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Studies of Unmanned Aircraft Systems from the Perspective of Operational Use

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Tuomo Tuohimaa

Miehittämättömän Ilmailun Haasteet

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Tämä opinnäytetyö koostuu neljästä kansainvälisestä tieteellisestä julkaisusta. Opinnäytetyössäni tuon esille miehittämättömän ilmailun haasteita – poliittinen, taloudellinen, taktinen ja tekninen näkökulma. Lisäksi tuon esille ne avaintahot, jotka kukin ovat omalta osaltaan vaikuttamassa miehittämättömään ilmailuun ”pelaajina” kentällä: Laitevalmistaja, lainsäädäntö, operaattori, palvelun tilaaja eli asiakas, loppukäyttäjä, liikemaailma ja lentotoiminnan kohde (ihmiset/infrastruktuuri). Avainasemassa ovat erityisesti ihmiset, jotka ovat huolissaan omasta yksityisyydestään sekä siitä, miten ”isoveli” valvoo heitä.

Tämän opinnäytetyön päätavoitteena on saada lukija ymmärtämään, kuinka monta erilaista toimijaa ja haastetta liittyy miehittämättömään ilmailuun. Miksi verkostoituminen on niin tärkeää, miksi ihmisillä sekä siihen liittyen yleisellä mielipiteellä on niin suuri merkitys miehittämättömälle ilmailulle? Yritän löytää vastauksia näihin kysymyksiin sekä mahdollisen ratkaisun tähän teemaan, käyttämällä apuna kehittämääni mallia. Tässä mallissa käytän erilaisia luokkia ja kategorioita kuvaamaan miehittämättömän ilmailun kokonaisuutta.

Olen kehittänyt edellä mainitsemani mallin aiempien tutkimusteni pohjalta kuvaamaan eri toimijoiden roolia ja toimintaa. Tämä malli auttaa ymmärtämään, kuinka paljon miehittämättömässä ilmailussa on sekä "näkyviä" että "näkymättömiä" toimijoita, kuinka paljon ne liittyvät toisiinsa, ja mikä on niiden välinen vuorovaikutussuhde. Toivon, että tämän mallin lisäämällä tietoisuudella on paljon helpompaa ymmärtää miehittämättömän ilmailun kokonaisuutta.

Tähän kokonaisuuteen vaikuttavia asioita on yllättävän paljon, eikä niitä välttämättä tulla aina edes ajatelleeksi. Miehittämätön ilmailu on paljon muutakin, kuin se, että hankitaan järjestelmä, minkä jälkeen aloitetaan lentotoiminta. Opinnäytetyöni yhtenä tavoitteena on saada lukija huomaamaan, kuinka paljon on olemassa erilaisia asioita, jotka omalta osaltaan kaikki, vaikuttavat miehittämättömän ilmailun kokonaisuuteen.

En edes yritä luoda mitään tyhjentävää listaa kaikista miehittämättömään ilmailuun vaikuttavista asioista, ja esille tuomani asiat ovat varmasti vain osa niistä. Opinnäytetyöni yhtenä päätavoitteena on saada lukija ajattelemaan miehittämätöntä ilmailua kokonaisuutena ottamalla myös huomioon siihen liittyvät erilaiset haasteet.

Ilmailuturvallisuus on yksi miehittämättömän ilmailun tärkeimmistä kulmakivistä. Lentotoiminnan lisääntyessä tämä tulee olemaan erityinen haaste monelle toimijalle. Oma arvioni on, että muutaman vuoden sisällä yhteiskunta tulee olemaan aivan uusien ja erilaisten haasteiden edessä, jotka liittyvät muun muassa yksityisyyden suojaan. Erilaiset haasteet eivät tule koskettamaan ainoastaan julkisia organisaatioita vaan ne tulevat näkymään myös kansalaisten jokapäiväisessä elämässä. Tutkimus- ja kehitystoiminnan merkitys on tärkeässä roolissa.

Avainsanat: Miehittämätön ilmailu, Haasteet, Kategoriat, Yleinen Mielipide, Yksityisyys

Laurea University of Applied Sciences **Abstract**
Leppävaara
Master of Business Administration
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Studies of Unmanned Aircraft Systems from the Perspective of Operational Use

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This thesis consists of four international scientific publications. In my thesis I research the challenges of the unmanned aviation - political, economic, tactical and technical point of view. In addition, I bring forth those key “stakeholders”, which each of those have their own efforts contributed to the unmanned aviation "as players" in the field: manufacturer, legislation, operator, customer, the end user, the business world, an object (human / infrastructure) and people, who are concerned about their privacy, as well as how 'Big Brother' is watching them.

Main goal of this thesis, is to gain knowledge to understand who are the "players" of Unmanned Aircraft Systems (UASs) and what are the main challenges. I also try to find answers to next questions: Why networking is so important? Why people and public opinion are in so big role? I try to find possible solution to this theme by using framework, I have made. In this framework I use categories and dimensions, to increase general awareness of unmanned aviation.

I have developed this model on the basis of my earlier studies, to describe and facilitate the role of the different actors and their activities. This framework helps to perceive, how much the unmanned aviation has both “visible” and “invisible” actors, how much they relate to each other, and what is the interaction between their relationships. By this knowledge, I hope, it is much easier to understand the complex of the unmanned aviation.

There are surprisingly many matters affecting of the unmanned aviation and most of those matters will not even been noticed at once. The unmanned aviation is much more than the acquisition of the system, and then starting the flight operations. One of the main objectives, of this thesis, was to get the reader to discover, how much there are different challenges of unmanned aviation.

I'm not trying to create a list of all themes affecting of unmanned aviation, and in this thesis, highlighted themes are definitely only a part of the total categories. One of my main goals in this thesis, is to get the reader to think about the unmanned aviation taken as a whole and take account of the challenges of the unmanned aviation.

