How and why Unmanned Aircraft Vehicles can improve Real-time awareness?

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***Abstract*—**Unmanned Aerial Vehicles (UAV) have been used for a long time to improve situational awareness for many parties. During last 30 years UAVs role has received more attention and interest in global perspective. There are many reasons how and why this has occurred. This paper highlights those issues; why this matter is important and considerable. When discussing about situational awareness and real time picture, we should remember that many parties need these issues when they are working. Especially decision makers and their assistants need to know what is happening in the field. For that reason, it is noteworthy to focus on one of the most important way how to accelerate making of situational awareness and real-time picture. This is one of the components how to do it and why we need it.

***Keywords*—**Public Safety, Real-time awareness, Real-time picture, Situational awareness, Unmanned Aerial System, Unmanned Aerial Vehicle.

I. Introduction

UNMANNED aerial vehicles (UAVs) have been designated in many ways: remotely piloted vehicle (RPV), drone, robot plane, and pilotless aircraft are a few of those names. In most cases, they are called unmanned aerial vehicles. United States Department of Defense (DOD) defines unmanned aircraft as follows [1]: *"An aircraft or balloon that does not carry a human operator and is capable of flight under remote control or autonomous programming. Also called UA." "That system whose components include the necessary equipment, network, and personnel to control an unmanned aircraft. Also called UAS." "A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semi ballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles. Also called UAV."*

UAS comprises the aircraft and the following elements [2]: 1) control station, 2) software, 3) health monitoring, 4) communication link(s) (for command & control + data), 5) data terminal(s) (payload exploitation), 6) payload, 7) launch & recovery systems, 8) flight termination system(s), 9) support & maintenance equipment, 10) power generation, distribution & supply, 11) air traffic control communications equipment (voice & data), 12) handling, storage & transport equipment, and 13) all required documentation related to aforementioned.

UAVs have a century-old history in aviation. UAVs were tested During World War I in 1920. At that time UAVs were not used in combat. Germany used a simple but deadly V-1 "flying bomb" during World War II what made base for post-war UAV programs in U.S. In Vietnam War UAVs were first time used in surveillance tasks. However, same type of UAV was modified to carry payload and had its first test flight on December 2002 [3].

The Israeli Air Force (IAF) had several UAVs in late 1970's and 1980's. It was noticed that Israel used UAVs successfully in Lebanon 1982. That encouraged U.S. Navy to acquire a UAV capability for the U.S. Navy [3].

There are several reasons why the UAVs role has only recently received more attention and interest in wider. Technique, which was not available a few years ago, is now available. UAVs might have received more attention in the past, if the crisis should be addressed by enforcement and intelligence during the conflict. The absence of such crises, together with the paradigm change needed to happen before unmanned vehicles were adopted, meant that the UAV is an advanced technology and has become available [3].

A. UAS categories

UASs have categorized many ways. According [2] UASs are categorized by size and altitude: a) Micro (μ), b) Mini, c) Mini; Lighter-Than-Air, d) Close Range (CR), e) Short Range (SR), f) Medium Range (MR), g) Medium Range Endurance (MRE), h) Low Altitude Deep Penetration (LADP), i) Low Altitude Long Endurance (LALE), j) Medium Altitude Long Endurance (MALE), k) High Altitude Long Endurance (HALE), l) Unmanned Combat Aerial Vehicle (UCAV), and m) Optionally Piloted Aircraft (OPA) & Converted Manned Aircraft.

UAVs are sometimes classified in following categories [4]: a) Tactical, b) Endurance, c) Vertical Takeoff & Landing (VTOL), d) Man Portable (larger than micro air vehicles), e)

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Optionally Piloted Vehicle (OPV) (capable of manned or unmanned flight operations), f) Micro Air Vehicle (MAV), and g) Research (developed for specific investigations).

