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ULTRA

Unmanned Aerial Systems in European Airspace

Thematic Priority: AAT.2012.7-25. Assessment of the potential insertion of unmanned aerial system in the air transport system

Instrument: Coordination and Support Actions (CSA)

D3.3 Impact of RPAS

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1. INTRODUCTION

1.1. Project Objective

The overall objectives of the ULTRA project are:

- To provide a comprehensive set of recommendations for the incremental insertion of civil Light RPAS (RPA with operating mass up to 150 Kg) in the European airspace in the short-term (i.e. within 5 years from now)
- To provide specific recommendations for selected “Use Cases” to be explored as “quick win” business cases.
- Highlight what needs to be done in order to unlock the full potential of the civil Light RPAS market in the long-term (i.e. 10-15 years from now)

These overall objectives are further divided into the following technical objectives in order to address the European Commission expectations for this project:

- Current RPAS status:

  Analyze current and past work relative to civil RPAS, including existing best practices – regulatory authorities and qualified entities (certification & operations), commercial (manufacturers & RPAS operators) and non-commercial (research, scientific, governmental non-military) –, and propose a starting point for Light RPAS operations in the short term.

- Realistic business model and short term, applications:

  Develop a business model for civil Light RPAS applications. Explore short-term, high value applications, and analyze their sustainability and level of impact on European industry and society.

- Social acceptance and building trust with the regulators:

  Perform an in-depth analysis on how to overcome the barriers and mistrust of (Light) RPAS by the general public. Follow a step-by-step approach to build trust between the (Light) RPAS industry and the regulators.

- Foster innovation in and support SMEs access to market:

  Foster the European innovation in terms of aviation automation and provide a path which facilitates access to market for European SMEs.

- Set of Recommendations:

  Develop recommendations to support a sustainable civil Light RPAS market in the short-term and highlights the steps needed in order to unlock the full potential of the (Light) RPAS market in the long-term.

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1.2. Background

The ULTRA project is an 18-month duration "*Coordination and Support Action (CSA)*" funded under the call *FP7-AAT-2012-RTD-1* of the *Transport* (including "Aeronautics") Cooperation Theme of the European Commission (EC) 7th Framework Programme (FP7) to address the activity: *AAT.2012.7-25. Assessment of the potential insertion of unmanned aerial system in the air transport system*, for which the following content, scope and expected impact were established by the EC:

Content and scope: *The study should establish the minimum requirements in terms of standards equipments and regulations to allow the safe insertion of UAS in the civil airspace. It should also anticipate the steps required for the certification and the validation of the insertion. In the light of this, the path to exploitation will be investigated: market trends, adaptation of infrastructures and investments, obstacles to social acceptance. The consortium should gather a representative group of stakeholders including among others manufacturers, regulators, air navigation service providers, and customers*.

Expected impact: *Proposals should demonstrate contributing to analyse and assess the innovation steps needed to allow the insertion of Unmanned Aerial Systems (UAS) for civil application in the air transport system*.

To address these requirements, with the focus on Light RPAS, the ULTRA Consortium defined the project objectives indicated in section **¡Error! No se encuentra el origen de la referencia.**, and organized the work in the following work packages:

- WP1 – *Regulatory and Certification Base*
    - Identification of gaps and new/modified regulations within the existing regulatory framework
    - Proposed set of actions to fill the gaps in the existing regulatory framework
- WP2 – *Adaptation of Infrastructures*
    - State-of-the-art report of civil RPAS solutions and enabling technologies
    - Time-phased alternative solutions for all equipment and infrastructure enablers
- WP3 – *Safety and Social Acceptance*
    - Safety aspects of civil (Light) RPAS operations
    - The social dimension of civil (Light) RPAS operations
    - Impact of (Light) RPAS (on society)
- WP4 – Business Case and Impact on European Industry
    - Most relevant use cases for civil (Light) RPAS in Europe in the 2013-2014 timeframe
    - Civil (Light) RPAS applications in Europe: Deployment plan and economic sustainability of the business case
- WP5 – Conclusions and Recommendations
    - Project Final Report
    - Dissemination activities and material, and project website
- WP6 – Coordination

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As indicated in the "project objectives", one of the main objectives is *to provide specific recommendations for selected "Use Cases" to be explored as "quick win" business cases*. Therefore, the work developed by the different work-packages will feed into the "selected use cases" in order to provide specific recommendations for them from the different key aspects addressed in the project, and support the development of the corresponding business cases. This work logic is depicted in Figure 1.

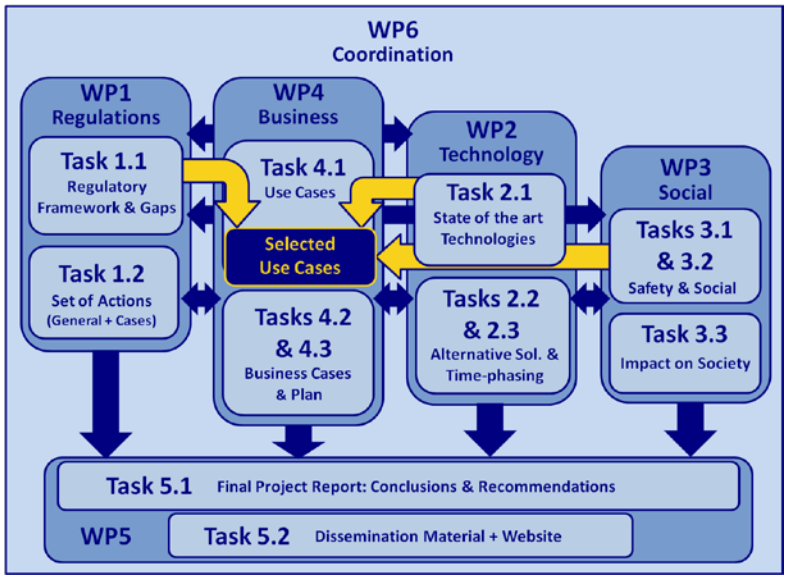

Figure 1 ULTRA work logic

The project started in June 2012 and its duration is 18 months. The ULTRA Consortium gathers a representative group of stakeholders including large and small organizations, as illustrated in Figure 2.

Figure 2 ULTRA consortium

It is worth noting that the ULTRA Consortium has been participating in the **European RPAS Study Group (ERSG)** of the European Commission (see ULTRA D1.1).

1.3. Purpose of the Document

A factor that may easily be overlooked is the impact that RPAS may have on society. The so called dull, dirty, and dangerous missions, which sometimes cannot be performed through other means, may lead to easier acceptance. Societal benefits, such as increasing public safety and fire brigade support resulting in less (severe) forest fires may significantly boost public acceptance.

The social dimensions have been addressed in Task 3.2. In this document the impact that RPAS may have on society will be further analysed. In fact this task is a reverse of the previous: it will take the operations of RPAS as a basis and will identify their impact. The document addresses specific RPAS characteristics and on specific missions, the four defined use cases, that will easy acceptance. Focus is put on those activities for which public acceptance is relatively easily achieved and suggestions are made towards promoting RPAS activities to the public.

1.4. Document Structure

The document is structured as follows:

- Introduction, which provides a description of the document purpose and indicates the references and acronyms list used throughout this document;
- Identification of RPAS missions, in which the use cases will be identified and described;
- Identification of societal impact, which addresses the public acceptance of the four selected use cases and the enhancement of the public image through those use cases;
- Social impact of identified missions, in which the social impacts are analysed per case;
- Suggestions for promoting RPAS activities, presenting means for promoting RPAS applications to the general public involving the main stakeholders from the sector;
- Conclusions and recommendations.

1.5. Applicable and Reference Documents

R.1 Grant Agreement (Contract) ref. ACS2-GA-2012-314680-ULTRA (Grant Agreement no. 314680). 7th Framework Programme. Coordination and Support Action. European Commission DG-Research & Innovation. June, 2012.

R.2 Annex I of the Grant Agreement (no. 314680) – Description of Work (DoW). 15/05/2012.

R.3 ULTRA, *WP3 Work Plan*, Amsterdam, January 2013.

R.4 ULTRA, *D4.1 – Most relevant user cases for civil UAS in the European Airspace in the 2013-2014 timeframe, Madrid*, February 2013.

R.5 ULTRA, *D3.1 Safety Aspects of Small RPAS Operations*, Amsterdam, July 2013.

