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# **Drones4Safety**

Research & Innovation Action (RIA)

Inspection Drones for Ensuring Safety in Transport Infrastructures

# D4S Project Start-up Package D1.1

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*Responsible institution:* The University of Southern Denmark

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PU	Confidential, restricted under conditions set out in Model Grant Agreement				
RE	Classified, information as referred to in Commission Decision 2001/844/EC				

## **Change Log**

Rev.	Date	Who	Site	Change
1	01/06/2020	Annika Lindberg	SDU	Created initial version.
2	29/06/2020	Emad Samuel Malki Ebeid	SDU	Final reviewed version.

### **Executive Summary**

The purpose of the deliverable (D1.1): Project Start-up package and the project handbook is to guide the Drones4Safety consortium members in the project cooperation processes. The document describes the scope of the project and the interactions of the parties involved in the project.

The document will be used by the team leaders within each organization, researchers, and administrative responsible and will be a clear guide of the different tools available to enable the exchange of information and management of the project.

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## Acronyms

Acronym	Description			
BVLOS	Beyond Visual Line Of Sight			
EC	European Commission			
EU	European Union			
IPR	Intellectual Property Rights			
PAB	Project Advisory Board			
PC	Project Coordinator			
PI	Principal Investigator			
PSC	Project Steering Committee			
QM	Quality Management			
RM	Risk Management			
TSC	Technical Steering Committee			
WP	Work Package			
WPL	Work Package Leader			

Explanations for H2020 terms can be found in the funding and tenders glossary: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary

### **1. Introduction**

#### 1.1 Purpose and scope of the document

The purpose of the project handbook is to guide the Drones4Safety consortium members in the project cooperation processes. The document describes the scope of the project and the interactions of the parties involved in the project as well as processes related to Quality Management (QM) (verification of project deliverables, continuous process improvement project) and Risk Management (RM). The project handbook is a tool available to all partners of the project containing all relevant information to facilitate and expedite efficient cooperation between the partners. It describes the roles of different actors in the project management structure, the meeting schedules and gives guidelines for performing the day-to-day project management activities.

The document will be used by the team leaders within each organization, researchers, and administrative responsible and will be a clear guide of the different tools available to enable the exchange of information and management of the project. The document is a living document that will be updated during the project lifetime when there are changes in the project governance structure or when a need for additional guidance is identified.

The content is intended for information and guidance only and does not replace the rules and regulations from the European Commission. Whilst every effort has been made to ensure the accuracy of the information supplied herein, The University of Southern Denmark (as project coordinator) cannot be held responsible for any errors or omissions. Project members are advised to consult the rules and regulations for the European Commission.

For more details about the European Commission rules and regulations look at the:

H2020 Online Manual: <u>https://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management/reports/periodic-reports\_en.htm</u>

Annotated Model Grant Agreement:

https://ec.europa.eu/research/participants/data/ref/h2020/grants\_manual/amga/h2020-amga\_en.pdf

## 2. The Drones4Safety project

#### 2.1 Project summary and objectives

The overarching aim of the D4S project is to develop a system of autonomous, self-charging, and collaborative drones that can inspect a big portion of transportation infrastructures in a continuous operation. The proposed solution harvests energy from overhead power or rail lines in the proximity of the desired infrastructure to be inspected to operate its drones for a longer time. The project gets information about the applicable transport infrastructure to be inspected from open maps and satellite data and forwards that information to its drones to conduct their autonomous mission. This will be achieved through the following objectives:



#### **Objective 1:** To develop a solution for harvesting energy for continuous drone inspection that:

- Refines the heavy-weight energy harvester that is developed by the project's partner, Fraunhofer IMS into mobile and lightweight version (below 2 kg).
- Works on different overhead power lines as well as rail lines.
- Offers a microelectronic interface module between the light-weight harvester and the drone's energy and control systems.
- Detects live cables and performs autonomous landing and grasp of the cables using custom software tools for the drone system in combination with data from the line operator.

#### **Objective 2:** To increase inspection efficiency by developing AI algorithms that:

- Improve the performance of AI algorithms, currently in use at DELAIR, to recognize infrastructure components and discover automatically eventual faults on assets.
- Automates the detection of defects and anomalies for bridges and railway infrastructure based on imagery and sensor data.
- Detects anomalies based on unsupervised and semi-supervised AI algorithms with drastically reduced need for large sets of training data and for human involvement.
- Adapts easily to specific new types of infrastructure to inspect.

#### **Objective 3:** To provide a platform for a collaborative drone operation for inspections that:

- Improves the inspection quality by using a collaborative drone system to inspect different sides of the desired infrastructure.
- Improves the accuracy of geo-tagging of inspection events by using recent advancements in GNSS technology (Galileo) and sensor fusion.
- Provides a communication platform for the autonomous multi-drone swarm that facilitates dynamic task allocation and planning as well as the continuous reporting with the mission control center.
- Improves online availability by using state of the art Low-Power Wide-Area (LPWA) technology to provide a wireless infrastructure independent of cellular network coverage.

• Integrates online information sources, such as local weather forecast, as well as providing access to cloud computing resources for post-processing services.

#### **Objective 4: To develop a failsafe inspection drone that:**

- Operates safely in harsh electromagnetic environments.
- Circumvents the effects of high-voltage/high-current signals on the drone's electronic systems.
- Compensates for the effects of high electromagnetic interference on the drone's sensors, such as compasses.
- Releases the drone safely from the cable in case of a drone failure being triggered.
- Can operate in the EASA "Specific" category following the preparation of a safety assessment based on SORA methodology in which air and ground risk are jointly evaluated with the hazards that are specific for the railway environment.

#### **Objective 5:** To build a cloud-based AI system for autonomous navigation that:

- Plans inspection missions with a given drone system.
- Monitors the state and location of the drones.
- Controls the drone system remotely and safely.
- Delivers inspection images, sensory data, and on-board analysis results to analysis systems.