Aviation Safety is one of the most important cornerstones of the unmanned aviation. This is going to be a particular challenge for many parties. I think that within a few years society will face completely new and different challenges, such as privacy. Different challenges do not only affect public organizations, but also in citizens daily life. In the future unmanned aviation-related research and development will become even more prominent.

Keywords: Unmanned aviation, Challenges, Categories, Dimensions, Public opinion, Privacy

List of Publications

P [1] I. Tikanmäki, T. Tuohimaa, J. Rajamäki, How and why Unmanned Aircraft Vehicles can Improve Real-time awareness?, International Journal of Circuits, Systems and Signal Processing, Issue 5, Volume 5, 2011, pp. 469-477.

P [2] T. Tuohimaa, I. Tikanmäki, J. Rajamäki, The Strategic Management Challenges of Developing Unmanned Aerial Vehicles in Public Safety Organizations, 10th WSEAS international conference on communications, electrical & computer engineering, Playa Meloneras, Spain, Mar 2011, ISBN: 978-960-474-286-8, pp. 34-39.

P [3] T. Tuohimaa, I. Tikanmäki, J. Rajamäki, Cooperation challenges to public safety organizations on the use of unmanned aircraft systems (UAS), International Journal of Systems Applications, Engineering and Development, Issue 5, Volume 5, 2011 pp. 610-617.

P [4] I. Tikanmäki, T. Tuohimaa, H. Ruoslahti, Developing a Service Innovation Utilizing Remotely Piloted Aircraft System (RPAS), International Journal of Systems Applications, Engineering and Development, Issue 4, Volume 6, 2012 pp. 279-287.

List of Abbreviations & Symbols

ATC Air Traffic Control
ATM Air Traffic Management
BLOS Beyond Line-of-Sight
CAA Civil Aviation Association
CSR Case Study Research
DSR Design Science Research
EASA European Aviation Safety Agency
EU European Union
FLIR Forward Looking Infrared
GPS Global Positioning System
ICAO International Civil Aviation Organization
ICT Information and Communication Technology
IFR Instrument Flight Rules
ILO Finnish Aviation Industry and Aviation Technology Program
IS Information System
IT Information Technology
LAUREA Laurea University of Applied Sciences
LEA Law Enforcement Agencies
LOS Line of Sight
MAV Micro Air Vehicle
MTBF Mean Time Between Failures
MTOM Maximum Take off Mass
NAUN North Atlantic University Union
NGO Non-Governmental Organization
R&D Research and Development
RPA Remotely-piloted Aircraft
RPAS Remotely-piloted Aircraft System
SIS Software-Intensive Systems
SME Small and Medium Enterprise
SMI Small and Medium Industry
SWOT Strengths, Weaknesses, Opportunities, Threats
TEKES Finnish Funding Agency for Technology and Innovation
UAS Unmanned Aircraft System
UAV Unmanned Aerial Vehicle
UAVS Unmanned Aerial Vehicle Systems Association
UK United Kingdom
U.S. United States
USA United States of America
VLOS Visual Line-of-Sight
WSEAS World Scientific and Engineering Academy and Society

Table of Contents

1 Introduction

This thesis consists of four international scientific publications and this summary, brings together these publications. The research showed the needs for Unmanned Aircraft Systems (UASs), and also a social general ignorance of it. People are nowadays increasingly worried about their privacy and for example how Unmanned Aircraft Systems (UASs) are being used – especially, who uses and for what purpose? This thesis also points out that the market has a huge economic promise for UASs and utilized services by UASs. There can be seen a catalyst for the development of technology in many areas. The research showed the importance of co-operation. Co-operation between the manufacturers and end users must be increased.

The publications [P1] focus is on improving real-time awareness by using UAS. UAS is one of the most efficient ways to create situational awareness and real-time picture. For example decision-makers in many organisations need to be able to exploit a real-time picture of the situation in different situations. As one of the main challenges can be seen ministries fragmented budgets, a lack of common practices of UAS and also the lack of cultural activities.

Publication [P2] points out the importance of networks and networking. Networking and common management is very important for the development of UAS to the use in a small country with limited resources like in Finland. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. It is important to create network, and obtain synergies from a wide-scale deployment of the UAS.

The publications [P3] focus is to address the challenges of strategic management in public organizations for improving their situational awareness and a real-time picture. Publication [P3] points out that Unmanned Aircraft Systems (UASs) can be used as a tool for improving these issues. This research points out also, that many counter parties must participate in UAS development activities.

Publication [P4] points out that the market has a huge economic promise for UAS, services utilizing them, and a catalyst for the development of technology in many areas. A good system is made in co-operation with the manufacturers and end users, in other words, increased co-operation is needed. Research and development is in a key position at this early stage.

On the basis of these studies, I developed a model to describe and facilitate the role of the different actors and activities. This framework shows how much the unmanned aviation has

both “visible” and “invisible” actors, how much they relate to each other, and the interaction between their relationships. The main goal in this theme can be described as “that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact” (Hevner et al. 2004, 82).

Unmanned Aircraft Systems are mainly used for various military operations. The civilian use of UASs is restricted by a lack of various instruments. Government activities and the civilian side of the UAS could be used for many different purposes. The scientific publications from this subject are focused on the building, planning and the technical properties of UASs. (Austin, 2010, Finn & Scheding, 2010, Mueller et al., 2006.)

In the utilization of UASs in Finland, there are many parties, whose vision and objective is to create the ability to develop and maintain these systems. A profitable international business potential may also be realized in the future. The degree of co-operation depends on the interaction between private sector strategies and public sector policies and institutions.

To take full advantage of current and future UAV platforms' capabilities, training programs are required to accomplish safe UAV operations. Military authorities in Europe insist that UAVs can be used in all classes of airspace and they should operate across national borders. This means that UAVs should be used outside of segregated airspace. Furthermore, national level regulations are not conducive to routine operations.