B. UAS related organizations

EUROCONTROL, Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) are coordinating their UAS activities. International Civil Aviation Organization (ICAO) has also started an official UAS study Group which have 14 countries and 7 international organizations participating. [2]

The European Organisation for the Safety of Air Navigation, EUROCONTROL, is an intergovernmental organisation with 39 member States and the European Community. EUROCONTROL was founded in 1960 as a civil-military organisation that is European repository of air traffic management (ATM). EUROCONTROL leads and supports ATM improvements across Europe and it is committed to build a single European Sky which delivers the ATM performance. EUROCONTROLs role in UAS aspects is to verify that ATM runs into requirements of justified airspace operators. EUROCONTROLs legality aspects include international (ICAO), regional (EASA) and national cooperation. [5]

Legal aspects which EUROCONTROL is dealing include: a) Regulatory Framework, b) Certification, c) Airspace, d) Licensing, e) Liability/Insurance, f) Interoperability of systems, g) High Seas Airspace, h) Control: responsibility and authority, i) Communication: e.g. spectrum (Air-Ground, Ground-Ground), j) Cross-border operations, k) Civil/military, and l) Airborne Collision avoidance (ACAS).

The European Organisation for Civil Aviation Equipment, EUROCAE, is an organisation which formed at Lucerne (Switzerland) in 1963. EUROCAE's aim is to provide a European forum for resolving technical problems with electronic equipment for air transport. EUROCAE applies only to aviation standards and related documents as required for use in the regulation of aviation equipment and systems.

EUROCAE is an association composed of members who are specialized technical fields of Aeronautics and many of them are considered to be among world's leaders in their fields. Members of EUROCAE include Equipment and Airframe Manufacturers, Regulators, European and International Civil Aviation Authorities, Air Navigation Service Provider (ANSP), Airlines, Airports and other users.

EUROCAE organises Working Groups (WG) in order to develop EUROCAE Documents (ED). WG members are experts working on a voluntary basis and they come from the association membership. EUROCAE has developed aviation standards over 43 years. [6]

In United States RTCA, Inc. (known as Radio Technical Commission for Aeronautics until their re-incorporation in 1991 as a not-for-profit corporation) develops consensus-based recommendations among other issues for air traffic management systems. RTCA is a federal advisory committee. RTCA Inc. was organized in 1935 and it includes more or less 400 government, industry and academic organizations around the world. Those member organizations stand for all sectors of the aviation, including government organizations, airlines, airspace users, airfield society and labour unions as well as aviation service providers and equipment suppliers. Its recommendations are used by the Federal Aviation Administration (FAA) based on policies, programs and legislative decisions and the basis for private sector development, investment and other business decisions. RTCA Inc. is a non-profit corporation founded to promote art and science of aviation and aviation electronic systems for the benefit of citizens. The organization operates a federal as a Federal Advisory Committee and develops consensus-based recommendations for the modern aviation problems. With UAVs it's possible for government agencies and business companies to increase efficiency, save money, improve security, and even save lives. Interest is growing a wide variety of uses, from aerial photographs, to surveying the land and the plants, the forest fire monitoring, and environmental conditions, to protecting borders and ports from intruders. [7]

The Federal Aviation Administrator (FAA) regulates and oversees all civil aviation aspects in the U.S. and is that fore National Airworthiness Authority. FAA established the Unmanned Aircraft Program Office (UAPO) to combine the UAS safely and effectively into the National Airspace System (NAS). To achieve this goal, UAPO works closely with the UAS community trough RTCA SC-203 to determine Minimum Aviation System Performance Standards (MASPS). SC-203 recommendations are based on the assumption that UAS and their activity do not have a negative impact on existing NAS users. [8]

The European Aviation Safety Agency (EASA), agency of the European Union, has specific regulatory and executive functions in civil aviation safety and environmental protection. EASA is an important factor in European aviation safety by promoting and developing common standards of safety and environmental protection in civil aviation as well as common rules at the European level. It monitors Members States' standards implementation and provide technical expertise, training and research for them. [9]