#### **2.2 Motivation**

The fulfillment of the objectives will lead to a collaborative, autonomous, and long endurance drone system that will be offered to large infrastructures managers, starting with railway and bridge operators, to inspect their infrastructure. Our data analysis predicts that the proposed system can inspect the whole European electrical railway system and a big portion of the European bridges that are near the high-voltage and/or railway cables. Table 1 shows the number of bridges (also in percentage) that can be inspected by the D4S project in the EU as a whole and in Italy as a target country. We have chosen Italy as a target country due to the national demand that is raised after the Genova bridge collapse in August 2018. The numbers are calculated based on the distance from the nearest overhead power line cable; 1 km for showing many of the bridges are very close to the cables, 3 km for showing the comfort range of inspection, and the 7 km for showing the feasibility range. Considering normal drones can fly for around 20 km per charge, thus, a drone can reach a part of an infrastructure, inspect, and go back to recharge.

Table 1: Number of bridges that can be inspected by Drones4Safety							
Distance from nearest power line cable	1 km	3 km	7 km				
Number of bridges in EU	228,805 (15.2%)	1,070,304 (71.1%)	1,371,241 (91.1%)				
Number of bridges in Italy	14,946 (38.7%)	28,557 (73.9%)	36,498 (94.5%)				

Railways lines in Europe extend nearly 217,000 km, of which approximately 9,000 km are high-speed lines; even though the triple of the length of the high-speed lines foreseen in Commission's current long-term plan in 2030 is unlikely to be achieved<sup>1</sup>, a sensible increase is foreseen within the Core Railway Network implementation of the Trans-European Transport Network<sup>2</sup> (TEN-T).

<sup>&</sup>lt;sup>1</sup> Special report: A European high-speed rail network. [Online]. Available: <u>http://publications.europa.eu/webpub/eca/special-reports/high-speed-rail-19-2018/en/</u>.

<sup>&</sup>lt;sup>2</sup> Infrastructure and Investment. Online: <u>https://ec.europa.eu/transport/themes/infrastructure\_en</u>

#### 2.3 Work plan summary

#### 2.3.1 Work packages, deliverables

The Work-plan has been designed to meet the objectives of the project, developing and integrating drone technologies, energy harvesting, artificial intelligence, and swarm systems which will be validated in two transport related use cases; bridge and railway inspections. The project is planned to last 36 months. The structure consists of 8 Work Packages (WPs): four parallel technical WPs (WP3-WP6), one technical WP for the overall drone system specification, requirements analysis and use case definitions (WP2), one technical work package for system integration, testbed establishment, validation and demonstration (WP7), one for project management (WP1) and one for dissemination, communication and exploitation (WP8). The timing and relations of WPs is given in Figure 2.

WP 2 – NEAT, all System specifications, requirements analysis, and use case definitions	WP 3 – FH, SDU, DL, NEAT, ARIC Energy harvesting and drone operations in harsh environments WP 4 – DL, SDU, EUC, NEAT, ARIC AI for fault detections in bridges and railways WP 5 – AU, SDU, EUC, FH, NEAT, ECTL Collaborative multi-drone system WP 6 – SDU, AU, EUC, DL, NEAT, ARIC, ECTL Mission control and navigation	WP 7 – EUC, all System integration, testbed establishment, use case validation and demonstration
WP 8 – <b>DBLUI</b> Project dissemi	E, all nation, communication, and exploitation	
WP 9 – <b>SDU</b> Ethics requiren	nents	[]

M1

Figure 2: The timing and the relationship of the work packages

WP1: Management of project resources, risk management, and coordination/reporting to the EC.

**WP2:** Regulations, requirements analysis for infrastructure inspection, system specifications of the whole drone system, and definitions of use cases and business model.

WP3: Redesign of the energy harvesting to tap energy from overhead power lines and railway cables. It considers mitigating the electromagnetic effects on the drone's electronic system.

**WP4:** Development of deep learning algorithms to detect faults autonomously in bridges and railways.

**WP5:** System design of a quad-rotor multi-drone system for continuous inspection missions, based on the state-of-the-art drone technology extending it with LPWAN communication to provide a platform for dynamic task allocation and autonomous route planning.

**WP6:** Build of software for conducting autonomous drone mission using advanced navigation techniques that offer the inspection operation as a service through the cloud solution.

**WP7**: Integration of the developed technologies in WP2-6 into a single drone that will be replicated to build a swarm system of 4 drones, with the establishment of the test bed and validating the D4S solution in two use cases to demonstrate the project's outcomes.

**WP8:** Dissemination, communication, IPR management, innovation management, knowledge transfer, links with other R&D projects and initiatives, and cost model.

**WP9:** Ethics (*Note*! *EC* has added the WP9 to the project. Therefore, the task "T1.6: Ethical issues" in WP1 that deals with the Ethics has been transferred to this new WP).