R.6 ULTRA, *D3.2. Identification of Social Dimension*, Amsterdam, November 2013.

R.7 GWEC (wind energy)

R.8 Powerline Inspections, Sickling M, Cyberhawk Innovations, RAeS Unmanned Aircraft Systems Conference UAS Operations: Dependable, Effective and Efficient?, RAeS London, 19 and 20 September 2013.

R.9 AIA Poll Demonstrates Popular Support for Civil Unmanned Aircraft Systems, UAS VISION, 24 June 2013, http://www.uasvision.com/2013/06/24/aia-poll-demonstrates-popular-support-for-civil-unmanned-aircraft-systems/

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1.6. Glossary

ANSP	Air Navigation Service Provider
CSA	Coordinated Support Action
EASA	European Aviation Safety Agency
EUROCAE	Europe Organization Civil Aviation Equipment
FAA	Federal Aviation Administration
HALE	High Altitude Long Endurance
JARUS	Joint Authorities for Rulemaking on RPAS
MALE	Medium Altitude Long Endurance
SAR	Search and Rescue
SESAR	Single European Sky ATM Research
SRM	Safety Risk Management
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
UAS	Unmanned Aircraft System

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2. IDENTIFICATION OF RPAS MISSIONS

As RPAS are new entrants in the societal landscape, application of these systems will likely have a societal impact at least for some years until they become commonly used systems.
Then, it is also likely that the current proliferation of potential applications will not last for ever: on one hand, some applications may never be accepted and, on the other hand, some others will develop exponentially due to various societal related reasons such as:

- cost efficiency – applications that do not bring cost benefit compared to other solutions will be abandoned by their operators if they cannot make money with them;
- safety – applications that cannot be performed safely will not be accepted by regulators;
- security – applications that raise security issues will be difficult to justify;
- protection of privacy – applications that may violate privacy will likely be rejected by population, even if their primary goal has nothing to do with a privacy issue;
- civil population protection - applications that are useful for the safety and the security of the citizen will likely be encouraged by the community, even if they impose some restrictions for airspace users or population on ground.

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Throughout the ULTRA project, four Use Cases as identified in Task 4.1 [R.4] have been used for elaboration (also summarised in Section 4 of the deliverable report of ULTRA WP3 Task 3.1 [R.5]). They have been selected based on their near-term applicability. This section will identify the basic social dimensions of the four use cases in order to identify the RPAS missions that have the greatest chance to be socially acceptable thanks to their positive societal impact. Based on the information from Task 3.2 deliverable report D3.2 [R.6], the missions of the uses cases are analysed through the criteria that are mentioned above.
Further on, the use cases are also characterized according to the dull, dirty, and dangerous attributes showing that some of them are difficult to be performed by aerial platforms flown by humans.
The four use cases that are considered are:

1. Aerial photography & Video
2. Wind energy monitoring
3. Disaster Management & Firefighting assistance
4. Pipe line & Power line inspection.

2.1. Use Case 1: Aerial photography & Video

The use of an RPAS allows a new dimension of aerial photography and video. From an operational aspect, they allow to take aerial photos and videos at very low altitudes not possible with conventional methods based on dolly cams, jibs and cranes or even manned helicopters. Furthermore, the miniaturization of professional image sensors allows them to be carried on-board of light RPAS, often with costs over EUR 40.000 for the camera head only.

Aerial photography and video can be extremely useful to prevent criminal activity or terrorist attack. This is an important social dimension of aerial photography enhancing security for citizens thanks to monitoring of

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ports, airports, large railway stations, nuclear plants, and buildings of particular artistic importance. Italy, for example is full of archaeological sites, where cities like Rome, Florence and Venice, and the Vatican buildings could represent an attractive site for terrorist attacks. The most common use of aerial video is for traffic monitoring by the police.

The description of this first use case shows the multiple aspects of aerial photography missions.
Many of them can be considered as dangerous as the only way to perform such missions would be to use a manned aircraft flying very low and/or close to obstacles.
This first criteria show that something new can be achieved thanks to the RPAS, hence a significant and positive societal benefit can be derived from this use case.

Regarding cost efficiency, this use case shows a real potential for the development of the aerial photography work with the associated employment benefit;

Safety is a primary concern for this use case as the RPAS may have to fly anywhere, close to populations and ground infrastructures. The societal impact of any repetition of accidents may not be accepted for some of the mentioned applications, i.e. those that are purely commercial, whereas others bringing a benefit to population will be justified even if they have a rather high crash rate, providing that those crashes have no other consequences than material.

Security does not appear to be an issue for this use case. RPAS used here will not carry payload that would lead a robber to highjack the RPA or a terrorist to use it as a high energy projectile.

Protection of privacy may be an issue, depending on the use that is made of the photos and/or videos that will be taken. A particular care should be taken to avoid deviations from the declared, and authorized, description of the case/mission.

Civil population protection: as shown in the description of the use case, this criteria may have a high value in this uses case when it concerns operations in the interest of the population. Lives can be saved thanks to RPAS making aerial photography & video to monitor various critical situations. This is less applicable for the missions, where photography & video material is gathered for purely commercial purposes like advertisements, commercials, etc.

2.2. Use Case 2: Wind energy monitoring

Wind energy generation is booming. The world´s wind power capacity grew by 31% in 2009. The global wind market for turbine installations in 2009 was worth about 45 billion EUR or 63 billion US$. Europe has 96.606 MW wind power capacity installed by end of 2011, the largest total amount in the world. [R.7].

Wind turbines are capital investments that require proper operation and maintenance to avoid costly equipment failures and unexpected repair and maintenance costs. A wind turbine is a complex machine functioning in a complex environment. Wind turbines are built by the integration of various technologies and elements coming from aeronautics, mechanical engineering, hydraulics, electrical and electronic engineering, automation, informatics as well as civil works for the foundations. As for any integrated system, some of the components are more important than others. For a wind turbine, neuralgic components hence identified as critical are the gearbox, generator and rotor blades. These critical components have to be carefully monitored by means of a maintenance program and regular inspections.

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If a fault occurs on one of these main components, it may lead to an unsafe situation for the wind turbine itself and for others, but inescapably it will lead to a financial risk with a loss of production. Therefore, a wind turbine has to be efficiently controlled by frequent inspections in order to protect the materials and preserve the continuity of production or, at least, to minimise as far as possible the shutdown period when performing maintenance work, repair or exchanging a component.

Some checks, like the gear box inspection, need the presence of a technician, while the overview of the blades, abnormal noise, structure cracks, erosion, can be easily detected by a small RPAS that can fly around a wind turbine collecting images and data through special sensors. In the United States there are many commercial companies offering inspection services for wind turbines by small remotely piloted helicopters.

The description of this second use case shows the rather commercial aspect of the wind energy monitoring use case.
It can be considered as dangerous as the only way to perform such a mission would be to climb along the mast of the turbine; such a mission would also be rather expensive to perform. The societal benefit is that this monitoring job, that has really to be done to make wind turbine operate safely, can be performed without putting humans at risk.

Regarding cost efficiency, this use case is particular as wind turbines and RPAS developments are contemporary. It is thus not easy to assess what would have been the solution to inspect wind turbines if RPAS would not have existed.

Safety does not appear to be a big issue for this use case as the RPAS will fly only close to the wind turbines, far from population and away from airspace users. Any accidents will thus have a minor or no impact on the society.

Security does not appear to be an issue for this use case as for the others. RPAS used here will not carry payload that would attract a robber to highjack the UA or a terrorist to use it a high energy projectile.

Protection of privacy should not be an issue due to the location of the flights.

Civil population protection: this criterion is not relevant for this use case.

2.3. Use Case 3: Disaster Management & Firefighting assistance

Light RPAS can bring benefits in situations involving damage assessment after natural or man-made disasters; these situations require in many circumstances low height aerial imaging where manned aircraft cannot operate safely or without disturbing the environment (due to helicopter downwash).

Fire fighters and civil defence have a need for low cost, low altitude and close range Point of Interest view for damage assessment and logistic assistance. The use of light RPAS allows flying in dangerous zones and close to buildings without creating moistures and danger shock waves usually created by full size helicopter blades. Micro helicopters can fly inside a nuclear plant to collect samples of radioactive materials or air. Apparently, RPAS have been used by the Japanese authority to collect samples of the Fukushima nuclear cloud and to address people towards clean areas. The use of light RPAS is significant for civil security operations, in particular for supporting the fight against building fires, post fire

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investigations, motorway road traffic collision monitoring, chemical cloud release monitoring, or searching frozen lakes for missing persons (thermal). RPAS greatly improve the pre-intervention situational awareness of the authorities, which can be of prime importance in case of dangerous environments like collapsed buildings (earthquakes), chemical clouds, floods, etc.