UVS International is an association which operates in France. UVS International presents manufacturers of UAS, subsystems and critical components and associated equipment for UAS, research organizations and academia. UVS International has members in 34 countries on 5 continents. Focus area of UVS International is UAS related airworthiness, certification and air traffic management (ATM) issues. The UAS associated problems are global, hence UVS International puts effort to harmonise various national and international approaches at the easiest possible stage aim to inserting UAS into non-segregated airspace. [2]

The Association for Unmanned Vehicle Systems International's (AUVSI) mission is to promote and support the unmanned systems community through communication, education and leadership. AUVSI is a global organization that holds robotics / unmanned systems community. AUVSI as a key player in unmanned systems and robotics community it is committed to facilitating the extension of knowledge and to promote educational opportunities of UAS. AUVSI is recognized as a source of knowledge in robotics and unmanned systems, and has been recognized both by governments, industry and universities. [10]

The European Unmanned Systems Centre (EuroUSC™) is independent Light UAS Approvals specialist. It's authorised to asses the airworthiness of Light UASs of maximum weight 150 kg. Safety is the main objective and the mission of EuroUSC™ is to make the light UAS revolution a reality. EuroUSC™ has background in military and civil aircraft operations; therefore it has understanding the commercial realities of UAS as well as operations and training. EuroUSC™ works with organisations and companies which develops practical ways to operate UASs. [11]

World's oldest non-profit-making association The Unmanned Aerial Vehicle Systems Association (UAVS) focuses on the development of networks, increased cooperation and a safe, integrated and comprehensive utilization of unmanned aerial systems. UAVS is an information channel between the government and industry in the UK and represents the UAS industry, and provides information about what is happening in the field of legislation, in particular in the UK. UAVS regularly consults its members and even wider the industry for future UAS topics that focus on UASs civilian use and commercialization. UAVS collect the information proposals to improve the CAP 722, 4th edition, the Unmanned Aircraft System Operations in the UK airspace -guidance. [12]

The Civil Aviation Authorities of Austria, Belgium, Czech Republic, France, Germany, Italy, the Netherlands, Spain and the United Kingdom have formed an organization named Joint Authorities for Rulemaking Unmanned Systems (JARUS). JARUS' active members are also EASA and Eurocontrol. Organization's final purpose is a single set of draft airworthiness, both airspace and operational requirements for civilian UAS below 150 kg or which are for research purposes and are accepted by participating countries.

The above-mentioned organizations and associations are just examples of dozens of different entities, which operate in the field of unmanned aerial vehicles.

C. *Structuring of the rest paper*

Chapter II of this paper discusses the theoretical background of this study and has two viewpoints; what is case study as a research method, case study and the development or implementation of the system and innovation; problem formation section discusses the historical use of UASs and gives examples potential governmental use cases for non-military UAS applications. Chapter 3 presents the problem solution of this case study. Chapter 4 sets out the conclusion of the case study and answers to research questions.

II. Theoretical Framework

A. *Case study research*

Theory-building research is begun as close as possible to the ideal of no theory under consideration and no hypotheses to test. It is impossible to achieve this ideal of a clean theoretical slate. Attempting to approach this ideal is important because preordained theoretical perspectives or propositions may bias and limit the findings. Investigators should formulate a research problem and possibly specify some potentially important variables, with some reference to extant literature. They should avoid thinking about specific relationships between variables and theories as much as possible, especially at the outset of the process [13].

Case studies have been used in teaching and research since the early 1900`s and have become increasingly popular [14]. It has been used for exploratory, descriptive and explanatory purposes, depending on basic questions such as "what, who, where, how many, how and why?" [14]. Case studies are often assumed to be more holistic than other types of business analysis, for instance by mixing quantifiable and qualitative data [14].

A relevant property of theory building is to compare emergent concepts, theory, or hypotheses with the extant literature. This includes questions what is this similar to, what does it contradict, and why? An answer to this process is to consider a wide range of literature [13]. Case study research will answer questions of "how?" and "why?" [15].

Case study can be descriptive in its nature but it can also test theories. Information can be obtained by survey, interview, observation and the use of archival material. Collected information may be either quantitative or qualitative. A case study will examine one case or multiple cases [16].