Table 2 - List of work packages							
WP#	Work Package Title	Lead No	Lead Short Name	Person- Months	Start Month	End Month	
1	Project management	1	SDU	21	1	36	
2	System specifications, requirements analysis, and use case definitions	6	NEAT	58	1	6	
3	Energy harvesting and drone operations in harsh environments	3	FH	64	4	24	
4	AI for fault detection in bridges and railways	5	DL	78	4	24	
5	Collaborative multi-drone system	2	AU	36	4	24	
6	Mission control and navigation	1	SDU	53	4	24	
7	System integration, testbed establishment, use case validation and demonstration	4	EUC	66	19	36	
8	Project dissemination, communication, and exploitation	8	DBL	26	1	36	
9	Ethics	1	SDU	3	1	36	
				405			

#### **Deliverable process:**

The following process needs to be followed when working with the deliverables in the project:

- The official EC deliverable template should be used. The template can be found in the project's MS Teams document repository (direct link is <u>here</u>).
- Two weeks before the official due date, the deliverables need to be submitted to the project coordinator for an internal review. The document should, therefore, be saved in the Teams project document repository in the WP specific folder in the <u>Deliverables</u> channel, <u>here</u>. See also Figure 2 below.
- The Coordinator submits the deliverables on the due date to EC in Participants Portal

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Opkald	WP1 - Project Management	. •	WP8 Project dissemination, communication	15. maj	Annika Lindberg
Filer	WP2 - System specifications, requirements analysis WP3 - Energy harvesting and drone operations WP4 - Al for fault detection WP5 - Collaborative multi-drone system WP6 - Mission control and nariogation WP7 - System integration, testbed establishment		WP7 System integration, testbed establish	15. maj	Annika Lindberg
₽			WP6 Mission control and navigation	15. maj	Annika Lindberg
			WP5 Collaborative multi-drone system	15. maj	Annika Lindberg
			WP4 AI for fault detection	15. maj	Annika Lindberg
	WP8 - Project dissemination, communication WP9 - Ethics		WP3 Energy harvesting and drone operations	15. maj	Annika Lindberg
			WP2 System specifications, requirements a	15. maj	Annika Lindberg
		0	WP1 Project Management ····	13. maj	Annika Lindberg

Figure 3: Deliverables channel in Teams

The complete list of deliverables under each WP is given in Table 3.

Tabl	Table 3: List of Deliverables									
Del	Deliverable name	WP	Lead	Туре	Diss.	Date				
1.1	Repository, Mailing Lists, and On-line Project Handbook	1	SDU	OTHER	PU	M1				
1.2	Data Management Plan	1	SDU	Report	PU	M6				
2.1	Preliminary Hazard Analysis	2	NEAT	Report	PU	M3				
2.2	Regulatory Gap/Barriers Analysis (initial)	2	DBL	Report	PU	M3				
2.3	Preliminary System Requirements Document	2	NEAT	Report	СО	M3				
2.4	Use-case Document	2	EUC	Report	PU	M6				
2.5	Final System Requirements Document	2	NEAT	Report	СО	M6				
2.6	Business Model	2	DL	Report	СО	M6				
3.1	Specification of harvester system	3	FH	Report	PU	M6				
3.2	3.2 Concept design of harvester components		FH	Report	СО	M12				
3.3	First implementation of harvester components	3	FH	DEM	СО	M18				
3.4	First implementation of the drone systems to grasp over cables	3	SDU	DEM	CO	M24				

3.5	Test report and results	3	FH	Report	СО	M24
4.1	Anomalies description, annotation guide & labelled dataset	4	DL	Report	СО	M9
4.2	Supervised/unsupervised anomaly detection neural network models	4	DL	OTHER	СО	M24
4.3	Virtual inspection module	4	DL	OTHER	PU	M24
4.4	Structural model for residual bridge capacity	4	DL	OTHER	PU	M24
5.1	Specification of the multi-drone swarm system including test and validation aspects	5	AU	Report	PU	M9
5.2	Multi-drone system threat analysis and specification of the security system design	5	AU	Report	PU	M12
5.3	Collaborative drone swarm system hardware and software	5	AU	DEM	PU	M24
5.4	Test and validation report	5	AU	Report	PU	M24
6.1	Specification of the Drone Inspection as a Service platform	6	SDU	Report	PU	M6
6.2	Platform implementation with modules for planning, monitoring, and control	6	SDU	OTHER	PU	M15
6.3	Implementation of the platform with data flow and visualization modules	6	SDU	OTHER	PU	M24
6.4	Test and validation report	6	SDU	Report	PU	M24
6.5	Highly accurate 3D-positioning module	6	ARIC	Report	СО	M24
7.1	Report on the system integration and validation	7	SDU	Report	СО	M30
7.2	Case study application 1: railway inspection	7	NEAT	DEM	PU	M36
7.3	Case study application 2: bridge inspection	7	EUC	DEM	PU	M36
8.1	Project Website	8	DBL	DEC	PU	M3
8.2	Dissemination, Communication and Exploitation Plan	8	DBL	Report	PU	M6
8.3	Report on Dissemination, Communication and Exploitation activities	8	DBL	Report	PU	M30
8.4	Report on stakeholders' engagement and liaising with other EU initiatives	8	DBL	Report	PU	M30
8.5	Recommendations for Standardisation and Policy Making	8	ECTL	Report	PU	M30
8.6	Regulatory Gap/Barriers Analysis (final)	8	DBL	Report	PU	M36
8.7	Cost Model	8	DL	Report	CO	M36
9.1	POPD Requirement No. 1	9	SDU	Ethics	CO	M1

# 3. Project Consortium

The members of the D4S consortium has been carefully selected based on their particular field of excellence to ensure a solid scientific, technical, and end-user foundation for effective collaboration and distribution of work. Several of the beneficiaries have a previous successful track record of collaboration, either in previous H2020- or in other funded projects, which sets the basis for the successful implementation of the D4S project.

The consortium holds 9 beneficiaries representing five EU Member States (Germany, Italy, France, Belgium, and Denmark). The diverse demographics of the beneficiaries in terms of both geological, cultural and political landscape adds to strengthen the consortium and contribute to developing a solution, that can be applied to all EU Member States.

