions intended to minimise false or nuisance alerts, which are potential concerns in the development of any system that triggers an alert to the flight crew. For example, ROAAS_RECO13 states the following: 'ROAAS Equipment should be designed so that ROAAS false alerts due to erroneous sensor inputs are minimized'. For CS-25 certification, the specifications of CS 25.1322 (Flight crew alerting) and the related AMC also apply at the aeroplane level, and should ensure that the ROAAS is developed with an acceptable level of design integrity that avoids nuisance and false alerts and provides reliable alerts to the flight crew when needed. Therefore, it is not

expected that the installation of a ROAAS will lead to an 'unjustified increase in the go-around rate'.

comment 24 comment by: *KLM*

· *The report states that ROASS avoids all runway excursions except those caused by mechanical failure or operations outside weather limitations. This concept is not representative to the real world flight operations. Performance limitations or alerting beyond a point of no return will limit the amount of excursions which can be avoided by a ROASS system. More research is needed to draw a conclusion of the effectiveness of the system. This is required before EASA makes any decision to pursue a ROASS system.*

response Not accepted.
The IA projections determined the number of accidents which could be prevented by the presence of a ROAAS. This includes a portion of the accidents for which only 50 % credit was provided, which means that in some cases, the ROAAS mitigates the consequences of the occurrence.

comment 36 comment by: *AIRBUS*

Airbus suggests to change:

For Option 2, all newly delivered airplanes as of 2022 would have to be equipped with a ROAAS. This would lead to higher overall costs (EUR 65 million to EUR 196 million), as a higher percentage of the fleet would need to be equipped.
By:

For Option 2, all newly delivered airplanes as of 2023 would have to be equipped with a ROAAS. This would lead to higher overall costs (EUR 65 million to EUR 196 million), as a higher percentage of the fleet would need to be equipped.

Justification:

Considering the publication date of the Decision (2020Q4), three years after the entry in force of this Regulation would lead to 2023Q4 for the implementation of ROAAS on all newly delivered airplanes.

response Partially accepted.
It has been decided to amend the proposed deadline in order to provide at least five years between the date of publication of the Opinion and the date of the production cut-in. Also, we recommend that the time between entry into force of the Part-26 rule and the date of the production cut-in must not be less than three years.

EASA plans to issue an Opinion for a Part-26 rule in Q3 of 2019. It is then anticipated that the Part-26 regulation would be published sometime between the end of 2020 and Q3 of 2021. When applying the above criteria, newly produced aeroplanes must be equipped with a ROAAS as of early 2025 or later, depending on when the Regulation is issued by the European Commission.

comment *45* comment by: *EBAA*

Attachment #1 :Appendix A

p.15-23 4.5. What are the impacts

EASA Text:

Option 0 is the reference option as described in the issue analysis in Section 4.1. As the technology is available and can be certified based on CRIs, it can be assumed that the technology will be introduced into the fleet at a rate that is very limited to negligible. This introduction will depend on the will of applicants for TCs/STCs to include such systems in their designs.

EBAA does not agree with the statement that the introduction will be very limited to negligible as the technology becomes available to business aviation segment of aircrafts. I.e. aircraft with 19 MOPSC of 19 or less and a MCTOM of 45.3 metric tons. Historically this segment is very prone to voluntarily include and install safety enhancing equipment as soon as it becomes available even if it has a relatively small safety improvement or operational advantage. Increasing the operational benefits for those operators with an ROAAS above a positive RIA threshold would even result that ROAAS would be installed over the majority of the fleet.

If EASA would be in favour of speedy and stimulating installation of ROAAS, a system of positive incentives leading to operational benefits should enable that.

4.5.1. Safety impact.

To EBAA available statistics show:

For statistics that following text refers to, see uploaded file Table 1

EASA text:

Out of 15 preventable accidents, there are two with the lower, 50 % credit, while among the preventable serious incidents, there are 18 cases out of 26 in which the most probable efficacy of ROAAS was estimated to be less than 100 %.