More importantly, conflicting literature represents an opportunity. The juxtaposition of conflicting results forces researchers into a more creative thinking than they otherwise could be able to achieve. The result can be deeper insight into the emergent theory and the conflicting literature, as well as sharpening of the limits to generalization of the focal research [13].

Case study, as a method, has been criticized; inter alia, the lack of scientific rigor [16]. Every researcher has to follow systematic procedures, reliable evidence and neutral perspective in case study research [15]. The second point of criticism of case study method is that case study provides a little basis for scientific research [16].

The development is learning by doing. Researchers who construct case study often participate in the development or implementation of the system they are researching [15]. The constructive research is one of the options currently available for a case researcher [14].

The constructive research approach is a research procedure for producing innovative constructions, intended to solve problems faced in the real world and to make a contribution to the theory of the discipline in which it is applied. The central notion of this approach, the (novel) construction, is an abstract notion with great number of potential realizations. All human artifacts are constructions. Artifacts are invented and developed, not discovered [14]. Use of design evaluation methods in case of case study is recommended [17]. By using observational method one has to study artifact in depth in business environment. Success is based on the researcher's skills; developing or constructing a theory or an object and the selection of appropriate means to justify the theory or to evaluate the item [17].

It is important to emphasize the significance of five components of a research design in case study; question, propositions, unit(s) of analysis, the logic linking the data to propositions and the criteria for interpreting of the study [15].

First strength of theory building from cases is its likelihood of generating novel theory. A second strength is that the emergent theory can be tested with constructs. A third strength is that the resultant theory can be empirically valid. The likelihood of valid theory is high because the theory-building process is tied with evidence that it is very likely that the resultant theory will be consistent with empirical observation. In well executed theory-building research, investigators answer to the data from the beginning of the research [13].

Some factors that lead to strengths in theory building from case studies also lead to weaknesses. The intensive use of empirical evidence can lead to theory which is overly complex. The result can be theory which is very rich in detail, but poor in the overall perspective. Second weakness is that building theory from cases may result in narrow and simple theory. Case study theory building is a bottom up approach such that the specifics of data produce the generalizations of theory. The risks are that the theory describes a very simple phenomenon or that the theorist is unable to raise the level of generality of the theory [13]. Theory developed from case study research is likely to have important strengths like novelty, testability, and empirical validity, which arise from the close linkage with empirical evidence [13]. Theory building approach is well-suited to new research areas or research areas where existing theory seems inadequate.

It is recommended to researchers to use multiple sources of evidence (triangulation) in case study. There may be explanatory, descriptive and exploratory case studies [15].

The process of building theory from case study research is a strikingly iterative one. When an investigator may focus on one part of the process at a time, the process itself involves constant iteration backward and forward [13]. Analyzing data is the heart of building theory from case studies and in the same time it is the most difficult and the least codified part of the process [13].

B. Problem formation

Laurea University of Applied Sciences has studied micro aerial vehicles (MAV) and their use of public safety professionals [18], [19]. The vision and aim of the Finnish aerospace and aeronautical engineering professionals is to provide an ability to develop and maintain UAS systems, and process the ability to refine international business. Prerequisite for this kind of activity include, inter alia, its own mini-systems development, subsystem development (sensors, data flow) and research involvement in international development programs [20].

Unmanned aircrafts are currently used mainly for various military purposes. On the civilian use of UASs is restricted by the lack of legislation. Government activities and the civilian side of the UAS could be used for many different purposes of use. UAS international aviation regulations concerning Visual Line of Sight (VLOS) in the use of Light Unmanned Aerial Systems (LUAS) might be ready 2012-2015. Total aviation regulations might be ready in 2020, after which the scheduled tasks as a government, as well as scientific research work can probably be implemented [21].

Next, we present a few examples of how to use unmanned aircraft in the Public Sector. There are numerous of organizations where the needs of UAS can be utilized.

Mass events and various events described below could be improved by using UASs. In case of security in various public events like football matches, demonstrations and other public safety issues, operational management as well as maintaining of situational awareness enhances by using UAS.