The Consortium is made up of the following beneficiaries:

Table 4: Project Consortium							
	University of Southern Denmark (PIC Number: 999904616)						
	Beneficiary ID	1					
	Shortname	SDU					
UNIVERSITY OF SOUTHERN DENMARK	Country	Denmark					
	Туре	University					
	WP involvement	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8					
	Aarhus University (PIC	C Number: 999997736)					
	Beneficiary ID	2					
AARHUS	Shortname	AU					
	Country	Denmark					
	Туре	University					
	WP involvement	WP1, WP2, WP5, WP6, WP7, WP8					
🗾 Fraunhofer	Fraunhofer-Gessellschaft zur Foerderung der Angewandten Forschung e.V. (PIC Number: 999984059)						
IMS	Beneficiary ID	3					
	Shortname	FH					
	Country	Germany					
	Туре	Research Institute					
	WP involvement	WP1, WP2, WP3, WP5, WP7, WP8					
	EUCENTRE Centro E	uropeo di Formazione e Ricerca in Ingegneria Sismica					
_	(PIC Number: 99984447	76)					
	Beneficiary ID	4					
	Shortname	EUC					
	Country	Italy					
	Туре	No-Profit Research Centre					
	WP involvement	WP1, WP2, WP4, WP5, WP6, WP7, WP8					
	Delair (PIC Number: 95	2199046)					
	Beneficiary ID	5					

	Shortname	DL			
	Country	France			
	Туре	Industry, Aerospace			
	WP involvement	WP1, WP2, WP3, WP4, WP6, WP7, WP8			
nOnt	NEAT S.r.l. (PIC Numb	er: 945643592)			
ICdl	Beneficiary ID	6			
	Shortname	NEAT			
	Country	Italy			
	Туре	SME			
	WP involvement	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8			
	Automotive & Rail Inn	ovation Center GmbH (PIC Number: 915280555)			
automotive + rail innovation center	Beneficiary ID	77			
	Shortname	ARIC			
	Country	Germany			
	Туре	Research Facility			
	WP involvement	WP1, WP2, WP3, WP4, WP6, WP7, WP8			
	Deep Blue srl (PIC Number: 998325941)				
	Beneficiary ID	8			
📀 deepblue	Shortname	DBL			
	Country	Italy			
	Туре	SME			
	WP/Task involvement	WP1, WP2, WP7, WP8			
	<b>EUROCONTROL</b> (PIC	C Number: 999483733)			
	Beneficiary ID	9			
	Shortname	ECTL			
EUROCONTROL	Country	Belgium			
	Туре	International Organisation			
	WP/Task involvement	WP1, WP2, WP5, WP6, WP7, WP8			

The project web site is located at https://drones4safety.eu/

#### **Project Coordinator:**

#### Emad Samuel Malki Ebeid

Associate Professor, SDU UAS Centre (Unmanned Aerial Systems), The Maersk Mc-Kinney Moller Institute Telephone: +45 65 50 24 81 Email: <u>esme@mmmi.sdu.dk</u> University of Southern Denmark Campusvej 55 DK-5230 Odense M

#### **Project Administrator:**

#### Annika Lindberg

Project coordinator and special adviser, TEK Innovation, Faculty of Engineering, Telephone: +45 65 50 40 48 Mobile phone: +45 93 50 74 59 Email: <u>akl@tek.sdu.dk</u> University of Southern Denmark Campusvej 55 DK-5230 Odense M The consortium represents the full value-chain for the development of an autonomous, self-charging, collaborative drone system for inspecting transport infrastructure: two universities (University of Southern Denmark and Aarhus University), one applied research institute (Fraunhofer), three railway/civil infrastructure inspection experts and providers (EUCentre, ARIC and NEAT), two regulatory companies (EUROCONTROL and DeepBlue), and one drone producer company (DELAIR).

The University of Southern Denmark (SDU), who has vast experience in coordinating and managing research projects under H2020 and FP7, coordinates the consortium. Besides the coordination, SDU contributes to the science itself with two research units; 1) SDU Unmanned Aerial Systems (UAS) Center, Faculty of Engineering and 2) SDU Department of Mathematics and Computer Science (IMADA), Faculty of Science. The capabilities of the beneficiaries are complementary and lead to a holistic approach towards meeting the objectives of the D4S.

An overview of the synergies and complementarities of the beneficiaries with regard to expertise are displayed in Table 5, which shows an in-depth view upon the specific areas of expertise in the consortium.

Table 5: Expertise of consortium partners – synergies and complementarities									
	SDU	AU	FH	EUC	DL	NEAT	ARIC	DBL	ECTL
Drone design	Х				Х	Х			
Infrastructure inspection				Х	Х	Х	X		
AI and fault detection	Х				Х				
Autonomous navigation	Х	Х			Х		Х		
Communication system design		Х			Х				
Swarm system		Х							
Energy harvesting	Х		Х						
Path planning and mapping	X	X			Х		X		
Access to test sites				Х		Х	X		
Drone Regulations	Х				Х	Х		X	Х

### 4. Communication and dissemination guidelines

Drones4Safety communication will be structured in a progressive way that allows the project to identify the best communication format according to the communication target and adjust the communication actions if they are not able to achieve the expected goals.

The communication activity will start with the definition of the key messages to communicate, a list of possible information categories that represent the main output of the project. The list of key messages will change in time, as the dissemination goals vary from the initial raising awareness on the project to the final goal of establishing a long-term impact of the project results on its target users.

For the **first** year of the project, the communication aims at promoting the project itself, make stakeholders aware of D4S, and its main goals. As the project starts to produce results (i.e. with the first yearly report) the key message to transmit moves from the project itself to its preliminary findings. Towards the end of the project, key messages will relate to recommendations to address the identified gaps and bottlenecks, and recommendations.

The **second step** in the plan consists of the identification of the target audience for the project's results. EC and Shift2Rail are for sure among the primary targets of D4S communication and dissemination. Other key targets of D4S communication are the members of the Advisory Board – as representatives of the main stakeholders. A direct link with them through the activities of WP8 will ensure continuous transmission of results and an immediate contribution and feedback to project activity.

