responsibilities and task allocation, and the efficiency of communication between the relevant actors. The results will be implemented in the planning and designing of the real-time simulation.

Other implications of the concept regarding certification and regulatory, legal issues, social, and ethical aspects will also be partially investigated within SAFELAND, with the main aim of identifying those elements that could be clear showstoppers in the future, and to propose possible mitigation solutions. The evaluation will include a safety and cyber-security assessment, investigating other hazardous situations that can be critical for safety (e.g., malfunctions of the system and of the communication channels, cyber-security threats) as well as an economic aspects analysis, taking also into consideration the cost/benefit relation of having a ground remote pilot station in each AOOC and/or airport.

However, since SAFELAND will release results at TRL2/3 with a time horizon for the application of at least 15 years, a contribution to overcome the obstacles and barriers related to the concept will also come from research related to the foreseen introduction of RPAS in non-segregated airspaces, and with the advancements of research in SPO.

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IX. References

[1] Neis, S. M., Klingauf, U., & Schiefele, J. (2018, September). Classification and review of conceptual frameworks for commercial single pilot operations. In *2018 IEEE/AIAA 37th Digital Avionics Systems Conference (DASC)* (pp. 1-8). IEEE.

[2] Schmid, D., & Stanton, N. A. (2020). Progressing toward airliners' reduced-crew operations: A systematic literature review. *The International Journal of Aerospace Psychology*, *30*(1-2), 1-24.

[3] Pilot and Technician Outlook 2020–2039 https://www.boeing.com/resources/boeingdotcom/market/assets/downloads/2020_PTO_PDF_Download.pdf

[4] SESAR "SESAR JOINT UNDERTAKING Single Programming Document 2019-2021", Ed. 3, April 2019

[5] International Civil Aviation Organization (ICAO), *Manual of Civil Aviation Medicine*, DOC 8984, 2012.

[6] Australian Transport Safety Bureau, Pilot Incapacitation Occurrences: 2010-2014, Report No. AR-2015-096, Feb. 2016.

[7] Evans S., Radcliffe S., The annual incapacitation rate of commercial pilots, Aviation, Space and Environmental Medicine, 83 (1), Jan. 2012.

[8] Bilimoria, K. D., Johnson, W. W., & Schutte, P. C. (2014, July). Conceptual framework for single pilot operations. In *Proceedings of the international conference on human-computer interaction in aerospace* (pp. 1-8).

[9] Schmid, D., & Stanton, N. A. (2019). A future airliner's reduced-crew: modelling pilot incapacitation and homicide-suicide with systems theory. *Human-Intelligent Systems Integration*, *1*(1), 27-42.

[10] Schmid, D., & Korn, B. (2017). A tripartite concept of a remote-copilot center for commercial single-pilot operations. In *AIAA Information Systems-AIAA Infotech@ Aerospace* (p. 0064).

[11] Liu, J., Gardi, A., Ramasamy, S., Lim, Y., & Sabatini, R. (2016). Cognitive pilot-aircraft interface for single-pilot operations. *Knowledge-based systems*, *112*, 37-53.

[12] Lim, Y., Bassien-Capsa, V., Ramasamy, S., Lui, J. & Sabatini, R. (2017). Commercial Airline Single-Pilot Operations: System Design and Pathways to Certification, IEEE Aerospace and Electronic Systems Magazine. vol. 32, pp. 4-21. DOI: 10.1109/MAES.2017.160175.

[13] Clean Sky, *List and Full Description of Topics* - Annex V: 9th Call for Proposals (CFP09), Oct. 2018.

[14] ACROSS Project, *Final Validation Report*, Deliverable D11.4, 2016

[15] Johnson W. W. (2015). Reduced Crew/Single Pilot Operations for Commercial Aircraft-Concept of Operations and Technology Needs, Report: ARC-E-DAA-TN22012, NASA Ames Research Center; Moffett Field, 2015.

[16] European Union Aviation Safety Agency (EASA) (2020). Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes CS-25, Amendment 26, 15 December 2020.

[17] Vicente, K. J. (1999). Cognitive work analysis: Toward safe, productive, and healthy computer-based work. CRC press.

[18] Harris, D., Stanton, N. A., & Starr, A. (2015). Spot the difference: Operational event sequence diagrams as a formal method for work allocation in the development of single-pilot operations for commercial aircraft. *Ergonomics*, *58*(11), 1773-1791.

[19] EUROCAE (2020). ED-272 Minimum Aviation Systems Performance Specifications for Remote Pilot Stations Conducting IFR Operations In Controlled Airspace.

[20] Stanton, N. A., Harris, D., & Starr, A. (2016). The future flight deck: Modelling dual, single and distributed crewing options. *Applied Ergonomics*, *53*, 331-342.

[21] Hobbs, A., & Lyall, B. (2016). Human factors guidelines for remotely piloted aircraft system (RPAS) remote pilot stations (RPS). *NASA Contractor report. Retrieved from http://human-factors. arc. nasa. gov*.

[22] International Civil Aviation Organization (ICAO) (2015). ICAO Doc 10019 Manual on Remotely Piloted Aircraft Systems (RPAS). 1st Edition. ISBN 978-92-9249-718-7.

[23] Castro, A. J., & Oliveira, E. (2011). A new concept for disruption management in airline operations control. *Proceedings of the Institution of Mechanical Engineers*, Part G: Journal of Aerospace Engineering, 225(3), 269-290.

[24] International Civil Aviation Organization (ICAO) (2019). LDACS White Paper – A Roll-out Scenario. DCIWG/3-IP01.

[25] Abeyratne, R. (2012). *Air navigation law*. Springer Science & Business Media.

[26] Chatzipanagiotis, M. (2007). Liability aspects of air traffic services provision. *Air and Space Law*, *32*(4/5).

[27] Diederiks-Verschoor, I. H. P., & Butler, M. A. (2006). *An introduction to air law*. Kluwer Law International BV.

[28] Hart, H. L. A. (2008). Punishment and responsibility: Essays in the philosophy of law. Oxford University Press.

[29] Bovens, M. A. P., & Bovens, M. (1998). The quest for responsibility: Accountability and citizenship in complex organisations. Cambridge university press.

[30] Schmid, R. (2000). Pilot in Commond or Computer in Command?. *Air and Space Law*, *25*(6).

[31] Contissa G. (2017) Automation and Liability: An analysis in the context of socio-technical systems. i-lex. Scienze Giuridiche, Scienze Cognitive e Intelligenza Artificiale.

[32] Contissa, G., Lagioia, F. & Sartor, G. (2018) Liability and automation: legal issues in autonomous cars. s.l.: Network Industries Quarterly.

[33] Schebesta, H., Contissa, G., Sartor, G., Masutti, A., Paola, T., & Taurino, D. (2015). Design according to liabilities: ACAS X and the treatment of ADS-B position data. In *Proceedings of the SESAR Innovation Days (2015) EUROCONTROL*.

[34] SAFELAND (2021). D1.4 – Final Concept. https://safeland-project.eu/sites/default/files/2021-06/SAFELAND_D1.4_Final_Concept.pdf