EBAA comment:

EBAA statistics (Table 1) show two accidents relevant to aircraft with a MCTOM of less than 45.3 and a MOPSC of 19 or less. Neither of the two accidents would have been prevented with a ROAAS. But even when these accidents would be taken into account, the risk of landing overruns in this category is considerably lower than with the “large commercial” aircraft and even lower than with general aviation light aircraft. Therefore the assumptions as indicated in options 0-3 in the text are incomplete.

4.5.1 Safety impact

page 18.

Table 4 list the number, but fails to indicate what the risk is. E.g. the effects a landing overrun with no damage into the runway strip or even RESA, capable of supporting the aircraft for a quick tow-out, cannot be compared with a veer-off as occurred in Trabzon with a B737 in January 2018. This table is therefore misleading. Which leads to the incorrect conclusion in the text that the number of accidents and fatalities will "significantly" be reduced.

4.5.1.2. Diversions, delay and cancelation costs avoided.

EASA text:

Delays, cancellations and diversions were monetised using values based on Eurocontrol recommendations. The average cost to an airline of a ground delay of a passenger air transport aeroplane is EUR 7 900 per hour, the average cost of a diversion to another airport for a scheduled commercial flight is EUR 13 900, and the average cost of a cancellation on the day of operation is EUR 33 100. During the 10-hour period while the runway is closed, we expect 15 arrivals to be diverted, 20 arrivals to be cancelled and 15 arrivals to be delayed. Among the 50 planned departures, 35 are assumed to be cancelled, and 15 are expected to be delayed.

EBAA comment:

Most of the mentioned costs are not fully relevant for business aviation as they are based on scheduled passenger airline costs and the size and type of airports schedule airlines are operating to and from. EBAA members mainly conduct on demand point to point operations, not scheduled operations. Also, these operations are often to and from smaller airports thus implying a lesser average monetary consequence for runway closure. Therefore, it can be assumed that the cost of diversion, cancelation and delay, as presented in table 6 is not valid and overestimated for business aviation.

EASA text:

Question to stakeholders on economic impacts:

Stakeholders are invited to provide quantified justifications of the possible economic impacts for the options proposed, or alternatively to propose another justified solution to the issue.

EBAA comment:

For statistics that following text refers to, see uploaded file Table 2

The above table represents EBAA calculations of RIA for aircraft with MOPSC of 19 or less and a MCTOM of 45,3 metric tons. Calculations are made for Option 1 and 3 and both show a negative RIA. Since option 2 is in between option 1 and 3 it is concluded that option 2 will therefore give a negative RIA as well.

response Not accepted.

Point 1: Regarding the suggestion to 'find incentives', EASA understands that the proposal would be to issue operational rules in order to restrict operations (e.g. ban operations on runways below a certain length, on contaminated runways, or approaches under certain degraded visibility/meteorological conditions, etc…) of aeroplanes not equipped with a ROAAS, and therefore provide an operational benefit to operators equipped with a ROAAS. This would therefore imply putting Option 3 into force, as most of the operators would probably want to avoid the operational restrictions. The IA does not support this option, and EASA prefers to keep the approach of Option 2.

Point 2 on preventable occurrences: During the period 1991-2017, for EASA Member States operators, there were 4 accidents and 2 serious incidents involving business jets that were deemed to be preventable with a ROAAS. This includes 1 fatal accident and 1 accident with injuries. 2 accidents resulted in the aeroplane being destroyed, while 2 other accidents resulted in substantial damage. Over the total of 15 accidents considered to be preventable, 4 accidents involved business jets, therefore we do not agree that business jets are less at risk than other commercial transport aeroplanes; business jets fly a small number of flight cycles, and based on these statistics, it could be concluded that they probably have a higher rate of preventable runway overruns than commercial transport aeroplanes.

Point 3 on the content of Table 4: Occurrences with few or negligible consequences, i.e. those classified as incidents, were excluded from the RIA. In order to provide better information on the retained preventable occurrences, we provide the detailed list of these occurrences as an appendix to this CRD.

Point 4 on cost estimation: The values used in the assumptions for delays, cancellations, and diversions are average values that are indeed less appropriate for business jet operations. However, it could also be claimed that:

— The average value used for aeroplane damage (EUR 11.1 million) is probably underestimated regarding the 6 preventable occurrences involving business jets because 2 of them were destroyed, and 2 others faced substantial damage;
— The cost of equipment is also somewhat overestimated for business jets, in particular the 'high estimate' value.