Besides those, other stakeholders that D4S wants to reach are all the ones directly affected by the outcomes of the project activities: other researchers and research projects interested in the strategic overview of EU drones regulation, industries, safety regulators, SMEs, and industrial associations not included in the Advisory Board.

**Finally**, the general public is taken into account in the communication planning. This audience can be composed by citizens, aviation and railway passionate, safety or security experts from other fields, aviation operators or whoever has an interest in the topic of the project and that are likely to browse the website, or thumb through a brochure. For this audience, clear, useful, and non-technical information have to be available.

The accurate identification of the target audience, including the identification of the audience characteristics and different needs, is fundamental to tailor the communication from the beginning of the project and increase the possibility to reach the dissemination goals. Communication will be personalized according to the category of the audience in terms of content, style, format and information use.

Personalization will not be limited to information content, but it will also consider the style of the message and the means through which it is disseminated (e.g. document, report, web site, workshops and so on). The Plan for the Exploitation and Dissemination of Results (PEDR) will specify the most appropriate set of dissemination means for each category of stakeholders. A preliminary list comprises:

- Primary stakeholders (EC, Shift2Rail2, Advisory Board members): Official reports and deliverables, periodic face-to-face meetings, D4S Workshops and roundtable consultations, technical handouts, articles on local/international press and EC communication channels.
- Specialized audience: Website; Academic publications; Articles and news on sector magazines or EU portals (CORDIS, Transport Research and Innovation Portal); Dissemination flyers and handouts; conference speeches, presentations and posters; D4S Workshops and dissemination events; participation to third parties conferences, brokerage events and exhibitions.
- General public: Website, Non-academic publications, articles in magazines, brochures, posts/news on social media (e.g. Twitter), open-access repositories for all D4S-documents being classified as "public".

The execution of the communication and dissemination activities, based on the goals, messages, target, and tailoring of communication, will include the planning and production of communication materials (website, brochures, roll-ups, handouts, flyers, social media groups, etc.) as well as the planning and execution of the dissemination actions (participation to conferences, organisation of events). The full list of materials and actions will be detailed in the first version of the PEDR, with mid-term refinement for PEDR second release. The most important D4S communication products will include:

- Logo, visual identity and different format of promotional materials (e.g. brochures, flyers, posters, roll-ups, banners, videos etc.) to raise awareness on the project, communicate its goal and summarise the results.
- Website is the core communication product of D4S, the website is intended to provide information about the scope of the project, the consortium, the available products and the periodical release of news and events. All public deliverables and products will be made available for download from the website. The website will also host the Open Database and the protected part for internal communication among the consortium.
- Social media channels: Social media applications, such as LinkedIn® groups and Twitter, will also be employed for disseminating the project outcomes. These channels will be set-up and kept alive communities

For more information about the communication plan for the project look at the Deliverable 8.2 Dissemination, Communication and Exploitation Plan or contact the project communication and dissemination manager at DeepBlue.

#### Project communication and dissemination manager:

Damiano Taurino, DeepBlue E-mail:damiano.taurino@dblue.it

#### **4.1 Documentation**

#### 4.2.1. Document repository

A collaboration platform and a document repository in Microsoft Teams have been created in order to facilitate the exchange of information in the project. All documents of the project, not only the mandatory deliverables, should be uploaded to it. Access to the repository has been given to each organization and project team member.



Figure 4: Teams collaboration platform and document repository

The Teams platform and document library contains links to the tools used in the project (GitLab, webpage etc.) it also contains the document repository for saving the project related documents and deliverables. The different channels in Teams can be used for communicating for example with the work package team.

Additionally, the project is using GitLab for managing the technical documentation and code.

For access to the collaboration tools, please contact the project coordinator and the administrator.

#### 4.2 Mailing lists

The following mailing lists have been created:

- <u>Project Technical mailing list:</u> The emails of the partner representatives who will follow and attend the project technical meetings including the project kick-off and the bi-annual workshops. To use the mailing list, send e-mail to: <u>technical@lists.drones4safety.eu</u>
- <u>Technical Steering Committee mailing list (TSC)</u>: The emails of the WP and partner leads participating in the project technical steering committee. To use the mailing list, send e-mail to: <u>tsc@mails.sdu.dk</u>
- <u>Project Steering Committee mailing list (PSC)</u>: The emails of the Principal Investigators participating in the project steering committee meetings. To use the mailing list, send e-mail to: <u>PSC@lists.drones4safety.eu</u>

For making changes or adding or removing users, please contact the project coordinator and the administrator.

#### 4.3 Drones4Safety logo and Acknowledgement to Funders

It is advised that the Drones4Safety logo appears in all the project related documents. Any material co-funded with the project budget needs to make explicit reference to it – see Publication and dissemination procedure – and, if possible, make use of the project logo.

In addition, the rules and regulations related to using EU logo need to be followed. For more information look at the grant agreement and article 38.1.2 Information on EU funding — Obligation and right to use the EU emblem.

Unless the Agency requests or agrees otherwise or unless it is impossible, any communication activity related to the action (including in electronic form, via social media, etc.) and any infrastructure, equipment and major results funded by the grant <u>must</u>:

(a) display the EU emblem

(b) include the following text: For communication activities: "*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861111*".

For infrastructure, equipment and major results: "*This [infrastructure] [equipment][insert type of result] is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861111*". When displayed together with another logo, the EU emblem must have appropriate prominence.

Any external publications related to the project (such as press releases/articles) must acknowledge the support from the EC-funded grant.

#### 4.4 Presentations, posters and graphical materials

Any presentation of content obtained from the project may make use of the corporative presentation template available at the document repository, <u>here</u>.