Forest fires can cause severe environmental damage, destroying the habitat of species, some of which are threatened, facilitating the spread of disease and pestilence, sterilising and eroding soils, modifying the quality of water and water courses and in general, making valuable forest space unsustainable. Also forest fires put human health at risk since fire releases biomass smoke containing pollutants; this can have a range of effects on people's health from a small eye, nose or throat irritation through to persistent cardio-pulmonary conditions and premature deaths. A constant monitoring of the countryside in the summer time may prevent arsons to destroy large territory of forests or other natural environments with the previously mentioned consequences.

RPAS are becoming rapidly recognised as powerful means for supporting crisis management through effective information collection. Rapid progress in mobile broadband communications will create a new situation where high-resolution pictures of fire risk zones, especially auto-fire maps, will be transmitted directly in real-time from RPAS. This evolution is further leveraged by the emergence of a new generation of aerial sensors and aerial image processing techniques, which will bring the quality of aerial images to an unprecedented level and makes them useful for decision-making, such as how ground or air vehicles can be used to reach the different areas hit by an earthquake, and using thermal sensors to identify where to search for persons under the debris.. The use of patrolling RPAS 24 hours a day 7 days a week for firefighting offers early fire detection (reduction of the average time lag before fires get detected) and immediate reaction to protect lives, housings and critical infrastructure.

The description of this third use case shows the multiple aspects of the firefighting assistance mission.
It can be considered as dangerous as the only way to perform such a mission would be to use a manned aircraft flying very low, close to obstacles and in an hostile environment (heat, turbulences...) – such a mission would be dirty as the environment may be unfriendly to anyone close to the calamity to be monitored.
This first criteria show that something that cannot (or difficultly) be achieved with other means can be performed by a RPAS; hence a significant societal benefit can be derived from this use case.

Regarding cost efficiency, this use case shows a real potential for the development of the Disaster Management & firefighting assistance work with the associated employment benefit;

Safety does not appear to be a big issue for this use case as the UAS will fly only close to places from which population should have been evacuated and/or is in great need for the help that can be provided more effectively by using the RPAS. Any accidents will thus have a minor or no impact on the society.

Security does not appear to be an issue for this use case. RPAS used here will not carry payload that would attract a robber to highjack the RPA or a terrorist to use it as high energy projectile.

Protection of privacy may be an (minor) issue, depending on the use that is made of the photos that will be taken. A particular care should be taken to avoid deviations from the declared, and authorized, description of the case.

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Civil population protection: as shown in the description of the use case, this criteria has a high value in this uses case. Lives can be saved thanks to RPAS being used for disaster management and firefighting assistance missions.

2.4. Use Case 4: Pipeline & Power line inspection

The worldwide oil network consists of valuable assets, which are owned, maintained and operated by private or government companies. Protecting such assets is crucial in continuing, not only oil business operations successful but also for (macro) economic reasons. For instance keeping guard of offshore oil & gas installations, which are situated across extensive maritime areas, is difficult and costly. And even though most pipelines are over land, the vast stretch that is required for monitoring makes security a daunting challenge. Attacks or damage to such installations can lead to enormous ecological damage, revenue losses and disturbs the international oil markets. One of the main problems of pipeline monitoring is the ability to detect oil leakages, pipeline faults and threats to provide immediate interventions. Benefits for citizens derived from the prevention of such catastrophic events are evident.

There is a need for cost effective solutions, provision of reliable and timely accurate data as well as capability for rapid deployment and enhanced safety.

Light RPAS can help to detect leakages, faults and security issues both offshore and on land. In fact, RPASs are today emerging as highly effective tools for confronting pipeline monitoring, and oil and gas security challenges. RPASs can remain in the air for an extended number of hours and inspect each rig thoroughly. Using manned aircraft for this role is impractical, because the frequent maintenance required to support so many flight hours would be extremely costly and time consuming, and the inevitable boredom involved would raise dangers for the pilot.

Another critical role for the RPAS is the infrared inspection of the thousands of miles of pipelines that transport oil and gas around the world. Oil and gas leaks show up well in infrared because of the temperature differences between the fluid and the soil. Undetected leaks have frequently caused disastrous fires, explosions and loss of life, as well as heavy economic losses. Even at night, an infrared camera reveals the presence of thieves and potential kidnappers, who often try to reach the rigs using small boats or break into a pipeline. Oil leaks and slicks also show up clearly in infrared, and by detecting them early a RPAS can save oil companies millions in fines and in lost oil.

The description of this last use case shows similarity with the wind energy monitoring use case: it is purely commercial.
It can be considered as dull as the only way to perform such a mission is to fly along the pipeline or power lines. Automation of the flight and processing of the imagery taken will enhance the societal benefit.

Regarding cost efficiency, this use case has to be analysed with care. The current sense and avoid requirements for RPAS and the state of the art of the technologies makes it less expensive to do the job with a manned aircraft. The societal impact of a generalisation of RPAS for this use case would be to destroy the manned aircraft business for this application and to create a new one, changing the needs in qualifications for the actors.

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Safety is a big issue for this use case as the RPAS will have to fly long distances in non-segregated airspace Accidents may have a big impact on the societal acceptance. This use case will have to be started only when safety can be guaranteed (to ground population and other airspace users)..

Security does not appear to be an issue for this use case as for the others. RPAS used here will not carry payload that would attract a robber to highjack the RPA or a terrorist to use it as high energy projectile.

Protection of privacy should probably not be an issue due to the location of the flights, which is often away from inhabited areas.

Civil population protection: this criterion is not relevant for this use case.

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3. IDENTIFICATION OF SOCIETAL IMPACT

In the deliverable report for ULTRA WP3 Task 3.2 [R.6] consideration is given to the benefits and acceptability of RPAS in general and as used in particular applications. Although that consideration makes reference to the particular use cases selected for detailed consideration in ULTRA, it does not concentrate on these use cases.

In this section the acceptability to society of RPAS as employed in the specific use cases and their sub-applications defined for ULTRA is considered. Following this, consideration is provided as to which sub-applications would provide the best opportunities for enhancing the image of civil RPAS use through both maximizing the acceptability and minimising the combination of risk and consequence of accidents for each of the four use cases.

3.1. Public acceptance of the four selected RPAS use cases

It should be emphasised that the selected use cases (see Section 2) are quite generic, overlap considerably in terms of the actual purpose and the chosen operations do not provide an indication of the full range of applications they are intended to cover. The difference between the use cases is more concerned with how physically and in terms of regulation the system operates than its specific application use.

For example, monitoring of infra-structure could be defined under use cases 1, 2 or 4. The difference is that under use case 1 it is local and within visual line of sight or the RPAS controller, under use case 2 it is local but requires the RPA to go beyond visual line of sight and under use case 4 it requires the RPA to go well beyond visual, and possibly beyond radio, line of sight. In addition, each use case can be quite varied in terms of their purpose and circumstances. For example, use case 1 can include everything from use in production of movies and television programmes to the ‘state’ uses of surveillance and border patrol.

To assist in gauging the public acceptability of the use cases, each has been considered against the extensions to aviation that provide a benefit to aviation defined in the deliverable report for ULTRA WP3 Task 3.2 [R.6] when considering RPAS applications in general. The five extensions to aviation are as follows:

a) Preventing the need to take flight crew into dangerous areas or subject them to intrinsically dangerous flight.
b) Preventing the limitations on flight duration of flight crew fatigue
c) Allowing flight operations previously difficult or impossible due to manned aircraft size
d) Allowing flight operations previously economically impractical due to manned aircraft costs.
e) Allowing flight operations more rapidly than previously practical due to manned aircraft operating limitations and infra-structure requirements.

The resulting consideration is provided in Table 1, with each of the use cases split into specific potential applications taken to form part of the use case when there is a difference in the extensions to aviation to which they conform.

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In Table 1 the likelihood of conforming to a particular extension to aviation with a specific application is indicated through the use of upper case and bold '**Y**' where it is probable and a lower case 'y' where it is considered only possible. Comments to assist in understanding the basis of the results given are provided in the final column of Table 1.