In addition, taking into account the obvious interest and a lack of similar activities in the rest of the world, non-European countries could decide to accept the specifications decided in Europe. Specifications could provide a basis for future Air Traffic Management (ATM) for civil UAVs. Aspects of, for example, airworthiness, certification, system safety, training and licensing of personnel outside the jurisdiction of Euro-control, must be dealt with the appropriate bodies of authority.

If we look at the training from an economical point of view, even though UAV is flying in non-segregated airspace, the pilot-in-command does not need to be a classified crew member. The pilot-in-command requires sufficient training so that they can interact with Air Traffic Control (ATC) and other airspace users, for example, IFR (Instrument Flight Rules) flight requires an instrument flight rating.

Training costs for operators of UASs are less expensive than manned aircraft pilots. However, the specifications require that the air traffic services provided to UAVs should be equal to

that of manned aircraft. Only air traffic controllers would need additional training, primarily in emergency situations unique to UAVs. In addition to this, air traffic controllers would need to familiarize themselves with UAV performance insofar as it relates to controlling the integration of the rest of the air traffic. In other words, the cost of controller training would be potentially relatively insignificant.

People are nowadays concerned about their privacy and how UASs are used. One reason for this is general ignorance of UASs. Elimination of the general ignorance requires, above all, openness and more information about the facts of the UASs. By encrypting these facts this theme turns on itself. In reference to Leukfeldt et al. (2012, 77), "*Threat to privacy is the increased aversion to risk in our current society. In the 20th century, the western world has experienced tremendous economic growth. People are much better off now than they were a century ago, and as a result they stand to lose much more. In recent decades this has led to the development of a "risk-averse-society" where increasingly stronger levels of control are implemented to prevent "mishappenings" and to limit risks."*

1.1 Challenges and players of Unmanned Aircraft Systems

Aviation safety will be definitely one of the cornerstones of unmanned aviation. What are the guarantees, that the use of UAVs is safety and in accordance with current regulations? And what is the entity that is responsible for ensuring that this is also done in practice? And which authority controls unmanned aviation in practice? As an example to mention, these things have to be answered before even thinking about using UASs in wider use.

Challenges for the UAS are presented in figure 1.

POLITICAL	TACTICAL
ECONOMICAL	TECHNICAL

Figure 1. Challenges for the UAS

In UAS - activities there are number of larger discrete entities that provide the basis for the whole action. In other words, no one can go in to the air just like that by using UAVs. In this thesis I will not concentrate on legislation or to the technical requirements. The main focus

will be the different challenges of using UASs. The matter can be described in the following figure 1.

In figure 2. I point out by using different categories, the players in the field of UAS and how they involve and affect together.

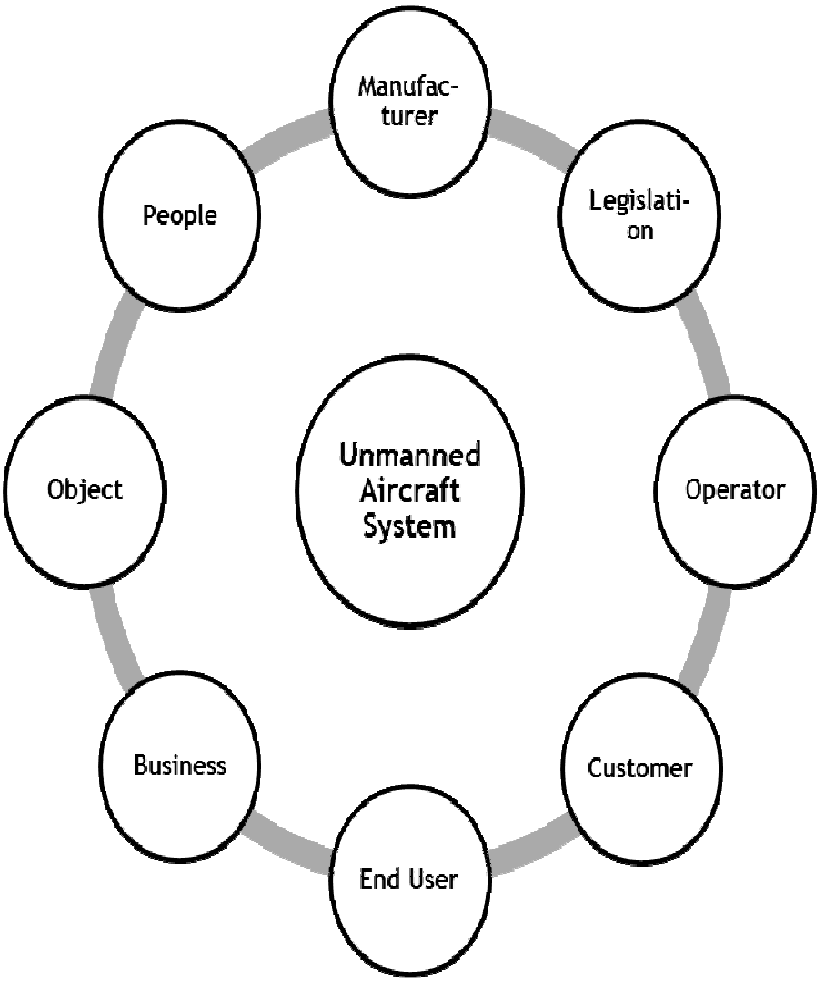

Figure 2. Players in the field of UAS (Categories)

Common goal of players in figure 2. and interest is UAS and their main interest can be for example described by using following questions:

1. How to make a profitable business by building these systems?
2. How to make a profitable business of using it?
3. What are the regulations and legislation concerning its use?
4. How to use it safely and efficiently?

5. Who can be the customers?
6. Who can be the end users?
7. What are we doing by using UASs?
8. What is the public opinion?
9. Are people concerned for use of UASs?

It can be said, that categories described in this figure 2. walk hand in hand and effective use of UASs needs first of all networking. These categories will affect to each other and you must see this as entirety. Thinking about building UASs as profitable business or how UASs are being used for different purposes, the importance of the people and public opinion is surprisingly important.