#### 4.5 Dissemination of results

The purpose of the Dissemination activities is to transfer information about the results generated during the project lifecycle to the relevant stakeholders and to gather their feedback. This will create awareness about the project results in facilitating their exploitation and allow stakeholders to become involved in the project activities. The most important communities with which the D4S consortium will interact are:

- A. Scientific community, developing research projects in the domain of railways, power lines and bridges inspection.
- B. Scientific community, developing research projects in the domain of automated drone operations.
- C. Railways, trains, power lines and bridges operators, interested in issues related to automated inspection.
- D. Drone operators and manufacturers interested in issues related to automated drone operations;
- E. Any other scientific organisation having an interest in the D4S research work (e.g. robotics or satellite navigation research communities).

The most important dissemination products will include:

• Periodical project reports, distributed and made available via the project website for download.

- 3 workshop events with real live demonstrations especially dedicated to stakeholders and potential users.
- Scientific papers and publications. The main routes to effective, high-quality scientific dissemination are through peer-reviewed publications, and through presentation and discussion of results at key scientific events. Building on the excellent publication track record of D4S partners, we will therefore aim to produce a sizeable volume of high-quality peer-reviewed research publications in leading conferences, technical workshops and journals during the project and continuing beyond, following our open access publication policy. The journals we will target include "IEEE Transactions on Power Electronics", "IEEE Transactions on Vehicular Technology", "IEEE Transactions on Computers" and "IEEE Transaction on Industrial Informatics".
- Infographics To reach relevant stakeholders, who would likely not be reached through scientific publications, we will convert the most relevant results from scientific papers into at least 2 easy-to-comprehend one-page infographics.
- Presentations at conferences and exhibitions. The conferences that we propose to target are listed below.

Dissemination products (brochures, posters, infographics etc.) will always be combined with dissemination activities. D4S will be in charge of the organization of three Workshops and one Dissemination event (at the end of the project) and will attend external meetings to present its results. It will also have close relations with the other activities of the European Commission working on the same domain. Continuous exchange of information and results will be guaranteed with all these projects. Additional effort will be spent to coordinate dissemination with other H2020 actions, organising whenever possible joint dissemination stands at large events such as TRA, joint meetings with EC, or a joint final dissemination event. Other networking activities consist in participating to third parties' conferences, workshops and events. A preliminary list of the events follows:

- Railway related events and conferences: InnoTrans (International Trade Fair for Transport Technology); SIFER (International Exhibition of Railway Technology); EXPO Ferroviaria (International Railway Industry Exhibition); IRSA (International Railway Symposium Aachen).
- Bridges related events and conferences: IABMAS (International Conference on Bridge Maintenance, Safety, and Management); ICCEIMM (International Conference on Civil Engineering Infrastructure Maintenance and Management); ICBRE (International Conference on Bridge and Railway Engineering).
- Conferences in the drone sector: ICRA (International Conference on Robotics and Automation); IROS (International Conference on Intelligent Robots and Systems); ICUAS (International Conference on Unmanned Aircraft Systems); RPAS Summit & Expo; The Commercial UAV Show; InterRPAS; RPAS Experience; ExpoDrónica; Dronitaly; Interaerial SOLUTIONS Expo; RPAS Berlin; Unmanned Systems Defense; Catalonia Smart RPAS Event; RPAS World Expo; European Transport Research Arena (TRA) conferences; SESAR Innovation Days conferences; Aerodays conferences; SESAR U-Space events; UVS International conferences.
- Conferences in the Transport sector: Air Transport Research Society Conference; ATM Seminar; European Aviation Conference; NECTAR (Network on European Communications and Transport Activities Research) Conference.
- Conferences on communication technologies: ICC (IEEE International Conference on Communications); ICT (International Conference on Telecommunications); GLOBECOM (Global Communications Conference).
- Conferences on AI and computer vision: CVPR (International Joint Conference on Computer Vision and Pattern Recognition); ICIAP (International Conference on Image Analysis and Processing); ECCV (European Conference on Computer Vision).
- Networking events: ICT Proposers' Day; Shift2Rail2; SESAR Innovation Days; World ATM Congress; EPRI Unmanned Aircraft Systems for Electric Utilities.

Networking with other EC and Shift2Rail2 funded projects on railways and bridges will be established.

In addition, networking will be established with other EC and SESAR funded projects on drones and U-Space topics, e.g., AW-DRONES, CORUS, GOF U-Space project, etc. and networking activities with JARUS and EUROCAE.

#### 4.5 Reporting

#### 4.5.1 Internal Bi-Annual status reporting

The Parties shall provide data on activities and resources spent every six months for **internal reports** to the Coordinator to ensure proper Project monitoring and to enable the timely identification of potential risks, delays etc.

Reporting	Туре	Month	Date (estimated)
1	Bi-annual report 1	6	1st General Meeting
2	Bi-annual report 2	12	2nd General Meeting
3	Reporting to the EC	18 (+2)	EC Project Review
4	Bi-annual report 3	24	4th General Meeting
5	Bi-annual report 4	30	5th General Meeting
6	Final reporting to the EC	36 (+2)	60 days after the end of the project

Status report includes the status for activities, deliverables and estimate for PM's

The scientific and financial reports must be submitted to the coordinator two weeks before the general meeting. The reports should be submitted in Teams under (WP1>Reporting>Internal Status Reporting), Please find a link to the folder <u>here</u>.

The standard template provided is provided by the Coordinator and will be sent to the partner leads and uploaded in MS teams accordingly.

#### **4.5.2 Reporting to the European commission**

The **official reporting to the Commission** is in 18 months periods. The project coordinator will send out the template and information about deadlines and reporting process the latest one month before the due date.

The official template from Commission needs to be used, including:

- a) **Financial reporting:** Each partner will upload their own financials in the EC system after which the coordinator will check and approve or decline the data in the system
- b) **Technical reporting;** Including structured tables from the grant management system (Part A) and the free text (Part B), core part of the report that explains the work carried out by all beneficiaries and linked third parties during the reporting period and gives an overview of the progress towards the project objectives, justifying the differences between work expected under Annex I and work actually performed.