In the case of lost or drowned person's search for land and inland waters and islands from air, or the lost of ship or boat, or search for locate in inland waters it is a police-led task [22].

The police have responsibility for leading various operational situations. Operational management situations can locate on land or inland waters. Police can appropriately provide rescue service related assistance to public order and security maintenance, hazard and disaster area isolation, transport, guiding, organizing the search for the lost, and other such measures [23]. Violent threats have become more common, for instance armed or dangerous person's search. In this kind of case, the local police resources may be very limited in the beginning of the situation.

Disaster or different kind of accidents investigation explains the cause of the accident and also the consequences of it. Accident Investigation Board maintains readiness to rapidly launch an investigation [24]. In major disasters overview of the creation of the situational picture, monitoring and management support to the activities is important.

In massive fire and building fires, UASs can observe the fire area size and allow the exact location of fire detection. Terrain and forest fire emergency observation is by law organized, when fire danger is obvious or other legitimate reason. UAS can be used for example, to search smoke or to locate oil and to support leadership. Intelligence task can be, for example storm damage and flood damage detection or any other similar task.

Rescue service has responsibility for leading the rescue authority on land and inland waters, fire and related measures of fire, explosion accidents, oil spills etc. In this kind of situations UAS can help rescue management.

International tracking issues have become important after European integration. UASs use can improve criminals tracking by creating a situational picture in multinational and interagency operations [25]. UASs may reduce risk to human life and they are cost effective when comparing to manned aircraft in some types of missions [26].

With UAVs it's possible for government agencies and business companies to increase efficiency, save money, improve security, and even save lives. Interest is growing a wide variety of uses, from aerial photographs, to surveying the land and the plants, the forest fire monitoring, and environmental conditions, to protecting borders and ports from intruders. [8]

Table I present potential use cases for non-military UAS applications. Following figures show how disasters such as the nuclear power plant accident, can be safely observed and monitored and target rescue authorities to the right place without endangering human lives. So far, Fukushima images were grainy, and they have been taken from a safe distance because of security reasons. Following images, taken from UAV, offer the first high-quality pictures of the place.

TABLE I
POTENTIAL GOVERNMENTAL USE CASES FOR NON-MILITARY UAS APPLICATIONS [2]

Custom Authorities	**Police Authorities**
Coastal patrol	Information gathering (in buildings)
On-shore border patrol	Special ops, anti-terrorist
EU maritime surveillance	Urban law enforcement
EU on-shore border patrol	Pre-intervention info gathering
Civil Security & National Police	Urban riot control
Contamination measurement	Perimeter defense
Systematic search ops	Hostile protest control
Natural disaster monitoring	Criminal investigation (several days)
Emergency medical/food supply	Surveillance of public gatherings
	Road traffic surveillance
Regional Fire Brigade	Delivery of non-lethal disabling means
Forest fire surveillance	Coastal border immigration control
National Fire Brigade	Ship lane surveillance
Forest fire surveillance	Permanent police surveillance
Natural disaster monitoring	Land border immigration control
Environmental	Maritime immigration control
Local science missions	EU land border immigration control
Atmospheric measurements	**Contractor Supplied Flight Services**
Wild game surveillance	Training
Fishery control	Terrain mapping
Ozone measurements	Aerial photography
Weather assessment	Monument inspection
Crop monitoring	Network comms relay
Sandbank shift measurement	Emergency comms network
Civil Security	**EU Civil Security**
Avalanche survivor search	Maritime surveillance
Coastal water surveillance	
Maritime search & rescue	

Fig. 1 Full Fukushima site, UAV shots offer high-resolution images of the site [27].

Fig. 2 Directly above the site taken photo on 20th of March, radioactive steam whirls from Unit 3 [27].

Fig. 3 An aerial view taken on March 24, Units 4 and 3 of the plant [27].