Therefore, if one were to compute the calculations presented in Table 9 only for business jets, the outcome in term of cost-effectiveness would probably show a similar trend to the one presented, which is a global evaluation for all CS-25 aeroplanes.

Point 5: EBAA Table 2: EASA is not in a position to fully understand and comment on the information provided in Table 2 of the EBAA. Please note that it is not correct to conclude that 'Since Option 2 is in between Option 1 and 3 it is concluded that Option 2 will therefore give a negative IA as well'.

The NPA IA concludes that Option 2 is the most cost-effective option. Depending on the estimation of the cost of equipment, the net costs are either negative (which is a benefit because this represents a cost saving) or positive (which represent the cost to be paid for preventing a fatality).

comment 46 comment by: *EBAA*

p.15-23 4.5. What are the impacts
EASA Text:
Option 0 is the reference option as described in the issue analysis in Section 4.1. As the technology is available and can be certified based on CRIs, it can be assumed that the technology will be introduced into the fleet at a rate that is very limited to negligible. This introduction will depend on the will of applicants for TCs/STCs to include such systems in their designs.

EBAA does not agree with the statement that the introduction will be very limited to negligible as the technology becomes available to business aviation segment of aircrafts. I.e. aircraft with 19 MOPSC of 19 or less and a MCTOM of 45.3 metric tons. Historically this segment is very prone to voluntarily include and install safety enhancing equipment as soon as it becomes available even if it has a relatively small safety improvement or operational advantage. Increasing the operational benefits for those operators with an ROAAS above a positive RIA threshold would even result that ROAAS would be installed over the majority of the fleet.
If EASA would be in favour of speedy and stimulating installation of ROAAS, a system of positive incentives leading to operational benefits should enable that.

4.5.1. Safety impact.
To EBAA available statistics show:

EASA text:
Out of 15 preventable accidents, there are two with the lower, 50 % credit, while among the preventable serious incidents, there are 18 cases out of 26 in which the most probable efficacy of ROAAS was estimated to be less than 100 %.
EBAA comment:
EBAA statistics show two accidents relevant to aircraft with a MCTOM of less than 45.3 and a MOPSC of 19 or less. Neither of the two accidents would have been prevented with a ROAAS. But even when these accidents would be taken into account, the risk of landing overruns in this category is considerably lower than with the "large commercial" aircraft and even lower than with general aviation light aircraft. Therefore the assumptions as indicated in options 0-3 in the text are incomplete.

4.5.1 Safety impact
page 18.
Table 4 list the number, but fails to indicate what the risk is. E.g. the effects a landing overrun with no damage into the runway strip or even RESA, capable of supporting the aircraft for a quick tow-out, cannot be compared with a veer-off as occurred in Trabzon with a B737 in January 2018. This table is therefore misleading. Which leads to the incorrect conclusion in the text that the number of accidents and fatalities will "significantly" be reduced.

4.5.1.2. Diversions, delay and cancelation costs avoided.
EASA text:
Delays, cancellations and diversions were monetised using values based on Eurocontrol recommendations. The average cost to an airline of a ground delay of a passenger air transport aeroplane is EUR 7 900 per hour, the average cost of a

	diversion to another airport for a scheduled commercial flight is EUR 13 900, and the average cost of a cancellation on the day of operation is EUR 33 100. During the 10-hour period while the runway is closed, we expect 15 arrivals to be diverted, 20 arrivals to be cancelled and 15 arrivals to be delayed. Among the 50 planned departures, 35 are assumed to be cancelled, and 15 are expected to be delayed. EBAA comment: Most of the mentioned costs are not fully relevant for business aviation as they are based on scheduled passenger airline costs and the size and type of airports schedule airlines are operating to and from. EBAA members mainly conduct on demand point to point operations, not scheduled operations. Also, these operations are often to and from smaller airports thus implying a lesser average monetary consequence for runway closure. Therefore, it can be assumed that the cost of diversion, cancelation and delay, as presented in table 6 is not valid and overestimated for business aviation. EASA text: *Question to stakeholders on economic impacts:* *Stakeholders are invited to provide quantified justifications of the possible economic impacts for the options proposed, or alternatively to propose another justified solution to the issue.* EBAA comment: The above table represents EBAA calculations of RIA for aircraft with MOPSC of 19 or less and a MCTOM of 45,3 metric tons. Calculations are made for Option 1 and 3 and both show a negative RIA. Since option 2 is in between option 1 and 3 it is concluded that option 2 will therefore give a negative RIA as well.
response	Please refer to the response to comment 45 (identical comment).