Table 1. Potential of ULTRA selected use cases to conform to RPAS extensions to aviation

Use Case	Extension to Aviation a)	b)	c)	d)	e)	Comments
1 Aerial Photography						
Plant Inspection	**Y**		**Y**	y	y	Close inspection of plant in conditions when other forms of close inspection are not possible/allowed. Cost effective inspection at short notice, if necessary.
Real Estate				**Y**		Cost effective local aerial photography.
Filming & Media	y		y	y	y	Aerial photography and filming, sometimes in circumstances when manned aircraft cannot be used for safety or disturbance reasons. Short notice aerial photography for reporting.
Damage & Insurance Assessment	**Y**		y	y	**Y**	Rapid response in areas which may well be dangerous. Cost effective aerial assessment for insurance purposes.
2 Wind Energy Monitoring						
Infra-structure Inspection	**Y**		**Y**	y	**Y**	Close inspection of infra-structure, including wind-turbines, in conditions when other forms of close inspection not possible/allowed. Inspection in areas where air vehicle out of direct sight. Cost effective inspection at short notice, if necessary.

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Use Case	Extension to Aviation a)	b)	c)	d)	e)	Comments
Aerial Survey for: Wildlife; mapping; mining; civil engineering; environmental monitoring		y	**Y**	**Y**	**Y**	Aerial photography and filming, sometimes in circumstances when manned aircraft cannot be used for disturbance or other reasons. Cost effective in difficult to access regions with possibility of continuous monitoring or rapid response to trigger information.
Agriculture: Precision agriculture; Spraying	y			**Y**	y	Survey of crops, etc. to assist in damage control and maximisation of yield. Cost effective for planned or rapid response use.
3 Fire Fighting and SAR Assistance						
Fire Fighting (Support)	**Y**				**Y**	Aerial vision of fire state and progression to assist in effectiveness and safety of fire fighting without risking manned aircraft crew in dangerous environment. Potential to provide response to rapidly developing situation.
Post-disaster Assessment	**Y**		**Y**	y	**Y**	Aerial vision of situation to assist in effectiveness and safety of rescue and address without risking manned aircraft crew in dangerous environment. Possibility to enter areas not accessible to manned aircraft for safety and/or size reasons. Potential to provide cost effective aerial response to rapidly developing situation.

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Use Case	Extension to Aviation a)	b)	c)	d)	e)	Comments
Search and Rescue	y	**Y**		y	**Y**	Aerial vision to assist search and rescue efforts, possibly in areas not accessibly to manned aircraft. Able to provide a cost effective approach both for rapid response and long duration/large area searches.
Emergency Operation Support	y	**Y**		y	**Y**	Could include several roles but considered most likely acting as a platform to assist communications in a rapid reaction and cost effective manner yet providing sustained cover.
4 Pipeline Monitoring						
Pipeline & Power Line Monitoring	**Y**	**Y**		y	y	Closer inspection of pipelines, power lines and associated distributed equipment and structure than easily/safely possible with manned aircraft. Can perform long endurance inspections cost effectively but can also react rapidly to trigger information.
River Monitoring		y		y	y	Monitoring of water course state and changes over extended periods or rapidly in response to trigger information. Cost effective relative to other monitoring approaches in either endurance or response case.
Border Patrol		**Y**		y	y	Border monitoring for long periods or rapidly at specific location(s) in response to trigger information on a cost effective basis.
Advertising Banner Towing		y		y		Long duration and cost effective banner towing.

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Notes:
Extensions to Aviation as defined prior to Table and further elaborated in section of Reference [R.8].
Upper case and bold '**Y**' indicates application probably conforms to extension
Lower case 'y' indicates application possibly conforms to extension

3.2. Enhancing the public image of civil RPAS through the use cases

The majority of more specific applications under each use case are noted in Table 1 as possibly conforming to several of the extensions to aviation defined. In addition, most applications are noted as having at least one extension to which they will probably conform. As a result, most of the noted applications should provide the possibility for an RPAS application acceptable to the general public provided measures are taken to ensure the risks to the public is limited when performing the intended operation. In addition, in the deliverable report for ULTRA WP3 T3.2 [R.6] five applications of RPAS recognised as likely to be particularly acceptable to the public have been considered in some detail. It is notable that, for all five applications considered as likely to be acceptable, one or more of the four use cases selected for ULTRA matches the application at least in part. As a result, it can be considered that, as well as having the potential to provide a beneficial impact on society, each of use cases has the possibility to be viewed by society as performing a role that is both acceptable and useful.

Although there is potential for all of the defined use cases to provide and be viewed as providing a beneficial impact on society, it is recommended that efforts should be made to select particular roles where those benefits are likely to be obvious to the public and the risk and extent of potential accidents is minimised. Therefore, concentrating in the near future on applications for RPAS which provide obvious and unchallenged benefit, whilst minimising the risk and consequences of an accident, would be the preferred approach.

It is recognised that there may be a divergence between applications that maximise benefit and acceptability to the society as a whole and those that attract sufficient funding to support development and advancement of RPAS in general. As a result, it is not intended that applications be restricted to those providing maximum public acceptance/benefit but that, where such applications exist, they are actively pursued.

In Table 2 each sub-application defined for the four use cases is ranked based first on its perceived basic acceptability as a role and then the combination of risk and consequence of accidents that might occur during its use. As a result, the potential for each sub-application to enhance the public image of civil RPAS is defined. In several cases acceptability and/or accident risk/consequence is variable. This is generally due to the spread of specific roles in the application and variation in where operations could be performed. For example an Aerial Survey of wildlife protection is seen as having High public acceptability whilst an Aerial Survey by a mining or oil company to define where to start activities is likely to have Low acceptability.

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Table 2. Potential to enhance the image of RPAS resulting from acceptability and accident risk/consequences of ULTRA use case sub-application roles

Sub-Application	Public Acceptability of Role	Combination of Risk & Consequence of Accident	Potential to Enhance RPAS Public Image
Use Case 1: Aerial Photography & Video			
Plant Inspection	Medium	Low - Medium	Medium
Real Estate	Low	Low - Medium	Low - Medium
Filming & Media	Low - Medium	Medium - High	Low - Medium
Damage & Insurance Assessment	Medium - High	Low	High
Use Case 2: Wind Energy Monitoring			
Infra-structure Inspection	Medium - High	Low - Medium	High
Aerial Survey (for various uses)	Low - High	Low - Medium	Medium - High
Agriculture (maximise efficiency)	Low - Medium	Low	Medium
Use Case 3: Disaster management & Firefighting Assistance			
Fire Fighting (Support)	High	Low	High
Post-disaster Assessment	High	Low	High
Search and Rescue	High	Low	High
Emergency Operation Support	High	Low	High
Use Case 4: Pipeline & Power line Monitoring			
Pipeline & Power Line Monitoring	Medium - High	Medium	Medium - High
River Monitoring	Medium - High	Low - Medium	High
Border Patrol	Low - Medium	Medium - High	Low

It is clear from Table 2 that all the sub-applications in ULTRA use case 3 provide a good opportunity to enhance the image of the civil use of RPAS in general. The acceptability of all sub-applications under use case 3 is seen as high and the combination of risk and consequence of accidents is low. It should be noted that this does not mean that the risk of accidents is low because, for example, in the case of firefighting support the risk of losing the RPA may be high. However, if an accident does occur, it is highly unlikely it will damage anyone or thing that would not be damaged by the fire being addressed. It may even be the case that loss of the RPA is, perversely, portrayed by the media as being a good thing because it was not the loss of manned aircraft or the loss of fire fighters on the ground in what proved to be a situation that was too dangerous for people.

In addition to all the sub-applications of ULTRA use case 3, one sub-application under use case 1 and two each under use cases 2 and 4 have high potential to result in RPAS image enhancement. This is important because it confirms that operations in all the four classes defined through the ULTRA use cases have the potential to enhance the image of the civil use of RPAS.

The fact that the use cases provide good potential for enhancing the public image of civil RPAS is not surprising. In making the selection of the use cases and their sub-applications, two of the criteria used were Social Acceptance and Safety (Population Flyover). These criteria, as defined in deliverable report D4.1 [R.4], correlate closely with public acceptability and combination of risk and consequence of accidents as used in constructing Table 2. In addition, the ranking of these criteria relative to others six criteria also used in defining the selected use cases was defined as the highest, equal to two other criteria (Current Utilisation and Technology Readiness) and higher than the four remaining criteria.