Fig. 4 Detailed close-up picture from Fukushima Unit 3 [27]

Fig. 5 Detailed close-up picture from Fukushima Unit 4 [27]

Pictures taken from Fukushima from satellites or from airplanes have been one way or another grainy. UAV can fly near the target because there is no harm for people inside the vehicle. Pictures above were taken following Fig. 6 type of UAV.

Fig. 6 Air Photo Service's Unmanned Aerial Vehicle [27]

III. PROBLEM SOLUTION

The research reported here has attempted to generate new theory on the basis of existing theoretical constructs to meet organizational needs. As we noted in the literature review, our specific research aim has been a relatively new one. Therefore, we use a case study approach, which is generally recommended as a suitable research design for theory-building [13], [15]. Design knowledge is to be applied by people who have received formal education in that field [28]. It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge [29]. Selection of research method to examine the research questions [30].

Interesting research topic in the IS field is how to effectively develop new systems. This is interesting because IT is developing and technical knowledge is growing. IT is applied to new areas, for example UAS, which were not previously believed to need IT support. In this process, new kinds of systems and development methods are created [31]. Case study research is a research to study one or at most a few carefully selected cases. The essential thing is to examine the case. The case study is the most common qualitative research method in business economics. Subject to research in case of the company is usually a process, function or department. In the case study is recommended to use a variety of sources, including interviews and written materials. All qualitative research is not a case study, but a case study may be greatly influenced by other trends in qualitative research [32], [33].

The process of building theory from case study research is a strikingly iterative one. When an investigator may focus on one part of the process at a time, the process itself involves constant iteration backward and forward [13]. Analyzing data is the heart of building theory from case studies and in the same time it is the most difficult and the least codified part of the process [13].

Researchers see the advantages of doing research in team. In our case team-work adds value and brings different point of views to research [34]. Examiner's prejudices should be anyhow avoided [13]. The investigator must be ready to receive and identify the opposite and contradictory information. In this sense, it is constructive to work with the researcher colleague.

Unit of Analysis in our case study is expert's best perceptions of the situation awareness and UASs role in it. In the other hand, experts give their own opinion not the organization's official position or vision [35].

Interviewees were designated based on their expertise. Interview questions represented to eight interviewees, 7 of which were answered. Four interviewees represent the public administration, two private or commercial sector and one represent the academic sector.

A. Research questions

Questions we selected base on the title of our report. Pilot interview was the basis of cross-questions to the following questions [15]. The main questions were chosen after the pilot interview. Interviewee's background concerning UAS was asked in basic questions: What is the organization you represent? In what role do you work? What is your earlier experience and knowledge in the UAV – area? In what task, how many years and what years?

Interview questions of our survey concerned following topics of UAVs; How and in what way UAVs can accelerate and improve maintaining of the real-time picture?, what and why will be the biggest challenges, weaknesses and restriction on the operation at this point in functionally, economically and legally both nationally and internationally? We also asked interviewees if they have else UAV-related matters, they want to highlight.

In our case study we use triangulation of data sources to analyze our research findings. Results are based on the answers we got from interviewees, collected articles from newspapers and video clips we analyzed. In theoretical framework we read scientific publications. The focus of the analysis in this study is improving the situational awareness by using UAVs.

On the civilian use of UASs is restricted by the lack of legislation. Government activities and the civilian side of the UAS could be used for many different purposes of use. UAS international aviation regulations concerning VLOS in the use of LUAS might occur 2012-2015. Total aviation regulations might be ready in 2020 after which the scheduled tasks as a government, as well as scientific research work can probably be implemented. An exception is the United Kingdom, which has prepared the provisions of unmanned aircraft for the purpose. Military aviation authorities have national regulations for the use of UAVs, including Finland [21].