comment	*55* comment by: *General Aviation Manufacturers Association / Hennig* **<u>Other Costs Not Considered</u>** The NPA identifies other direct and indirect costs that were not included in the calculations. EASA points to adaptation of SOPs/checklists; crew training; and functional checks. One item not considered among other costs (or for that matter direct costs on the operator) is the impact of false alerts, especially if false alerts result in unnessary go-arounds or overly aggressive braking. GAMA recommends that the agency include in the Regulatory Impact Analysis (RIA) a consideration of the cost of an increased rate of go-arounds.
response	Noted. This aspect has been considered. ED-250 contains various provisions intended to minimise false or nuisance alerts, which are potential concerns in the development of any system that triggers an alert to the flight crew. For example, ROAAS_RECO13 provides the following: 'ROAAS Equipment should be designed so that ROAAS false alerts due to erroneous sensor inputs are minimized'.

For CS-25 certification, the specifications of CS 25.1322 (Flight crew alerting) and the related AMC also apply at the aeroplane level, and should ensure that the ROAAS is developed with an acceptable level of design integrity that avoids nuisance and false alerts and provides reliable alerts to the flight crew when needed.

EASA does not expect that a ROAAS will generate an unjustified increase in go-arounds or aggressive braking, and therefore no corresponding cost has been added in the IA.

comment	*60* comment by: *Bombardier* The unit costs would depend not only on the recurring installation cost for each new aircraft but also on the amortized non-recurring cost to design and certify ROAAS on each configuration of each aircraft type. The cost/benefit analysis should consider that aircraft types/configurations with lower production volumes (for example aircraft type nearing end of production) may have a higher per unit cost than what is indicated here.
response	Noted. The recurring installation cost includes the amortised non-recurring cost required for the design and certification of the ROAAS. Considering the current available information and the trend in newly produced aeroplanes registered in EASA Member States, EASA does not foresee that such an issue could occur in practice. Furthermore, the actual date of applicability of the future Part-26 rule (anticipated to be early 2025 or later) will leave enough time for stakeholders to find a solution that fits their needs.

comment	*92* comment by: *Collins Aerospace Avionics* We believe the cost range for implementation to be too low, especially for Options 2 & 3. We do not see adequate inclusion of cost impact of false alerts.
response	Noted. First point: In the absence of data provided by the commentator, EASA considers that the cost values, based on data provided by other stakeholders , are valid. Second point: ED-250 contains various provisions intended to minimise false or nuisance alerts, which are potential concerns in the development of any system that triggers an alert to the flight crew. For example, ROAAS_RECO13 provides the following: 'ROAAS Equipment should be designed so that ROAAS false alerts due to erroneous sensor inputs are minimized'. For CS-25 certification, the specifications of CS 25.1322 (Flight crew alerting) and the related AMC also apply at the aeroplane level and should ensure that the ROAAS is developed with an acceptable level of design integrity that avoids nuisance and false alerts and provides reliable alerts to the flight crew when needed. EASA does not expect that a ROAAS will generate an unjustified increase in go-arounds or aggressive braking, and therefore no corresponding cost has been added in the IA.

comment	*93* comment by: *Collins Aerospace Avionics* We request that the Agency consider training and procedural mitigations as a Policy Option.
response	Please refer to the response to comment 91.