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4. SOCIAL IMPACT OF IDENTIFIED MISSIONS

4.1. Introduction

This section seeks to combine the social aspects that have been identified in the previous chapters. The various social aspects have as shown some general influence and relation to the use of unmanned systems, but they also have specific impact on the four use cases. I.e. the aspects relevant for inspection missions flown over open areas with few or no people are different from the ones relating to photography or firefighting missions flown in towns or other areas that are densely populated.

In paragraph 4.2 for each of the four use cases, an in depth description of the social dimensions is provided and how they affect that exact use case. Next, a brief description of the economic impact for each of the use cases is provided in paragraph 4.3. Paragraph 4.4 shows a comparison chart with the effect of social impact issues the four use cases, including:

- Liability and insurance
- Automation and liability
- Privacy and Data protection
- Benefits for citizens
- RPAS Acceptable risk, and
- Ethics

As far as possible this section attempts to take recent academic research in the field of automated systems and RPAS into account, although most research until now is focussed on applications for RPAS and the use hereof and to a much smaller degree on the impacts hereof. Further, the autonomy, legislative and psychological aspects will be analysed as a separate section that served the purpose of an easy accessible overview of all the social dimensions.

4.2. Social aspects of the four use cases

4.2.1. Aerial Photography & Video

Aerial photography and video by High Altitude Long Endurance (HALE) and Medium Altitude Long Endurance (MALE) RPAS can be used as replacement for satellites, offering a versatile and moveable alternative to expensive and often stationary satellites, while light RPAS can replace manned aircraft and photography & video assignments previously performed with different types of mechanical devices – that are often difficult to move and assemble and require several people for operations.

To categorize the operations to be conducted by RPAS for Aerial Photography and Video assignments, the most obvious differentiation is to divide the operations into commercial and non-profit/government missions.

a) Commercial operations, including TV shoots, aerial mapping, various inspections etc.
b) Government operations, which will cover public services and specifically police operations.

The following describes each of the social dimensions for operations under a and b.

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Category a

For operations in category a, the effects are easily available for the general public through the entertainment industry, digital navigation applications etc. Through making the public aware of the advantages of these applications it should be possible to achieve greater public approval. This will fall under the *benefits for citizens.*

Privacy and data protection will be covered by normal commercial rules for what commercial operators are allowed to do. For footage, the general rules in most states are that the photographer has the property rights but is not allowed to make use of it, if the use is compromising or in other cases fall under what the observed people find intrusive – for a further discussion see the ethics section. For mapping and other tasks the privacy issue is already known from various satellite observation services, making the legislation a question of adaptation and adjustments rather than development of new legislation.

Liability and automation liability issues will be addressed mostly in the scope of similar current activities performed with more conventional techniques. This means that the liability is mostly of a commercial nature for organizations operating RPAS. With failures in the in automated systems, liability will be an additional factor for the insurance companies to take into account when insuring operators. This is already done for RPAS operators today.

Risks when operating RPAS for these purposes are limited if the mission is designed in a proper way. As with any other type of aircraft, there is the risk of pilot error and mechanical malfunction. RPAS may be operated in either isolated working environments (studios, or outdoors) or over open space, in which case the risk to people is limited. Risks can be mitigated by observing strict safety policies.

When using RPAS for photography and mapping assignments, the *ethics* dimension is different from ethics of traditional photography. Although many areas are observable through the use of super-zoom cameras and powerful lenses, RPAS does give access to private property and the possibility of intruding on people's privacy. As depicted under the privacy section this is an area that traditionally grants many rights to the photographer and less to the people who are the subject of photos. As ethics of operators is likely not to be sufficient to limit the operations, it should be stressed that the ethical dimension should be seen in connection with the privacy and data protection section.

Category b

Public services and police operations may have a negative effect on public acceptance of the use of RPAS. The actual effect is dependent on the specific activities performed with RPAS and how they are communicated to the general public. However, some police operations do have a positive effect on the opinion of the general public's opinion on RPAS. An example is the search (and rescue) of lost children. Or the liberation of people who were held hostage. This will also lead to an increased positive perception of the use of RPAS and will help changing the sentiment towards RPAS use as a technology that can deliver *benefits to civilians.*

Privacy and data protection is of course a general concern and important issue when it comes to public service/police operations – already without unmanned vehicles. In this respect, the current rules and regulations that apply will have to be maintained and it has be to ensured that the data transmission from aircraft to the operator and video personnel is not tampered with or accessed by unauthorized people. These issues are not different from the existing problems regarding privacy.

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Most government and public authorities are self-insured, meaning the *liability* issues are less relevant when it comes to operations performed by public entities. As counts for commercial operators, the current rules do however have to be elaborated, in order to guarantee that any incidents resulting from automation are covered in the same manner as incidents originating from human error.

Risks for use by public services remain the same as for use by other entities, however the public may be less tolerant to risks imposed by governmental services. Hence it is a factor to be considered against the mentioned positive effects of the use of RPAS by public services. Likewise *the ethical dimension* is not much different from commercial operations described above. Of course the balance between striking a reasonable use, without it developing into a big brother society has to be kept.

4.2.2. Wind energy monitoring

With the emergence of wind farms as one of the main energy sources in Europe, the demand for alternative methods to inspect the wind farms is growing. Traditional inspections require the wind farms to limit operations while technicians access them. This is costly in terms of manpower, loss of production as well as there is a safety risk related to climbing the towers and conducting the inspections in a relatively high altitude.

As wind farms share some of the public concerns that are towards the use of RPAS, in terms of noise and safety, at the same time as they often are placed in remote locations, RPAS are an excellent technology to use for the routine visual inspections.

Concerning the social dimension identified, it can be said that RPAS inspections of wind farms will offer *benefits to civilians,* as maintenance can be done more easily and without the need for engineers to climb the towers. This will in turn ensure a more stable and reliable source of electricity production that can be distributed to the consumers. For offshore wind farms this issue becomes even more relevant, as they are often placed in areas that are difficult to reach by any other means than boat or aircraft. Using RPAS, this can be sailed close to the location and then operated around the wind farms from the vessel.

Privacy and data protection does not pose a big challenge for this use, as there often is no privacy to intrude on in the vicinity of wind farms. Equally, data protection does not pose a great challenge, as the data collected does not carry any value or importance to any other than the owners and operators of the wind farms. Given that the sensors used for wind farm monitoring do not have to be optical, but can be either infrared or acoustic, depending on the type of inspection, the concern for data protection issues is even smaller.

Concerning *liability* this is an issue that becomes very relevant for any damages to either the wind farms or the RPAS. If the operator of the RPAS is the same as the owner of the wind farms, it is to be considered as minor risk, but if not, this is an issue to be covered.

Risks are closely connected to the liability issues in this regard. There is a risks that the RPAS will crash with the wind turbine and cause damage – leading to a service interruption in the supply of electricity. This risk is however outweighed by the benefits of using RPAS for such assignments.

Ethics is not a pressing issue to wind energy monitoring, as it is a pure technical assignment that only involves the observation of technical infrastructure.

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4.2.3. Disaster Management & Firefighting assistance

Disaster management and firefighting assistance are areas in which RPAS can provide essential assistance, not only by providing images, but possibly also by delivering actual services such as fire extinguishing, delivery of equipment etc. Imagery will remain an essential task for emergency responders, as they will be able to get an overview of a given emergency in very short time, allowing resources to be allocated appropriately, which is essential for any kind of emergency response.

Little doubt can be raised over the fact that the *benefits to civilians* are quite significant, when emergency services have an improved chance of providing essential and life-saving assistance to emergencies. Whether it is saving property of lives or detecting a source of potential pollution, the use of RPAS will be positive to civilians. Further, it will offer an opportunity to emergency responders, not to put their own health and lives at risk to the same degree. Being able to detect and plan the effort will be a great achievement in this sense. The sensors used for such an application will offer the most advantages if they are thermal, so they can search for people as well as they can monitor where the source of fires are, so they can be extinguished as quickly as possible.

As use of RPAS in connection with emergency response is not much different from the efforts undertaken with traditional emergency response work *Privacy and data protection* should not be considered a big issue in this respect. Data protection is probably the most relevant issue, as precautions have to be taken, so images and data from emergency efforts are not leaked to media. This poses the “usual” requirement to emergency services, but also to the encryption of data transmission from the aircraft to the remote pilot and monitoring personnel. Taking the already existing use of thermal cameras as an example, this is however not a new challenge to emergency services and should not pose an insurmountable challenge.