B. SWOT -analysis

All the informants emphasize how important UAVs features with a quick decision-making in a proactive way and overall situational awareness are. Immediate creation and sending of data to the managerial position is particularly important. As well as an accurate real-time picture is necessary to transfer in real-time. Application for UAVs use to speed up the situational picture may be applications where the airplane's use is too expensive to endoscopy or to photograph the object. Informants emphasized the following: *"The situational picture can be accelerated by operating UAS, which is located in suitable sensors and by flying often enough above the target area and move the sensor data to the positions where it is needed." "The management can be provided by real-time picture of what is actually happening, and thereby speed up decision-making in a proactive way. Real-time picture can also be transmitted where it is needed."*
"Management needs real-time image and even the continuous live image."

Informants also highlight the importance of a real-time videos and images recording and analysis possibility afterwards. One informant put that into following words: *"Files can be shared or to explore to the experts who can analyze it and give instructions to the management. Similarly, investigations, etc. can begin immediately."*

As weakness interviewees mention several operators scattered budgets, which are limiting issue of UAVs implement. They are also concerned that UAVs are too expensive for one organization for their own use and informants suggest that UAVs should be concentrated to one user group to maximize the benefit of the devices. According to informants there is limited operating experience in Finland and access to international cooperation. The economic challenges are the development and dissemination costs. Different kind of tools and equipment are constantly renewing and their management is challenging. Procurement and development have been tried to do in previous years, but the government financial situation prevents to invest in development projects. One informant verbalized like this: *"There is no equipment or personnel, which dominates the job. Devices are too expensive for only one organization for their own use. Everywhere should be linked to both authorities as municipalities, cities, industry, or with other research."*

One concern according to informants is resistance to change of new concepts and systems for dismounting the traditional way of operating hampers implementation of UAS. Authorities are developing their own systems; instead they invest in the common and workable system. Equipment should be concentrated to one user group to maximize the benefit of the devices: *"The market is ready for low cost and reasonable UAV equipment, initially, the matter is considered to be sufficiently simple and generally applicable." "In the future, the UAS is important, as the technology becomes more affordable to buy."*

Functionally the challenge is the lack of ignorance like some informants prompt: *"The general ignorance of the UAS is a major challenge, but as this interview shows for its part, we are getting rid of it." "The image media give of the UAV does not contribute to the expansion of activities. Media want to tear the large headlines like "Big Brother Watching" and "Robot Airplanes Throwing Missiles". Aforementioned is a very one-sided view on this matter."*

The biggest challenge for operationally use of UAVs is that legislation does not know well enough UAVs as an aircraft. Training and other requirements are not specified for UAS-operation as well of the operator and the actual apparatus. Especially for large UAVs development is waiting for standardization. As one informant aptly impressed: *"Legislation lives in the past, in a time when an airplane was always manned."*

Table II summarizes the main characteristics according to informants' answers concerning strengths, weaknesses, opportunities and threats, i.e. it illustrates SWOT-analysis of using UAS in improving real-time picture.

TABLE II
SWOT-ANALYSIS OF USING UAS

Strengths	**Weaknesses**
Rapid situational awareness	Several operators scattered budgets
Equipment quickly in place where needed	Equipment too expensive for one organization for their own use
Data can be sent immediately to management center	Ignorance of the benefits of new activities
Real-time image and video can be stored for later analyzing	Lack of legislation
UAS per flight hour is cheap compared to helicopters	General ignorance of the UAS

Opportunities	**Threats**
Equipment concentrated to one user group to maximize the benefit	Authorities are developing their own systems
MAV's flight restrictions compared to UAVs flight restrictions are more liberal	Lack of legislation
UAS technology becomes more affordable to buy	Resistance to change of new concepts and systems
Market is ready for low cost and reasonable UAV equipment	

In threat prevention - by supplementing and maintaining real-time picture – UASs can be used for public order and safety, rescue, border security and immigration monitoring and observation.

UAS based knowledge of the authorities must increase to influence the development of confidential relations between different authorities and actors. In this way may be found new ways of working. Cross-administrative strategic definition of policy approach must be taken into account in all UAS activity. Developing, raising awareness and drawing attention to the authorities and other actors to cooperate extensively the operation of the UAS and activate the function is essential. Clarifying the definition of UAS in such a way that public authorities and other actors have UAS similar interpretations in purpose that there is a common language on the same terms. Enhance the capability of UAS implementation in order to accelerate and improve of a real-time picture through the systematic training and guidance. Implementing UAS -system and developing recommendations for action for UAS use in purpose to improve legislation and UAS performance.