For more information about the content and structure for the EC reporting, look at the:

H2020 Online Manual: <u>https://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management/reports/periodic-reports\_en.htm</u>

Annotated Model Grant Agreement:

https://ec.europa.eu/research/participants/data/ref/h2020/grants\_manual/amga/h2020-amga\_en.pdf

#### 4.5.3. Time reporting and audit

The proposed system is the use of monthly timesheets. It is requested that the hours committed to the D4S project are recorded and retained by each institution for audit and review purposes by the European Commission. There is not a specific requirement for the timesheet template from the coordinator, but the regulations from the European Commission need to be followed when reporting time.

Audit of the grant can be performed during the project or started up to 2 years after the final payment Each beneficiary much prove:

- The formal link between seconded staff members and the sending organization
- The secondments took place for the time reported
- The researcher worked for the project during the secondment
- The unit cost category A were used in full for the seconded staff member

Each beneficiary much keep:

- Documents in agreement with internal accounting rules and practices of the organization
- Record to prove that the researcher worked on the IPROPBIO project
- Records about the hosted TC researchers entitled to funding
- Records and other supporting documentation, after the balance, is paid, for a period of 5 years

### **5. Project Governance structure**

#### **5.1 Management structure**

The main goal of project management is to provide a focused, lean but effective framework to support the partnership in achieving the scientific and technical objectives of the project. The management structure designed by the project and the decision pyramid are shown in Figure 5.

Responsibility for the overall management and technical direction of the project will rest with the Project Coordinator (PC) SDU UAS Centre (University of Southern Denmark), who will be the primary point of contact with the European Commission. Responsibility for individual work packages will rest with the Work Package Leaders (WPLs) identified below, who will report to the Technical Steering Committee (TSC) as depicted in the management architecture in Figure 5. Where a work package is split across more than one institution, the day-to-day management of each task will be handled locally, with the task manager reporting to the WPL. In order to ensure good integration of the project and sound overall management, the Project Coordinator will convene annual technical workshops containing representatives from the entire project team.



Figure 5: Management structure

These workshops will be open to invited external researchers/industrialists, including members of the Project Advisory Board (PAB), and will usually be accompanied by a physical meeting of the Project Steering Committee (PSC). In addition, the Project Coordinator will convene management meetings involving the relevant partners and members of the Project Advisory Board, as necessary and appropriate. These meetings will be conducted either using video/tele-conference facilities or in person, as appropriate and with due consideration of cost, urgency, and effectiveness.

Technical teams working on a work package that is spread across partners will coordinate through email, video/tele-conferencing, telephone, and scheduled meetings. Finally, the research teams will maintain regular

contact with the Technical Steering Committee and each other through regular email reports and video/telephone conversations.

Progress will be carefully monitored with progress reports and monitoring documents open to inspection by the EU project monitoring officer. In the event of a serious and urgent matter involving all partners, the Project Coordinator may also convene an extraordinary meeting of the PSC. All project documentation (whether managerial, legal or technical) will be maintained through a centralised electronic repository, accessible to all consortium members on an open basis, and incorporating audit trails concisely recording reasons for changes etc. We propose to use SVN, which provides suitable low-cost, low-overhead, low-risk solutions that all partners are familiar with. Our technical reports will form the basis for the public deliverables that will appear on the project website.

**Project Coordinator**: The Project Coordinator (PC) is SDU UAS Centre (University of Southern Denmark). Its role is to act as the primary point of contact with the European Commission, to receive feedback on research results from each work package, to ensure the project maintains effective progress towards the project objectives based on these results, to produce any required project management reports, to ensure that deliverables are produced according to the planned schedule and delivered to the Commission and project reviewers as required, and to resolve disputes between project partners as and when these arise. The PC will convene regular management and technical meetings, monitor progress on each work package, collate deliverables, and maintain good contact with each site, in addition to producing the annual management reports, and ensuring that each site produces the required financial (audit) certificates. The PC will also be responsible for ensuring that the Consortium Agreement (including IPR issues, voting rules and the conflict resolution procedures) and any other legal documents are properly prepared and managed.

**Project Steering Committee**: The Project Steering Committee (PSC) comprises one representative from each partner (usually the Principal Investigator) and is chaired by the Project Coordinator. The purpose of this committee is to decide the general technical direction of the project. It will also take major decisions on project finances, addition of partners, removal of non-performing partners, IPR issues, reallocation of workload, etc. It will meet in person at least once per year, supplemented by more regular teleconference meetings as needed. Extraordinary meetings may also be convened on request by any partner. Each representative has one vote, which may be made by proxy if necessary. Decisions are taken by consensus, if possible, otherwise by majority vote, with the Project Coordinator retaining the casting vote.

	Ordinary meeting	Extraordinary meeting
Project Steering Committee	Once a year	At any time upon written request of a Member of the PSC

**Technical Steering Committee**: The Technical Steering Committee (TSC) comprises the WPLs, plus the Project Coordinator (who will act as chair). Its purpose is to ensure the effective running of the project on a day-to-day basis, and to coordinate work across work packages. In particular, the Technical Steering Committee will be responsible for the implementation of the directives of the Project Steering Committee, for the guidance and monitoring of the technical WPs, for coordination among WPs, for the timely preparation, approval, and forwarding to the Commission of the deliverables produced by the WPs, and for the resolution of conflicts amongst WPs. It will meet on a regular basis, usually through a monthly teleconference. Meetings may also be convened on request by any member. Each member of the Technical Steering Committee has one vote, which may be made by proxy, or in absentia, if necessary. Decisions are taken by consensus, if possible, otherwise by majority vote, with the Project Coordinator retaining the casting vote.