As counts for other assignments undertaken by (semi) public authorities, the issue of *liability* is difficult to address as the operator of course carries a liability responsibility towards third parties, but operations are conducted to the greater good of civilians. Especially for operations in emergency and disaster situations, it remains essential that the organization performing the relief work undertakes some of responsibility and liability as it is otherwise left to the remote pilot or the operator. As the advantages should be clearly greater than the loss this only means that it should be in the interest of such organizations to undertake these duties and responsibilities.

It does not take the use of RPAS to create *Risks* when working with fires or emergencies. This is a line of work that is already associated with serious risks for the people working in it as well as the potential people to be rescued. Hence, the benefits of using RPAS will outweigh the risks associated with crashes, the RPAS becoming incontrollable etc. This does not mean that RPAS should be operated without any consideration to the environment they are in or to the specific circumstances.

As long as the guidelines for operations are followed and the information gathered and transmitted or stored in a safe way, there should be no *Ethical* concerns regarding this type of operations.

4.2.4. Pipeline & Power line inspection

As one of the use cases often mentioned as an obvious choice for RPAS integration, pipeline – and obviously also power line – inspection is a mission that otherwise would involve either a considerable number of men or expensive operations using manned aircraft. The characteristics of the operations in some ways are similar to those of inspecting wind farms, as the infrastructure to be observed is often

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placed in areas that are difficult to reach and cause no major concern for people if RPAS should be operating in those areas.

The *Benefits for citizens* will be improved reliability of electricity and other energy sources. Currently inspections are made from vehicles or from manned helicopters. These operations are both expensive and difficult to conduct as pipelines and power lines are often found in rural areas that are difficult to access. Making inspections easier accessible will lower expenditure for infrastructure companies that in effect should lead to lower consumer prices for utilities. Lower consumer prices should be considered a benefit for all citizens.

As counts for the *Liability* for operations, the infrastructure companies would be the obvious operators of RPAS for the inspections. As operations are mostly conducted around critical infrastructure, insurance must be obligatory to ensure that remote pilots can operate freely and conduct the work thoroughly, without having the threat of expensive lawsuits hanging over their heads. For damage to other property or people normal insurance policies should apply in the same way as for manned aviation.

Collection of data should not pose a problem in terms of *privacy and data* protection as the only data collected will be in relation to the physical state of the infrastructure. However, properties adjacent to these infrastructures may be observed as well, which may lead to privacy intrusion. The same applies to the ethics of these types of operations.

The *Risks* concerning these types of operations will be very limited, as there will be no people and only limited property and livestock to be found in proximity of infrastructure of this kind. If an accident were to happen, the consequences could however be big for the supply of utilities transmitted through the relevant infrastructure. This risk should however not be considered greater than that of using manned aircraft for similar operations.

4.3. Economic impact for each of the use cases

Deliverable D4.2 shows the economic sustainability of the four cases of light RPAS use. In this paragraph the economic impact that could be derived from the same use cases is examined. First of all, RPAS can perform missions which are impossible for manned aircraft. Very light unmanned helicopters or multi-rotor systems may collect images, video, make inspections or carry small parcel, all operations that cannot be performed by manned aircraft. Therefore, in general terms, the RPAS use for the four cases offers enormous saving of costs of personnel, fuel, maintenance, insurance and administration. It is certainly difficult to make an economic assessment of savings offered by the use of RPAS in the four examined cases, but the economic advantage produced by these for cases alone, in a ten years' time for the whole of Europe is probably in the region of a few hundred millions of Euros. Investing in RPAS can result in a positive benefits/costs ratio and high ROI (return on investment).
More specifically we may observe the following economic advantages for the four cases.

4.3.1. Aerial photography & video

A very concrete use that produces considerable saving is the border control. Instead of deploying manned aircraft to identify illegal immigration boats – or other threats to a State - RPAS deployment offers enormous money saving also in terms of rescued lives and risks mitigation for pilots. Alternative use of coastal Guard presents high costs and risks, especially in bad meteorological conditions. Aerial

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surveillance is also basically important to prevent criminal activity. RPAS may supply police forces with images and video relating to traffic problems, risky demonstrations of protest. Cost savings are evident with respect to manned helicopters use or land manned operations for police monitoring.

4.3.2. Wind energy monitoring

Ground operations for wind energy monitoring are very expensive. They involve personnel, transport means capable to reach inaccessible sites, considerable time to perform the task. In comparison RPAS can perform the same tasks in much less time and minimal costs. This monitoring can take place very frequently and this prevents stops of energy plants, which produce revenue loss. Especially very small remotely piloted helicopters or multi-rotor systems can make this monitoring in a very effective way controlling small parts of the generator and blades.
Considering the present dimension of this business, the total economic benefits produced by the use of RPAS for monitoring wind energy plants is really considerable.

4.3.3. Disaster management and firefighting assistance

After natural disasters, like earthquake or floods, the possibility to have an assessment of damages and people still in dangerous situations permits to reduce the effective damages bringing in such a way considerable economic advantages. Fukushima nuclear contamination and Philippines tsunami represent a clear example of events monitored by light RPAS, which collected images and video to coordinate interventions to help the population of these areas.
An average of 70.000 forest fires take place every year in Europe, destroying large forest areas, mainly in the Mediterranean region. Economic damages are estimated at 1,5 billion Euro per year. Light RPAS may assure a frequent monitoring, especially in the summer time, of all area at risk representing in such a way an effective prevention system for fires, including detection of arsons.
Once the fire develops, RPAS may assure coordinated interventions by fire brigades, civil protection and other firefighting aircraft to limit damages.

4.3.4. Pipeline and power line inspection

Nowadays pipelines are the most important infrastructure to supply energy to houses and industries. The economy of a country basically depends on energy supply. Any interruption of this supply may cause enormous economic damages. Maintaining the efficiency of pipelines for gas or oil is therefore a must to avoid such economic damages. The efficiency can be assured by a continuous inspection of the pipelines in order to intervene rapidly in case of suspected excavation near or in the direction of pipelines, thus preventing damages. Light RPAS can make inspections in a very effective way at a much lower cost and in a discrete way for their silent flight. The same monitoring can be performed for electric power lines.
The result of preventing energy interruptions alone could be an economic advantage of hundred millions of Euros.

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4.4. Social impact issues comparison chart

Table 3. Social impact issues for the four use cases

	Aerial Photography & Video	Wind energy monitoring	Disaster management & firefighting assistance	Pipeline & Power line inspection
Liability and insurance	Concerns mostly operations over populated areas.	Insurance issue for damages to wind farms. Not different from current inspections.	Rules for operations during Emergencies must apply.	Insurance issue for damages to infrastructure. Not different from current inspections.
Automation and liability	For missions over people, special arrangements will have to be made.	Insurance issue for damages to wind farms.	Rules for operations during emergencies must apply.	Insurance issue for damages to infrastructure.
Privacy and Data protection	Should abide to rules regarding normal propriety of photography. Possible that new rules should be developed in order to protect people from intrusion.	No privacy issues should be affected. Data collection only concerns maintenance issues and as such is not confidential.	No real issue. Ensure that photo/data feed is protected from hacking.	No privacy issues should be affected. Data collection only concerns maintenance issues and as such is not confidential.
Benefits for citizens	Lower cost, better footage.	Lower cost for energy production should lead to lower prices.	More efficient rescue operations. Less risk for emergency personnel.	Lower cost for energy transmission should lead to lower prices.
RPAS Acceptable risk	Risk acceptable as operations are performed with slow flying small RPAS at low altitudes	Risk is incidents in rural areas. Hence effects will be minimal – and not greater than current inspections	Acceptable risk is high as operations will already be in emergency struck areas.	Risk is incidents in rural areas. Hence effects will be minimal – and not greater than current inspections.
Ethics	No major ethical concerns.	No ethical concerns.	No major ethical issues.	No ethical concerns.

5. SUGGESTIONS FOR PROMOTING RPAS ACTIVITIES

5.1. Promotion activities for the general public

For the promotion of the use of RPAS for the general public, it is important to recognise and apply the following three phases:

1. Make the use of RPAS visible to the general public;
2. Stimulate positive opinions by convincing arguments;
3. Provide readily available information on the use/application.