Strengthening cooperation for ensuring comprehensive real-time situational picture, and to removal of barriers to cooperation, which are based on broad cooperation with the traditional security authorities, other public authorities, industry and NGOs confidential co-operate under the same goals. The actions are based on extensive, real-time picture. Real-time picture is a basis for designing, dimensioning and coordinating the various authorities in the same complex tasks. It's carried out by activating the authorities to participate by using the shared resources.

As a conclusion for this chapter are our main informant's suitable words: *"By far the biggest challenge to the UAS world is that international and national aviation legislation does not recognize unmanned aviation… although the UAS can accomplish some things more easily, more efficiently, safer, and more preferably in a way that has not previously been possible, UAS is only one tool among many. ... the entire aviation world is not changing unmanned."*

IV. CONCLUSION

The starting point of this study was to find out how real time picture and situational awareness can be improved (How and why?). The research was started by a desire to explore is it possible and how it can be done by using UAS. Our study was focused to UAS generally and we delimited other systems like micro and mini aerial vehicles out [36].

The theoretical part focused on theory building of case study research and how we can exploit it in our report. Most scientific publications concentrate on building, planning and technical properties of UAS. Unmanned aircrafts are currently used mainly for various military purposes. Our study was limited to civilian use of UASs, which is restricted by the various instruments lack. Government activities and the civilian side of the UAS could be used for many different purposes of use.

The empirical part of the study was limited to few examples how UAS can be applied in different cases. Research interviews revealed, how important is interviewee's expertise, when applying case study research method and little or no scientific material is available. Without expertise, research work about the whole issue could be worthless.

Case study research improves profound understanding. The aim of the study was to analyze and assemble a clear summary about the issue by utilizing different kind of data. We succeeded to clarify the implications for different organisations when UAS is applied in the future. Research objectives were successfully and the research questions were received answers. From the research, the needs for UASs can be seen, as well as social general ignorance how UASs could be exploited in civilian use.

Several sources in our study revealed growing needs for UASs. Our findings showed the importance of continuing the research in the field of UASs. Further research may address, e.g. the legality aspects, possibilities for authorities common UASs, and the overall commercialization and business models of UASs. In the future, this topic will be much more explored. Following of technical and operational developments of UASs is interesting. The future shows, how quickly the use of UASs raises or what will happen. In the future, it is also important to find out what have not yet been taken into account.

Cooperation between different users of UASs is essential and interoperable services for e.g. fire and rescue, police, customs and border control authorities are needed. Service providers must be familiar with the various actors' needs to be able to meet the demand by the right way. Therefore, selecting a product with a wide variety of different operational needs should be given special attention.

Public safety UAV operations must meet at least the following six criteria: 1) economy, 2) ease of use, 3 credibility, 4) real-time documentation and the creation of a snapshot, 5) speed, and 6) reliability. In threat prevention – by supplementing and maintaining real-time picture – UASs can be used for public order and safety, rescue, border security and immigration monitoring and observation [36].

Public safety authorities are fragmented into several operators with scattered budgets, which are limiting issue of UAVs implement. In their view, UAVs are too expensive for one organization's own use, and they suggest that UAVs should be concentrated to larger user groups to maximize the benefit of the devices. The economic challenges are the development and dissemination costs. Different kind of tools and equipment are constantly renewing and their management is challenging. In previous years, some procurement and development work have been tried. Today in Finland, the government financial situation prevents to invest in development projects.

Today, all authorities are developing their own systems; instead they should invest in the common and workable system. Equipment should be concentrated to larger user groups to maximize the benefit of the devices. One player is unable to cope on their own for systems implementation and operation. Funding for such a large system than a UAS does not succeed within a one public organization measures. For that reason, it is essential to create a network, and thereby obtain synergies from a wide-scale deployment of UAS.

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