UAS – activity is strongly associated with military aviation and, more recently, for example the U.S. Army has operated by using unmanned aerial vehicles (UAV) in Pakistan, Yemen, Iraq and Afghanistan. In these operations there have been civilian casualties, which is why this action will trigger a broad opposition and has created many non governmental organizations in different parts of the world. At the same time, people have been particularly concerned about the privacy and are we heading towards Orwellian society. The undeniable fact is before thinking the use of unmanned aviation on "civilian side", for example manufacturers and end users must be able to justify its benefits to the people.

Ball et al. (2012, 274 - 275) point out, *that "visions of an automated surveillance-military killing machine may appear fanciful; such schemes have nevertheless attracted considerable research and development finance. Additionally, the longstanding tendency of military technologies to migrate into civilian application should alert us to the possibility of such technophiliac dreams taking root in domestic contexts. In the 1990s, the end of the Cold War stimulated questioning of the US military`s vast techno science infrastructure. In 1994, the US Attorney General and Deputy Assistant Secretary for Defence signed a memorandum of understanding on "operations other than war" in which they agreed to the development of advanced technologies and systems terms that could be used for both law enforcement and military application. The idea of "dual use" technologies was particularly influential in the development of "sub-lethal" weapons. It is also evident in the utilization of Unmanned Aerial Vehicles (UAV), developed in military contexts and now increasingly deployed in policing contexts such as drug law enforcement, border control and even traffic policing."*

Ball et al. (2012, 275 - 276) point out also, *"On a purely technical level, the demand for control of time and space in military operations has migrated into civilian spheres, with a multitude on innovations from containerization to Global Positioning Systems redeployed for civil-*

ian application. Militaries continue moreover to scrutinize civilian innovations in communication and surveillance for potential military application. For some theorists, there is far more at stake in military surveillance." Ball et al. (2012, 276) also state, that *"The implications of these developments should continue to be interrogated by surveillance scholars. Moreover, the blurring of border control, policing and military power may well mean that military fantasies of techno-control are destined to re-emerge in domestic settings with ever greater rapidity, and may increasingly emerge from within these settings."*

I am sure, that research and development will become in very important role of UASs. You must be able to see large entities, consider the meaning of networking and the meaning of these for the profitable business. There is no shortcut to happiness. If we think this matter from the point of view of manufacturer and end-user, the importance of expertise becomes to extremely important position. For example, if they have no previous experience in the practical flight operations, so what will happen for the aviation safety? There are already now warning examples, when matters did not go as expected. Aviation accidents are not conducive to a positive business or public opinion.

The other example is privacy. If you do not take into account the importance of it, so very soon the public opinion will turn against UASs and that will dramatically affect on this matter. There already now exist many articles in media of Big Brother and drones in the skies. Very important issue of UASs is openness and transparency. If people already know, that UASs are being used for different purposes, so what is the point of concealment?

As I earlier said, research and development done by the players together, described in figure 2., will be in very important role. Scientifically this matter is described in figure 3.

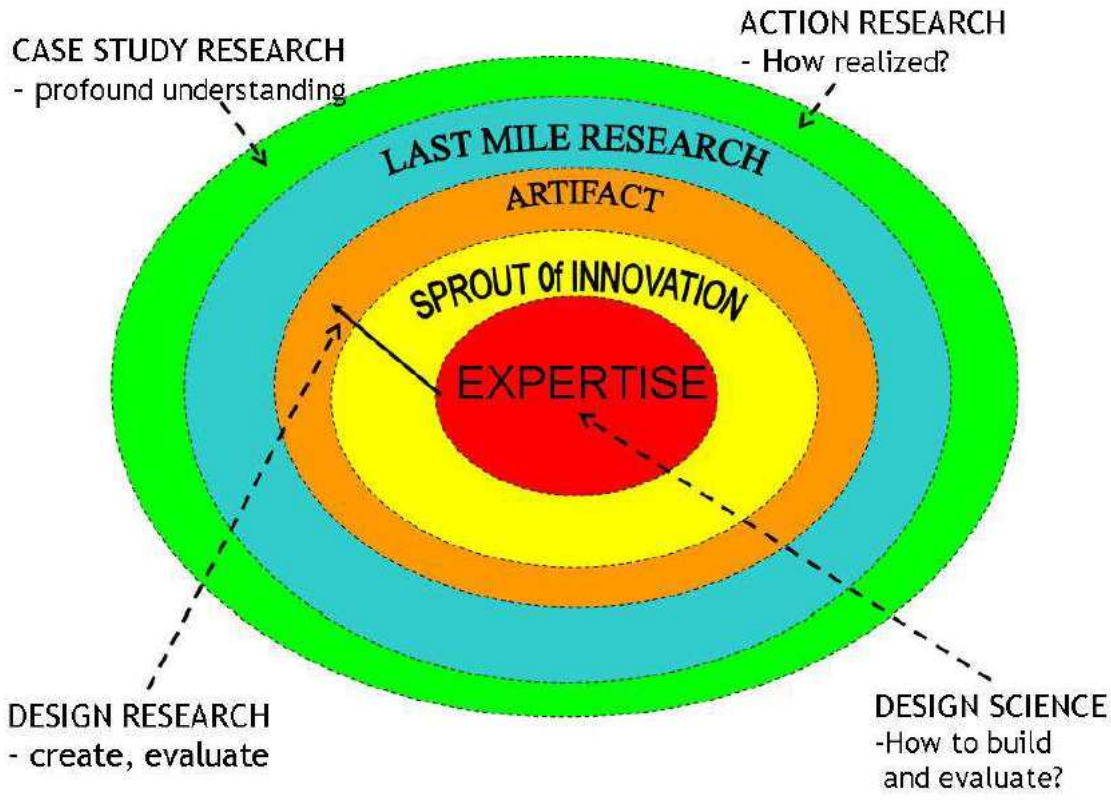

Figure 3. Body of Knowledge (Tikanmäki, I. & Tuohimaa, T., 2010)

Through expertise innovations and artefacts may be expected in different organisations. The mission of design science is to develop knowledge, how to build and evaluate innovations and artefacts. The mission between design science research and design research is almost the same. It is construction and evaluation of technological artefacts to meet organizational needs and also the development of their associated theories. Hevner et al. (2004, 82) describe design-science research as follow: "The principle of design-science research is that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact". The method of this thesis is design science research.