Ad.1. Visibility
Currently, the majority of the use of RPAS concerns applications not always visible to the general public, although they often represent socially appealing applications. To promote the use of RPAS and the social acceptance, the general public has to be aware of their use, for which application the RPAS are being used, and what the use has as benefits (to them). The general news media can be a very effective channel to achieve that visibility. It is therefore important to involve the media in the right applications and in a structured way. The (national) RPAS sector organisations can be facilitators in that process, both by informing the media on (new) activities and bringing them in contact with competent organisations.

Ad.2. Positive opinions
Positive opinions with the general public should only be stimulated by convincing arguments for specific use of RPAS and their application(s). These arguments will have to be substantiated and have to be publically known, so that they can be verified. This is even more important, since involving the general news media also involves a risk, when safety and/or privacy issues arise. Therefor the following prerequisites have been identified:

1. Provision of an independent website for informing the general public in a purely impartial way;
2. A thorough knowledge on the major threats and benefits;
3. A public debate in workshops involving umbrella organisations to enhance RPAS awareness;
4. Identification of the privacy and data protection awareness with (and of) RPAS operators.

These prerequisites will be elaborated on in paragraph 5.2 “Preparation activities”.

Ad.3. Available information
Once the general public is being informed on the use/application of RPAS, Individuals and/or organisations will feel some need for further information. It is therefore eminent that objective information will be readily available to the general public. A proper means for that can be a website maintained by an independent organisation. Thus remaining or emerging questions after the exposure in the media can be answered.

5.2. Preparatory activities

Promotion to the general public is a complex activity and not obvious. In general, use has to be made of indirect ways of communication, through existing channels like news media and Internet (websites). The public opinion can be influenced in a desired way, but also rapidly turn to an opposite direction, whether that is according to the truth or not. It is therefore important to prepare well that activity. The next presents the most essential preparatory activities.

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5.2.1. Website to collect opinions and inform the public

The creation of a dedicated website is suggested, where it will be possible to collect public opinion on RPAS to assess the degree of knowledge of their characteristics and possible use, in order to decide what must be done to gain public acceptance. At the same time this tool could be used to inform citizens about the advantages that RPAS can offer for increasing security, preventing natural disasters, and improving the environment.

This website would therefore permit the dissemination of a large amount of information aiming to create public awareness and familiarity with RPAS. The development of the web site would be of the utmost importance for the dissemination of research. It would inform a large audience of the research aims, progress and achievements. In order to reach and involve specialised audiences (including researchers, RPAS operators and decision-makers), the web site would make available documentation and research materials developed during the research, as well as proceedings of the workshops and other communication/dissemination activities.
The web site should also host a virtual meeting space (i.e. a blog and/or a forum), developed with Content Management System (CMS) technology, for the discussion and exchange of opinions and documents.

5.2.2. Stakeholder questionnaire for identifying major threats and benefits

The next prerequisite to start promotion activities is a clear understanding of the threats and benefits of the use of RPAS for the applications to be used in the promotion. If a promotion activity is started from a wrong view on the benefit of a certain mission that may work far more negative than no promotion at all. This urges the identification of the major threats and benefits beforehand.

For this, cooperation is recommended with the major stakeholders:

- EU organisations (LIBE, EASA, SESAR, Eurocontrol, Frontex)
- National Aviation Authorities (NAA)s
- Data Protection Authorities (for privacy and data protection threats)
- Joint Authorities for Rulemaking on Unmanned Systems (JARUS)
- Light RPAS community (manufacturers and operatoris)
- Civil liberties associations (EGE, NGO Statewatch, etc,)
- Consumer Associations
- Research institutions
- Academia

A questionnaire should be prepared to be sent to these organisations in order to understand what, in their opinion, are the major threats that the civil use of RPAS could raise versus the benefits that these devices could produce for citizens. The result of the questionnaire can then be discussed in a meeting with the above organisations aiming to have clear indications on what will be permitted (favourable and less favourable), or prohibited RPAS activities. After the presentation of the EU RPAS project, the questionnaire will raise issues regarding (inter alia):

- Awareness of these organisations regarding the RPAS technology and payload that RPAS can carry;
- Threats and concerns they see in respect of the use of RPAS;
- How they see a positive use of RPAS for civil purposes;

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- The future technical and legislative provisions they would like to see put in place by the EU or national authorities.

Workshops are vitally important to involve the stakeholders and agree on a strategy to reach the target of establishing a set of recommendations for the European Commission and Member States in order to take the necessary measures for efficient integration of RPAS into the common airspace.

While establishing a set of recommendations for efficient integration of RPAS into the common airspace is a pre-requisite for the deployment of RPAS, the identified threats versus benefits can be used in the public debate.

5.2.3. Public debate on RPAS acceptance

At the occasion of workshops a public debate should be foreseen involving umbrella organisations to foster awareness in the general public and to create familiarity with the RPAS technology and their operation. The exposure to the benefits of RPAS will reduce the risk that there is no acceptance of RPAS due to the uncertainty in the unknown. Stressing the improvement in security and the environment may substantially help in gaining public acceptance of RPAS. The role of RPAS in humanitarian operations (Search and Rescue) or in testing for nuclear and volcanic clouds should also be highlighted, like the role of RPAS in the Fukushima nuclear disaster.

Citizens expect the RPAS community to have ethical behaviour comparable with existing behaviour for the use of other means of data collection. They want to have a legal entity to blame in case of infringement of ethical rules. Considering a Remote Pilot operating the RPA from some distance may influence the initial attitude of the public towards acceptance. Complying with some ethical principles would help to build public awareness and familiarity with RPAS technologies and concepts op operation in order to gain acceptance of such technology and deployment thereof.

Civil liberties organisations and press can be a concrete risk for the acceptance of RPAS deployment for a pre-conceptual attitude or for the dissemination of wrong information regarding technology and/or missions of civil RPAS. Authorities should maintain a constant monitoring on these organisations to prevent negative campaigns on RPAS. EU citizens should not suddenly discover that robots fly over their heads invading their privacy.
The main target should be: “Strongly involve media” in order to replace the bad image of military drones with the positive use of RPAS.
The RPAS Steering Group in their Roadmap have suggested the creation of a “facilitator group” aiming at studying and implementing those measures that may “facilitate” the acceptance of RPAS by civil society.

5.2.4. Privacy and data protection operator questionnaire

For privacy and data protection, operators could be invited to fill an online questionnaire. This could also be facilitated through the previously mentioned web website in paragraph 5.1.1. The questions can aim at acquiring information on the following issues:

1. Awareness of any particular threats to privacy and data protection that each RPAS operation could give rise to in the field of activity of the operator.
2. Awareness of the fact that privacy and data protection are key aspects to successful deployment of civil RPAS and to enhance their public acceptance.

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3. Existence of specific privacy and data protection policies that operators are following in the use of RPAS.
4. Investigate possible misuses of data that is not relevant for the purposes of the specific RPAS operation.
5. Detailed description of the modalities of treatment and processing of personal data organized by each operator (Who is involved? What procedures are followed?).
6. Adoption of any security measures to protect the data being collected.
7. Investigate the existence of specifically trained personnel to deal with privacy and data protection issues.
8. Analyse the modalities and levels of communication with the national privacy and data protection authorities.
9. Awareness of the national and European legislation concerning privacy and data protection issues.
10. Operator's opinions about the adequacy of the normative framework on privacy and data protection.
11. Existence of codes of conduct or good practices related to the treatment and processing of personal data.

Dissemination of the results of this questionnaire on the website can help the public in better understand the privacy and data protection issues and judge the risks involved.

5.3. Promotion activities for the four selected RPAS use cases

5.3.1. Aerial photography & Video

This use case will likely be the most self-promoted one as it is highly commercial. The promotion will be done as part of the day-to-day activities by the operators looking for business with various clients categories. Conventional advertisements will be used, such as company websites, publications in newspapers and magazines and e-mail marketing.
Whereas no specific action appears to be needed in order to promote the uses case to make the mission known by the public, information may be useful to make clear the legal framework in which the missions can be performed. This information dissemination can be considered as promoting the use case as it should make the public confident about the limitations of the authorised uses that have been set up to protect their privacy.