Boeing comment 2:
THE PROPOSED TEXT STATES
4.5.4 Economic Impact.
REQUESTED CHANGE
Boeing recommends that the cost-benefit analysis take into consideration the complexity of certain aircraft to comply with these requirements and primary usage of aircraft to minimize divergence from the international (other) approaches which support voluntary equipage.
JUSTIFICATION
It is not clear the basis and assumptions for the cost data analysis presented in the NPA. The NPA states:
"The unit cost for the introduction of a ROAAS is estimated to range from EUR 10 000 to EUR 120 000 per airframe. The low estimate uses EUR 10 000 for a new aircraft, and EUR 40 000 for a retrofit, while the high estimate calculates EUR 30 000 for a new aircraft and EUR 120 000 for a retrofit. The analysis is based on the assumption that the technical requirements for this safety standard are sufficiently generic that they can be met by different airframe and equipment manufacturers."
Thus, we recommend a cost-benefit analysis that accounts for the complexity and primary use of certain aircraft.
When cost and/or benefit circumstances prevent aircraft of specific types from complying with the requirements of this regulation, automatic exemptions to these aircraft types would provide a pragmatic solution without materially impacting the percentage of European Operator's fleet coverage.
For example, the following criteria should be considered:
(a)aircraft types being produced in limited numbers;
(b)aircraft types for which re-engineering costs required would be disproportionate due to old design or architecture which does not support ROAAS;
(c)aircraft which accommodate a limited number of crew and/or supernumeraries, such as freighters.
Without the considerations listed above, the cost to implement the change to the design would be disproportionately high due to the inability to amortize the cost over a large population of aircraft produced.
Response:
Not accepted.
Considering the current available information and trend in newly produced aeroplanes registered in EASA Member States, EASA does not foresee that such an issue could occur in practice. Furthermore, the actual date of applicability of the future Part-26 rule (anticipated to be early 2025 or later) will leave enough time for stakeholders to find a solution that fits their needs.

Concerning the case of freighter aeroplanes, these aeroplanes share their avionics architectures and type certificates with other non-freighter aeroplanes, therefore equipping such aeroplanes will not require amortising the cost on the freighter versions only.

4. Impact assessment (IA) — 4.6. Conclusion	p. 23-24

comment	*20* comment by: *CAA-NL*

	The Netherlands support the conclusion to propose Option 2 as the way to go.
response	Noted.

comment	*37* comment by: *AIRBUS* Airbus suggests that there may be an Option between Option 2 and Option 3 to mandate ROAAS on recently delivered aircraft which would significantly increase the safety benefit associated with a ROAAS system without significantly increasing the costs. **Rationale / Justification**: Airbus agrees that Option 3, full retrofit represents a significant cost to the industry to design, certify and install ROAAS on all aircraft types. The majority of the cost is attributed to updating systems on old aircraft types to be compatible with ROAAS (e.g. TAWS, flight displays, GPS receiver, warning computer etc …). However, with Option 2 only 25% of the fleet would be equipped by 2025, and 50% of the fleet by 2030. Airbus considers that recent fourth generation aircraft can be retrofitted with ROAAS for cost similar to installing ROAAS on in-production aircraft. Airbus estimates the cost to retrofit recent aircraft could be between 30,000-60,000 Euros. The NPA document 2013-09, is considering the operating fleet from 2012-2032 period, whereas the new version of the NPA has delayed and shifted the fleet to be considered. Based on forecasted data from Ascend which includes aircraft retirement schedule, if ROAAS was mandated on aircraft with an individual certificate of airworthiness from 2012 onwards, more than 50% of the European fleet would benefit from ROAAS by 2026 as compared to only 25% with Option 2 and nearly 90% equipped by 2037. Using the NPA impact analysis methodology, 17 accidents would be avoided with a cost effectiveness similar to Option 2.
response	Noted. With the selection of Option 2, in reality, it is probable that the proportion of aeroplanes equipped with a ROAAS will be greater than the forecast indicated in the IA. Many operators will probably recognise the benefit brought by this system and will also want to have fleet commonality. Defining a threshold for an intermediate option as proposed in this comment is theoretically a good idea, but in practice, it is foreseen that finding a common threshold (date) acceptable to all manufacturers would be impossible.

comment	*47* comment by: *EBAA* **p.23-24 4.6. Conclusion** EBAA concludes that mandatory installation of a ROAAS in <u>aircraft with a MOPSC of 19 or less and a MCTOM of 45.3 metric tonnes or less</u> is not acceptable due to a negative RIA and very negative Return of Investment and negative cost effectiveness.