1.2 General ignorance and privacy

People are nowadays increasingly worried about, how Unmanned Aircraft Systems (UASs) are being used and in other words is "Big Brother" watching them. One of the main concerns is especially, who uses UASs and for what purpose? People are also worried about, where all the gathered data is collected and who is able to access it. One of the main research findings in this thesis was also the general ignorance of people about UASs.

The other example of peoples concern is privacy. If you do not understand the importance of it, so very soon the public opinion will turn against UASs. There already now exist marks of it. For example, there are many articles in media of “Big Brother” and “Drones” flying in the skies. The steepest statements are how to shoot down flying UAVs. For this reason, one of the most important issues in the use of UASs, is openness and transparency. This concerns especially the use UASs of different authorities. There is no logical reason for concealment. Otherwise it is expected even stricter statements in media. The following articles in media can be true in the future: “The air combat against UAVs in the skies”, “Air battle between UAVs in the sky” or something else.

It is evident that eye-catching headings in media will affect to the public opinion and thus this also will affect to the political climate. Political influence can be seen in legislation and in other regulations concerning UASs. As shown in figure 1. political opinion has the effect to economical, technical and tactical challenges. It can be said that these challenges walk hand in hand and they have influence to each other. As we can see the public opinion is in important role of these challenges and through this to the “players” in the field of UASs shown in figure 2. In this theme of UASs, it is not the same, how people are concerned of their privacy and what they feel.

This chapter of thesis introduces the importance of privacy and public opinion and next there are few good examples of it: Despite the technological developments of UASs, *“the current legal landscape surrounding UAVs is contested: the Civil Aviation Authority (CAA) is currently investigating the illegal use of UK airspace by the Merseysides Police when deploying similar technology in chasing a suspected car thief. Other ethical debates surrounding the emerging use of this surveillance technology concerns the governance of law enforcement. Most prescient is the incursion of the private sector into the state`s delivery of social control, both in terms of the commercial influences upon security policy and the impetus to generate “cost neutrality” by using government surveillance infrastructures to undertake commercial work.”* (Ball et al. 2012, 206.)

As a “warning example” Penney (2008, 1) points out; “*Canada's electronic surveillance legislation has failed to keep up with advances in wireless and digital communications technologies. In some respects, the current regime unjustifiably impedes efforts to investigate suspects using these technologies; in others, it fails to adequately protect against the novel threats to privacy posed by those technologies. Contrary to the position of many commentators, the reforms that have been proffered to date by government would not significantly enlarge the state's surveillance capacity. They are instead only modest adaptations of entrenched principles to new circumstances. More needs to be done, however, to ensure that*

the (mostly) sensible balance that Parliament and the courts have struck between privacy and crime control is preserved in the face of technological change."

Haggerty et al. (2010, 25) state that in surveillance there are watchers and the watched; the watchers develop accounts of those who are watched, accounts that serve the watchers interests in making decisions. In transparency there are also watchers and watched but here the watched develop accounts on themselves. These accounts are targeted at the interests of the watchers but here the accounts given respond to or aim to fulfil legal requirements or more loosely defined public concerns. In effect, the interests of the watchers are either formulated into legal requirements or loosely interpreted by the watched, for example when corporations reveal information about their environmental policies. In reference to Bauman & Lyon (2013, 18), what you call a liquid modern world, surveillance morphs into some significant new forms, of which drones and social media offer fine examples. Each produces personal information for processing, but in different ways. Bauman & Lyon (2013, 18) point out also: *"Are these media complementary, such that the blithe use of one, social media, naturalizes us to the more unwitting extraction of personal data in another field by means of miniaturizing drones? And what do these new developments mean for our anonymity and relative invisibility in the everyday world?"*

Finally Goold et al. (2009, 34) point out, "*despite the steady expansion in surveillance that has taken place over the past thirty years – we are still some way from living in an Orwellian state. Aside from the fact that most governments remain publicly committed to individual privacy and restraining the surveillance powers of agencies like the police and security services, the technology required to enable the state to make cheap and effective use of the vast amounts of data it routinely collects remains some way off."*

1.3 Research questions

The main research questions in publications of this thesis are:

1. What are the main challenges, categories and dimensions of UASs?
2. Why people, public opinion and privacy are in so big role?

Sub questions in publications are:

3. Why research and development are important in developing UASs?
4. What are the main threats and weaknesses in developing UAS - action?

1.4 Objective and scope

Main goal of this study is to gain knowledge to understand by using categories (figure 2.) how many "players" there are in the field of UASs and what are the main challenges, why networking is so important, why people and public opinion are in so big role? By answering to these themes I try to find possible solution, to increase general awareness of this theme for many parties. In this thesis, it is used multiple methods; publications [P1] and [P4] are made by using case study research and in publications [P2] and [P3] is used design research as a method.

Publication [P1]: In this publication the method was case study research and the goal for the publication was improving the situational awareness and real-time picture by using UASs in organizations. The basis for this publication was to determine how situational awareness can be improved by using UAS. The research showed the needs for UAS, but it also showed a social general ignorance of UAS use in civilian use. Publication focuses on improving real-time awareness by using UAS. 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. UAS is one of the components how to do it and why it is needed.