5.3.2. Wind energy monitoring

Promotion of RPAS for this use case will be rather confined as the number of wind turbine operators is not so high. The business case of this application will likely be analysed by turbine operators with two options, either having their own RPAS fleet or call on RPAS private operators' services developed for such a mission. The promotion of this activity will have to be highly technical, with rational and economical demonstrations on the feasibility and on the efficiency of the service provided by the unmanned aircraft systems. However, this is a specific appealing application to promote the use of RPAS with the general public. In fact use can be made of the popularity of wind energy as a means of electric energy generation to make the general public more familiar with the use of RPASs in society.

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5.3.3. Disaster Management & Firefighting assistance

This use case mostly encompasses state applications. Its promotion will have to be made mainly to national and local public authorities in order to point out the benefits of their uses.
Conventional advertisements in magazine or via email marketing will thus be likely inefficient.
The promotion of RPAS for this application has suffered in the past of the proliferation of operators proposing very specific services to fire fighters in a very optimistic way. Preliminary tests were then rather disappointing and users were confused about the systems that would be appropriate. RPAS business for such public uses is serious; its promotion has to be made in a fair and realistic way to be lasting and sustainable. Also, this use of RPAS can be used in a general promotion campaign to introduce RPAS uses in society and increase the acceptance with the general public.

5.3.4. Pipe line & Power line inspection

This use case has some similarities with the wind energy monitoring one; its promotion will be rather confined as the number of pipeline operators is not so high. The business case of this application will likely be analysed by these operators with two options, either having their own RPAS fleet or call on RPAS private operators' services developed for such a mission. Private operators, as part of their commercial activities, will promote the use of RPAS with professional advertising supported by their specific experience (effectiveness, efficiency safety records, etc.). Contrarily with the wind energy monitoring, comparisons with manned aircraft solutions will be needed as these missions are currently performed by manned aircraft. Detailed analyses will have to be made and presented, pointing out the economical and safety related benefits. Due to the very specific characteristics of these applications, they seem less suitable to be used for RPAS promotion with the general public.

5.3.5. Channels of communication

The promotion activities can be performed using different channels of communication. The most important to reach the general public have been depicted in the table below, indicating for each use case the possible application. The main means / channels of communication seen as helpful for the promotion to the general public are:

- Website
- E-mail newsletters
- Social media
- News media coverage
- Demonstrations
- Documentaries

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Table 4. Channels of communication specifics for the four use cases

Means of promotion	Aerial Photography	Wind energy monitoring	Fire Fighting & SAR assistance	Pipeline inspection
Website	Example photos and possibly video footage.	Explanation on the inspection method, the benefits and economic advantages.	Explanation on the tactical operations, the advantages over conventional methods of observation and some video coverage of actual applications.	Explanation on the application and the economic advantages over other means for performing the inspections.
E-mail News Letters	No specific use for news, so less useful.	No specific use for news, so less useful.	Some interest for actual occurrences.	No specific use for news, so less useful.
Social media	When Aerial Photography covers news items, then it can be appealing.	Not of interest.	When actual images can be shared through the social media, this may be is very appealing to the general public.	Not of interest to promote the pipeline with the general public.
News Media coverage	Can be very useful and appealing to the general public when news items can be reported.	Will only reach the news media if some mishap occurs, which may bring the use of RPAS in a bad light.	Can be very useful and appealing to the general public.	Will only reach the news media if some mishap occurs, which may bring the use of RPAS in a bad light.
Demonstrations	The use case is not typically suitable for demonstrations.	Not suitable for demonstrations, due to the fact that wind turbines often are located in remote areas.	Demonstrations can be set-up for instance during exercises. Appealing to the general public.	Not suitable for demonstrations, due to the fact that wind turbines often are located in remote areas.
Documentaries	Can facilitate the promotion of the application.	Interesting to the general public by combining the innovative way of inspection with the environmental friendly energy generation.	Interesting to the general public due to the positive impact of the applications.	Can facilitate the promotion of the application.

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6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

This report identified the basic social dimensions of four use cases, which have been selected within the ULTRA project based on their near-term applicability. The use cases are also characterized according to the dull, dirty, dangerous attributes showing that they are difficult to be performed by aircraft flown by humans.
The four use cases considered are:

1. Aerial photography & Video
2. Wind energy monitoring
3. Disaster Management & Firefighting assistance
4. Pipe line & Power line inspection.

The RPAS characteristics and missions identified for the four defined use cases, show that:

1. The Aerial Photography & Video missions can be characterised mainly by commercial and governmental missions. These differ strongly with respect to public acceptance and ease of promotion, since the commercial missions will be promoted by the operators themselves. The governmental mission's acceptance may depend on the actual application whether this concerns law enforcement and crowd control or humanitarian missions, like searching for lost children.

2. The Wind energy monitoring missions can benefit from the popularity of the environmentally friendly form of energy generation. The use of RPAS enables an effective and efficient maintenance of the wind turbines, while safety, risk and privacy are hardly a problem to the general public due to the often remote location of wind energy farms. Promotion probably has to be actively sought, since the operators will focus their marketing mainly on the owners of the wind farms and not spend resources on large scale advertising their activities.

3. The Disaster Management & Firefighting assistance missions consist mainly on observations and information gathering. This use will result in an improved situational awareness for the emergency services and thus in a more effective management of the disaster or fire and assistance to the casualties. These kind of missions will promote the use of (light) RPAS in itself. Safety and risk issues are of less importance, due to the urgent assistance of casualties and the already present damage. Privacy and data protection are comparable to the conventional means being used. These missions will contribute to social acceptance and the promotion of light RPAS deployment.

4. The Pipeline & Power line inspection missions performed with light RPAS are an attractive alternative to the conventional means of inspection, mostly performed with small helicopters. More environmentally friendly, due to lower pollution and noise emission, this application will be likely to find acceptance with the general public. Especially, due to the operation in rural areas, safety and risk are no big issues. Also privacy and data protection do not seem to hamper this application. The promotion of light RPAS deployment through this use case will need special attention, since operators and the owners of the pipelines and power lines themselves, commercially seen, may not have any urge to contribute to promotion.

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There may be a divergence between applications that maximise benefit and acceptability to the society as a whole and those that attract sufficient funding to support development and advancement of RPAS in general. As a result, it is not intended that applications be restricted to those providing maximum public acceptance/benefit but that, where such applications exist, they are actively pursued.

In several cases acceptability and/or accident risk/consequence is variable. This is generally due to the spread of specific roles in the application and variation in where operations could be performed. For example an Aerial Survey of wildlife protection is seen as having High public acceptability whilst an Aerial Survey by a mining or oil company to define where to start activities is likely to have Low acceptability.

Light RPAS may perform operations that cannot be performed by manned aircraft. Therefore, in general terms, use of RPAS offers enormous saving of costs of personnel, fuel, maintenance, insurance and administration. It is difficult to make an economic assessment of savings offered by the use of RPAS in the four examined cases, but the economic advantage produced by these for cases alone, in a ten years' time for the whole of Europe is probably in the region of a few hundred millions of Euros.

The promotion of light RPAS for the general public requires three lines:

1. Making use of RPAS visible to the general public;
2. Stimulating positive opinions by convincing arguments;
3. Providing readily available information on the use/application

This asks for some preparatory activities, such as setting up a website for information dissemination, identification of major threats and benefits, a public debate on RPAS acceptance, and identification of privacy and data protection treatment by the operators. For the actual promotion, several communication channels can be used, such as: websites, e-mail newsletters, social media, news media coverage, demonstrations, and documentaries.

6.2. Recommendations

It is recommended to:

1. Select particular RPAS roles, where benefits are likely to be obvious to the public and the risk and extent of potential accidents is minimised. Therefore, the preferred approach is by concentrating on applications for RPAS which provide obvious and unchallenged benefit, whilst minimising the risk and consequences of an accident.
2. Create a dedicated website, to collect public opinions on RPAS, to assess the degree of knowledge of their characteristics and possible use, in order to decide what must be done to gain public acceptance. At the same time this tool can be used to inform citizens on the advantages that RPAS can offer for increasing security, preventing natural disasters, and improving the environment.
3. Prepare and sent a questionnaire to the major stakeholders, in order to understand what, in their opinion, are the major threats that the civil use of RPAS could raise versus the benefits that they could produce for citizens.
4. Ask operators to fill in an online questionnaire acquiring information related to threats to privacy and data protection RPAS operation could give. Dissemination of the results on a website can help the public to better understand the privacy and data protection issues and judge the risks involved.
5. Start promotion activities for the four selected RPAS Use Cases to show the public the benefits of RPAS usage.
6. Strongly involve media.

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