	Ordinary meeting	Extraordinary meeting
Technical Steering committee	Monthly	At any time upon written request of a Member of the TSC

**Work Package Leaders**: The Work Package Leaders (WPLs) are responsible for tracking progress within their work package, developing metrics for each deliverable at the outset of each task, ensuring that the results are properly reviewed against these metrics, and consequently providing feedback to the Project Coordinator on the achievement of goals. WPLs (Table 6) have been chosen on the basis of managerial experience, technical expertise, and commitment to the work package programmes.

WP	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9
WPL	SDU	NEAT	FH	DL	AU	SDU	EUC	DBL	SDU

#### Table 6: Work Package Leaders (WPLs)

**Principal Investigators:** One person will be nominated Principal Investigator (PI) by each partner at the beginning of the project. The PI is responsible for properly managing the budget allocated to the partner and for performing all the tasks that are carried out by that partner, reporting to the appropriate WPLs where necessary. PIs also act as line managers for the researchers/developers employed on the project by the partner. PIs will usually also act as WPLs for the main WPs that are carried out at that site and may be allocated their own technical tasks. They will normally be the partner's representative on the Project Steering Committee. They will be chosen for their technical expertise and experience of line management and budget handling.

**Project Advisory Board:** The Project Advisory Board (PAB) will comprise a small group of invited academics and industrialists who will provide input to the project on general technical trends and directions, and advise the PSC where required. The initial composition of the PAB will be determined at the outset of the project. We intend to include industry and academic experts from robotics, AI, and inspection and energy harvesting systems domains, as well as telecommunication and transportation. The PC is authorised to execute with each member of the PAB a non-disclosure agreement, which terms shall be not less stringent than those stipulated in this Consortium Agreement, no later than 30 calendar days after their nomination or before any confidential information will be exchanged, whichever date is earlier.

**Consortium Agreement:** The partners are bound by a formal consortium agreement that has been signed prior to the beginning of the project, and in which their roles, responsibilities and mutual obligations will be defined both for the project life and, where relevant, beyond. This will formalise key issues including conflict resolution, IPR procedures, governance structure etc. The DESCA Model Consortium Agreement for Horizon 2020, including the European Commission's inputs, will constitute the basis for the consortium agreement, which will include the following aspects:

- Technical provisions (technical resources made available, maximum efforts, modification procedures);
- Rules for dissemination and use (confidentiality, ownership of results as described in Section IPR management), legal protection of results, pre-existing knowledge of partners, etc.);
- Organisational provisions (committees, modification procedures, mutual payments, etc.);
- Legal provisions (legal co-operation status, term of the agreement, penalties for non-compliance with obligations, applicable laws).

**Progress monitoring:** The WPLs will monitor the status of the deliverables and will monitor the progress of their respective work packages. They will report to the PSC regularly and on the occasion of the regular PSC meetings. Other criteria for progress monitoring include:

- Activities carried out (on a task and WP basis);
- Resources spent (overview per partner);
- Deviations from the initial work plan and their implications including adjustments of the plan, if necessary;
- Status of deliverables and milestones;
- Dissemination and exploitation activities.

All the project beneficiaries have the responsibility to:

- Inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action
- Submit reporting data and deliverables to the coordinator in good time

Progress reports will be structured in accordance with the reporting guidelines provided by the European Commission. All reports will be archived and used as a reference and a basis for further progress reports and controlling tasks.

**Conflict resolution:** The decision-making procedures are aimed at finding a consensus among the partners and at avoiding any adverse effects of one partner's activities on those of another partner. In the event that a dispute arises which cannot be settled amicably between the partners concerned, it will be resolved according to the following principles:

- It will first be addressed within the relevant WP through discussion chaired by the WPL.
- If this fails, the issue will be presented by the WPL either to the Technical Steering Committee or to the Project Steering Committee, depending on the nature of the problem (technical or business/strategic).
- The relevant board will attempt to resolve the issue through the usual voting procedure.
- Disputes that could then still not be settled finally will be subject to arbitration in Brussels pursuant to the rules of arbitration of the International Chamber of Commerce. The award of the arbitration panel will be final and binding.

The PC, PSC, and PTC will use the Milestones summarized in Table 6 as control points of the Project.

Table 6: List of milestones							
Milestone	Milestone name	Related	Due date	Means of verification and success			
number		WPs	(in month)	criteria			
M1	Specification and	2	6	Deliverable 2.5			
	Design of the D4S			Final System Requirements Document			
	architecture						

M2	Energy harvesting	3	24	Deliverables 3.3 and 3.4 Implementation and testing of the harvester components
M3	Detection and recognition of defects	4	24	Deliverables 4.1 and 4.2 Supervised/unsupervised anomaly detection neural network models
M4	Swarm system	5	24	Deliverables 5.1, 5.2, 5.3, 5.4 Specification and testing of algorithms for swarming. Security analysis for the multi drone system.
M5	Integration phase	7	28	Deliverable 7.1 System integration of D4S system
M6	Validation of the D4S system (Final review)	7	36	Deliverables D7.2, D7.3 Completion and acceptance of all project deliverables

#### 5.2 Risk Management

The partners have agreed to set up a risk management process that identifies technical but also organisational risks that might occur from the project start to its end.

Every partner identifying a risk must inform the project coordinator as well as the leader(s) of the WP(s) concerned. All risks will be logged in a register and repetitively reviewed at progress meetings. Each risk identified will be described as follows:

- Impact on the project
- Action plan for mitigation
- Work package(s) impacted by the risk
- Likelihood level (high, medium, low), i.e. the probability of occurrence
- Severity level (high, medium, low), i.e. the impact on the project
- The mitigation action plan contains: full definition, responsible for action, target date for closing, status (open/closed)

The identified risks (including management, scientific and technical risks), their probabilities and impacts and a description of the respective contingency plans can be found in the project risk management tool, located on the document repository, <u>here</u>.