One fact to take account is that different actors develop their own systems and do not invest in the joint development of the system. The use of UASs should centralize to a single service provider, thus can achieve the best output-input ratio of the use of the system. As a result of above mentioned follows, that it is important to create a network between actors and thus to achieve synergies in the development and deployment of UAS. SWOT – analysis of this publication shows main points of strengths, weaknesses, opportunities and threats of the implementation of UAS. This publication also shows how important cooperation between authorities is. On the other hand, service providers should be familiar with the different actors' needs in order to meet the demands in the right way.

Publication [P2]: In this publication the method was design research. The goal for the publication was to address that networking and common management is very important for the development of UAS to the use in a small country like Finland with limited resources. This publication deals with the networking of UASs. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. That is why it is vitally important to create network, and thereby obtain synergies from a wide-scale deployment of the UAS. Strengthening cooperation and removal of barriers to cooperation under the same goals is essential. Joint research, education and training activities related to authorities' communication, as

well as the authorities' partnerships between the public authorities by ensuring management, situational picture and messaging systems for compatibility and possible integration contribute to the goal.

Publication [P3]: In this publication the method was design research. The goal for the publication was to address the challenges of strategic management in public organizations for improving situational awareness and a real-time picture. Unmanned aircraft system (UAS) is a tool for improving situational awareness and creation of a real-time picture. Persons acting on the ground, their leaders and other decision-makers should be able to exploit a real time picture of the situation when making decisions. There are many organisations, which have the need for the situational real-time picture. This publication deals with the importance of networking and co-operating between authorities and their duties. In this point of view, the challenge for UASs use include ministries fragmented budgets, a lack of common practices of the new system of exploitation and the lack of cultural activities.

The importance of cooperation between authorities has discovered an important subject to develop. The Finnish Government's Security and Defence Policy states that close cooperation between the authorities achieves synergies by cutting overlap and support functions thus enabling an efficient use of resources. Situational awareness and government collaboration will be developed both nationally and internationally. In UAS development activities, many counter parties must participate.

Publication [P4]: In this publication the method was case study research. The goal for this publication was to find out how services can be produced by using Unmanned Aircraft Systems, what obstacles are there in the operational point of view and to explore is it possible and how it can be done by using RPASs. This study succeeded to clarify the implications for different organisations when RPASs are used in the future and it shows the needs for RPASs, but also a social general ignorance on how RPASs can exploited in civilian use. The importance of networks and networking in today`s world cannot be overstated. The market clearly has a huge economic promise for all RPAS MTOM (Maximum Take off Mass) classes and services utilizing them. These markets are a catalyst for the development of technology in many areas, which will have significant spin-off potential.

In April 2011 was held the first official Finnish UAS -course. In that course, UAS related activities were generally divided into three sections; business, training and end users. This kind of course might be seen as the beginning for networking and collaboration of many parties. A good system regards the end user, and it is made in co-operation with the manufacturers and

end users. Increased co-operation is needed. RPA systems will be the business of the future. Research and development can be seen in a key position at first step.

2 Methods and Research Process

Hevner & Chatterjee (2010, 3) state, that research is a process through which we try to achieve systematically and by using data the answer to a question, the resolution of a problem, or more understanding of a phenomenon. This process is called research methodology, has eight diverse characteristics:

1. Research originates with a questions or a problem
2. Research requires a clear articulation of a goal
3. Research follows a specific plan of procedure
4. Research usually divides the principal problem into more manageable sub problems
5. Research is guided by the specific research problem, question, or hypothesis
6. Research accepts certain critical assumptions
7. Research required collection and interpretation of data or creation of artefacts
8. Research is by its nature cyclical, iterative, or more exactly helical

Hevner & Chatterjee (2010, 5) point out, *"design science research is a research paradigm in which a designer answers questions relevant to human problems via creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence. The designed artefacts are both useful and fundamental in understanding that problem."* The first principle of DSR (Design Science Research) is in reference to Hevner & Chatterjee (2010, 5) following: *"The fundamental principle of design science research is that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact."*

Hevner & Chatterjee (2010, 5) state that in technology there are many tools, techniques, materials, and sources of power that humans have developed to achieve the goal of their needs. Technologies are often developed in to some specific task requirements by using practical reasoning and experimental knowledge. Hevner & Chatterjee (2010, 5) state also that behavioural science draws its origins from natural science paradigm to find the truth. It starts with the hypothesis, and after that researcher collect data, and either prove or disprove the hypothesis. Design science is fundamentally a problem-solving paradigm whose main goal is to produce an artefact which must be built and after that evaluated.

Hevner & Chatterjee (2010, 6) state also, design is often a complex process and the design for useful artefacts is hard due to the need for creative advances in domain areas where existing

theory is often insufficient. Lee (2001) states as follows: *"Research in the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomenon that emerges when the two interact."* Cross (2001) points out: *"We must not forget that design knowledge resides in products themselves; in the forms and materials and finishes which embody design attributes. Much everyday design work entails the use of precedents or previous exemplars - not because of laziness by the designer but because the exemplars actually contain knowledge of what product should be."*

March and Smith (1995) state, that acquiring such knowledge involves two complementary but separate paradigms; natural (or behavioural) science and design science. In reference to Hevner & Chatterjee (2010, 10) the behavioural science paradigms have roots in natural science research methods. It seeks to develop and justify theories (i.e., principles and laws) that explain or predict organizational and human phenomena surrounding the analysis, design, implementation, and use of information systems. Such theories inform researchers and practitioners of the interactions among people, technology, and organizations which must be managed if in information system is going to achieve its stated purpose especially improving the effectiveness and efficiency in organization.

Hevner et al. (2004) and Järvinen & Järvinen (2004) state that investigators need to understand the target environment, its requirements, and also the subject to the investigation of the problem. It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge (Orlikowski & Baroudi 1991, 24). Design knowledge is to be applied by people who have received formal education in that field. (Van Aken 2004, 225.) Dubé & Paré (2003, 612) point out that researchers see the advantages of doing research in team. In reference to Simon (1996) design science has roots in engineering and the sciences of the artificial. It is a problem-solving paradigm. It tends to create innovations which define the ideas, practises, technical capabilities, and products through which the analysis, design, implementation, and use of information systems can be effectively and efficiently accomplished.