	Table 9 does not include the option of a voluntarily installation of a ROAAS with operational benefits. Thus, a balanced conclusion related to the LANDING OVERRUN RISK cannot be made. EBAA is therefore strongly in favour of Option 0, voluntary installation, for aircraft with a MOPSC of 19 or less and a MCTOM of 45.3 metric tonnes or less for the mentioned reason. Business aviation segment aircraft also have a high likelihood to voluntarily install ROAAS and potentially ROAAS can be seen a standard for business aviation size aircraft. Partly as business aviation is prone to include new technology and as a consequence of this NPA when "larger" commercial aircraft used in scheduled operations are mandated to be equipped with ROAAS. However, mandating an installation, even according to Option 1 will result in negative RIA, and have a potential to be very costly for those aircraft that are still in production of older certification where installation of ROAAS would mean introduction of a completely new generation of technology, compared to the rest of the aircraft, including avionics.
response	Not accepted. As already explained in the responses to the previous comments above, EASA considers that business aeroplanes should not be excluded; refer for instance to the responses to comments 39 and 41. Furthermore, if, as assumed by the EBAA, business jet operators intend to voluntarily equip their aeroplanes, then this means that future regulation will actually not create a cost impact, and that the business jets community should support the EASA initiative to equip aeroplanes with a ROAAS.

comment	_81_ comment by: _Dassault-Aviation_ **<u>Comment:</u>** Page 24 Table 9: At least for the last table presenting the cost estimates summary, it would be reasonable to present rounded values of the estimates, instead of values with 9 significant digits which actually result from sometimes quite rough hypotheses.
response	Noted. This remark will be considered for future IAs. Note, however, that the text in Section 4.6.1 comparing the options uses rounded cost values.

comment	_94_ comment by: _Collins Aerospace Avionics_ We suggest this position be re-visited after further analysis per industry comments.
response	Noted. After the analysis of the comments, the recommended option is confirmed.

6. References	p. 27

comment	_82_ comment by: _Dassault-Aviation_

	Comment: Page 27 §6.3: It is suggested to add a reference to EUROCAE ED-250
response	Noted. Please note that the NPA will not be re-published.

Appendix A - Attachments

Table 1 & 2.pdf
Attachment #1 to comment #45

Appendix B – List of preventable occurrences considered in the IA of NPA 2018-12

Identified occurrences involving EASA Member States operators – 1991-2017: 64 longitudinal runway excursions during landing (27 accidents and 37 serious incidents)

41 of these 64 occurrences longitudinal runway excursions (64 %) deemed preventable with a ROAAS (15 accidents and 26 serious incidents)

Table 1: Preventable accidents

Occurrence date (local date)	Occurrence type	Country of occurrence	ROAAS credit*	Manufacturer	Aeroplane type	Registration	Injury level	Fatalities	Injuries (all)	Aircraft damage
25/9/1991	Accident	Germany	1	Dassault	Falcon 20C	I-NLAE	Fatal	1	7	Destroyed
11/10/1991	Accident	Cayman Islands	1	Boeing	737	VR-CCW	Minor	0	0	Substantial
13/8/1996	Accident	United Kingdom	1	Learjet	25	EC-CKR	Minor	0	4	Destroyed
30/7/1997	Accident	Italy	1	ATR	42	F-GPYE	Fatal	1	0	Destroyed
7/12/1997	Accident	United Kingdom	0.5	Fokker	F-27	G-BNCY	None	0	0	Substantial
24/09/1999	Accident	Austria	1	Learjet	36A	OE-GMD	None	0	0	Substantial
1/07/2000	Accident	United Kingdom	1	Fokker	F-27	G-JEAP	None	0	0	Destroyed
2/11/2002	Accident	Ireland	1	Fokker	F-27	G-ECAT	None	0	0	Substantial
2/8/2005	Accident	Canada	1	Airbus	A340	F-GLZQ	Serious	0	33	Destroyed
19/3/2008	Accident	Germany	1	Dornier	328	D-CTOB	Minor	0	5	Substantial
09/2/2009	Accident	France	0.5	Airbus	A321	F-GYAJ	None	0	0	Substantial
29/3/2013	Accident	France	1	Airbus	A321	SX-BHS	None	0	0	Substantial
24/5/2013	Accident	Bulgaria	1	Airbus	A320	LZ-MDR	Serious	0	2	Substantial
11/12/2015	Accident	France	1	Cessna	550	M-AGGY	None	0	0	Substantial
5/8/2016	Accident	Italy	1	Boeing	737	HA-FAX	Serious	0	2	Substantial