Pirinen states (2009, 7), the task of design science, is to produce design science knowledge to improve the activities of design and construction. The mission of design science is how to construct and evaluate innovations and artefacts. The method of design science research and design research is almost similar. Pirinen (2009, 6) points out that *"Design Research consists of activities concerned with the construction and evaluation of technological artefacts to meet organizational needs as well as the development of their associated theories"*.

Challenge for the design-science researchers in Information Systems is to inform leaders of the capacity and the impact of new IT objects (artefacts) (Hevner et al. 2004, 99.) In reference to Suomala et al. (2005, 180) innovation is generally regarded as the invention, which has practical application value. The growing importance of innovation in the traditional understanding of innovation has received several extensions. Suomala et al. (2006, 2208) state also, that "*the idea of innovation becomes a target for implementation when it is sufficiently interesting and baffling*." Ojasalo et al. (2009, 71) state, that meetings of the professionals of the different field are considered as situations which are valuable and produce many innovations.

Van Aken (2005, 22) points out that *"understanding the nature and causes of problems can be very helpful when professionals are designing solutions. Design science develops knowledge on the advantages and disadvantages of alternative solutions".* In reference to Van Aken (2004, 224-225) the function of a design science is to develop knowledge for the design and realization of artefacts or to solve improvement problems. Van Aken (2004, 225) also state, that design science develops knowledge for the professionals in its field. Design knowledge is to be applied by people who have received formal education in that kind of field. The researchers need to understand the implications of their research perspective, and act in ways that reflect of their knowledge (Orlikowski & Baroudi 1991, 24).

Design science is active with respect to technology and its focus is on problem solving. It takes often a simplistic where designed artefacts must function. The design of an artefact, and an assessment of its utility, compared with competing artefacts, is an essential design-science research. (Hevner et al. 2004, 100.) Nunamaker et al. (1991) point out, the new artefact is always based on one concept. Järvinen & Järvinen (2004) state, this means the concept of a resource, technical, human, or informational resource, or a combination thereof, recovery. Järvinen & Järvinen (2004) state also, that idea can be based on a new theoretical invention.

Hevner et al. (2004) consider as a basis for research the business environment which consists of people, business organization and technology. The targets of research in their view are human form of roles and competencies as well as the organization's strategies and processes, and technologies which support these. Hevner et al. (2004) and Järvinen & Järvinen (2004) state, that investigators need to understand the target environment, its requirements, and also the subject to the investigation of the problem. In reference to Becker & Whisler (1967, 469), *"In any other area of research, empirical work must stem from and relate to theoretical analysis."*

As shown in figure 4., March & Smith (1995, 251) propose a framework to guide difference between research outputs and research activities.

Research Outputs	***Research Activities***				
		Design Science		*Natural Science*	
		Build	Evaluate	Theorize	Justify
	Construct				
	Model				
	Method				
	Instantiation				

Figure 4. A Research Framework (March, S.T. & Smith, G.S., 1995)

Research outputs (artefacts); constructs, models, methods and instantiations are the first dimension of that framework. On the other hand the second dimension is based on design science and natural science research act ivies: build, evaluate, theorize and justify. Design science's function is building and evaluating IT artefacts while natural science intents theorizing and justifying (March & Smith. 1995, 251).

2.1 Focus of the research

The focus of the research in publication [P1] was to determine how real time picture and situational awareness can be improved. The focus in this research was also, is it possible, to improve real time picture and situational awareness by using Unmanned Aircraft System (UAS). The Unit of Analysis in publication [P1] is expert's best perceptions of how to improve situational awareness by using Unmanned Aircraft System (UAS). In this research different interviewed give their own personal opinion. From the base of the interviews in publication [P1] was made SWOT analysis, which helped in focusing the research. Data for research in publication [P1] was collected by interviewing, documents, collected articles and scientific publications. Collected data in publication [P1] deepens the acquired knowledge from additional literature and collected articles.

The publication [P2] deals with the importance of networks and networking. A smooth and seamless cooperation between different spheres of government contributes UASs implementation for public needs for improving and speeding up situational awareness and creation of real-time picture. Strengthening cooperation and to removal of barriers to cooperation is essential for many parties. Joint research, education and training activities contribute also the goal for many parties. Data for research in publication [P2] was collected by documents, collected articles and scientific publications. Collected data in publication [P2] deepens the acquired knowledge from additional literature and collected articles.

The focus of the research in publication [P3] was to determine the main challenges in the use of Unmanned Aircraft System (UAS) between different authorities. Publication [P3] concentrates in co-operation challenges in the use of Unmanned Aircraft System (UAS) and the analysis of the research is based on identifying different opportunities and means of authorities. Publication [P3] concentrates in co-operation challenges in the use of Unmanned Aircraft System (UAS) and the analysis of the research is based on identifying different opportunities and means of authorities. The publication [P3] deals with the importance of networking for co-operating authorities and their duties. Networking is emphasized between cooperation with national authorities, because the players are under the supervision of different ministries. The real challenge for UASs use, which was pointed in this research, include ministries fragmented budgets, a lack of common practices of the new system of exploitation and the lack of cultural activities. Data for research in publication [P3] was collected by documents, collected articles and scientific publications. Collected data in publication [P3] also deepens the acquired knowledge from additional literature and collected articles.

Publication [P4] has attempted to generate a new theory on the basis of existing theoretical constructs to meet organizational needs. As noted in the publications [P4] literature review, this research`s specific research aim is a relatively new one. The material collected for this research Publication [P4], is based on interviews, international and national aviation regulations, scientific publications, collected articles and literary material. This case study uses triangulation of data sources to ensure the credibility and validity of the results.