*‘1’ means 100 % ROAAS credit, ‘0.5’ means 50 % credit

Table 2: Preventable serious incidents

Occurrence date (local date)	Occurrence type	Country of occurrence	ROAAS credit*	Manufacturer	Aeroplane type	Registration	Injury level	Fatalities	Injuries (all)	Aircraft damage
23/6/1999	Serious incident	Sweden	0.5	McDonnell Douglas	MD-80	LN-RLF	None	0	0	None
9/3/2000	Serious incident	Sweden	0.5	Hawker Siddeley	HS 748	SE-LEX	None	0	0	None
8/3/2001	Serious incident	Switzerland	1	Embraer	ERJ-145LR	I-EXME	None	0	0	Minor
22/2/2002	Serious incident	Sweden	0.5	British Aerospace	146-200	G-FLTA	None	0	0	Minor
28/5/2003	Serious incident	United Kingdom	1	Cessna	560 Citation Encore+	D-CAUW	None	0	0	Minor
26/1/2004	Serious incident	Germany	0.5	Dornier	328	D-COSA	None	0	0	Minor
14/8/2005	Serious incident	Germany	1	Embraer	ERJ-145	G-EMBD	None	0	0	None
26/1/2006	Serious incident	Germany	1	Embraer	ERJ-145	HB-JAO	None	0	0	None
08/3/2006	Serious incident	United Kingdom	1	Hawker Siddeley	HS 748	G-BVOV	None	0	0	None
18/5/2007	Serious incident	Netherlands	1	Fokker	50	OO-VLI	None	0	0	Minor
28/10/2007	Serious incident	Iceland	0.5	Boeing	737	TF-JXF	None	0	0	Minor
16/12/2007	Serious incident	Bulgaria	0.5	British Aerospace	146-300	LZ-HBE	None	0	0	None
31/1/2008	Serious incident	Finland	0.5	Saab	340	OK-CCD	None	0	0	Minor
21/3/2008	Serious incident	Frence	0.5	Boeing	737	EI-DAF	None	0	0	Minor
31/10/2008	Serious incident	Spain	1	Boeing	737	EC-HJQ	None	0	0	Minor
5/1/2009	Serious incident	Germany	1	Embraer	ERJ145	G-EMBW	None	0	0	Minor
25/1/2010	Serious incident	Norway	0.5	Bombardier	CRJ-200	SE-DUY	None	0	0	Minor
15/6/2013	Serious incident	Greece	1	Boeing	737	SU-BPZ	None	0	0	Minor
25/8/2013	Serious incident	Czech Republic	1	Boeing	737	OK-TVG	None	0	0	None
25/5/2015	Serious incident	Norway	0.5	Boeing	737	LN-RCZ	None	0	0	Minor
7/1/2016	Serious incident	Romania	1	Boeing	737	YR-BAS	None	0	0	None

6/4/2016	Serious incident	Sweden	0.5	Fokker	F28	YR-FZA	None	0	0	Minor
5/2/2017	Serious incident	Italy	1	Cessna	525	CS-DGW	None	0	0	Minor
28/4/2017	Serious incident	Iceland	0.5	Boeing	737	YL-PSH	None	0	0	Minor
25/7/2017	Serious incident	Romania	1	Boeing	737	EI-DCR	None	0	0	None
30/9/2017	Serious incident	Germany	1	Airbus	A320	D-ABHO	None	0	0	None

*'1' means 100 % ROAAS credit, '0.5' means 50 % credit

Note: In NPA 2018-12, on page 19, the third paragraph includes an error regarding the number of preventable serious incidents with a 50 % ROAAS credit. As shown in Table 2 above, instead of 18, there are actually 12 cases out of 26 with an estimated 50 % credit. This does not affect the result of the RIA, which only considered the prevention of accidents.