One way of collecting data were focus interviews in UAS Familiarisation course in East Lapland Vocational College on April 2011. Focus interviews were accomplished by concerning some specific issues with colleagues, participating in that course, and instructors. The results were used for publication [P4]. In this case, it was possible to get an objective view of events and the subjective interpretations of participants. The analysis of documents and other sources of data create a deeper understanding of the subject of the research in publication [P4]. Document analysis reinforces information that is collected in a many different ways. The use of triangulation, increasing reliability of research, is essential. Analyzing case study data is the heart of theory building. The focus of the analysis in the publication [P4] is to find out how services can be produced by using Unmanned Aircraft Systems and what obstacles are there in the operational point of view. During the research process special attention was paid to three areas; design issues, data collection and data analysis.

2.2 Research findings

This chapter presents the research findings. Results are based from the interviews, survey, participation-observation, collected articles, literary material and scientific publications. In a

theoretical framework, scientific publications were used. Triangulation of different data sources was also used in analyzing the research findings. The analysis of different documents and other sources of data created a deeper understanding of the whole subject. By document analysis was gathered information in different ways. Nunamaker et al. (1990-91) present a multimethodological approach to IS research that integrates theory building, experimentation, observation and systems development phases together as in figure 5.

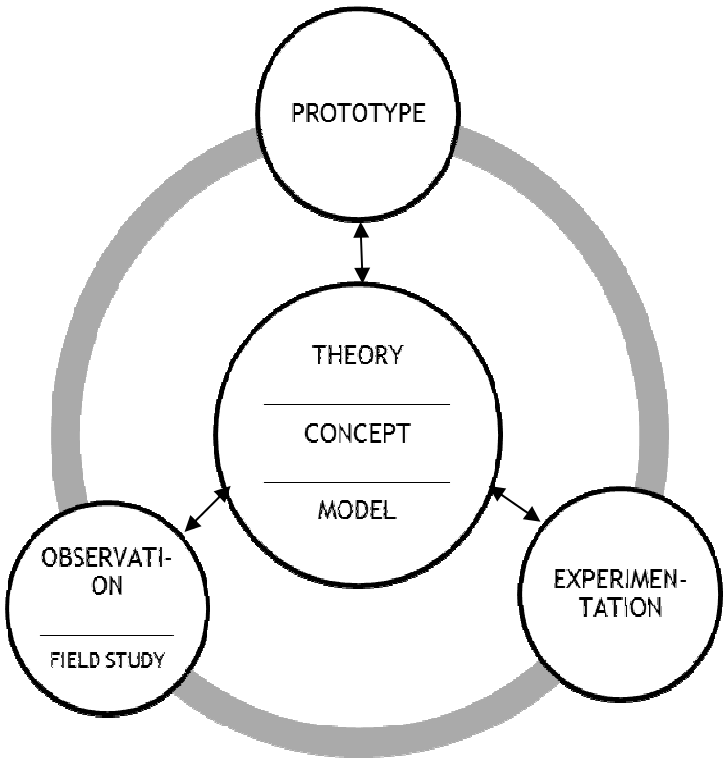

Figure 5. Multimethodological approach to IS framework (Nunamaker et al. 1990-91, 94)

In reference to Nunamaker et al. (1990-91) research life cycle has four elements:

1. Theory building
2. Experimentation
3. Observation
4. Systems development

Theory building involves:

1. Development of new ideas and concepts
2. Conceptual Frameworks

3. Models
    3.1 Mathematical
    3.2 Simulation
    3.3 Data

4. Methods

Nunamaker et al. (1990-91) point out; theory building models are usually concerned with generic system behaviours subjected to rigorous analysis and often display limited practical relevance to the target domain. Relevance of theory refers to potential insights and impacts on practical applications. Theory building or basic research contributes to the body of knowledge in a research domain but produces no system that takes advantage of this new knowledge. As Nunamaker et al. (1990-91) state, theory building or basic research contributes to the body of knowledge in a research domain but produces no system that takes advantage of this new knowledge. In my research process basic knowledge was increased for this research domain and it raised new ideas, concepts, methods and models (Nunamaker et al. 1990-91).

In the research process theory building was included in every publication, because in all of the publications were presented something new to raise new ideas to continue research process. On this basis new knowledge helped to define main "goal" in every publication. The material for theory building in this research was collected by interviews, scientific publications, collected articles and literary material. One method for collecting data for theory building was interviews. The focus interviewees were designated based on their expertise on aviation laws and aviation industry. Triangulation of different data sources were used to assure the credibility and validity of the results.

Nunamaker et al. (1990-91) state, that theories may be suggest to research hypothesis, guide design of experiments or conduct systematic observations. Experimentations can be done in laboratory and by field experiments or by using computer and experimental simulations. Experimentation concerns itself with validation of underlying theories. Experimental designs are guided by theories, facilitated by systems development and used to refine theories and improve systems. In reference to Nunamaker et al. (1990-91) when more practical knowledge is needed for the research, experimentation can be used and it is useful for the main result. And those results of experimentation can provide feedback to other research phases.

In observation research methodologies can be case studies, field studies or sample studies unobtrusively obtained. These are used to get a general feel for what is involved. It helps to

formulate hypotheses to be tested in experimentation or to focus later investigations. In this case insights are gained in natural, more holistic settings and relevant to domain studied. (Nunamaker et al. 1990-91.) In participation-observation in UAS Familiarisation course in East Lapland Vocational College on April 2011, experimentation and observation was used for further research issues with student colleagues and teachers in that course. This way, the experimentation provided feedback to other research phases as in the fourth publication [P4]. The analysis of research created a deeper understanding of the subject. The researchers should understand the implications of their research perspective, and act in ways that reflect that knowledge. Authors of this publication [P4] have a long experience in different organizations, where the needs of UAS can be utilized.

The structure of framework of research is shown in figure 6.

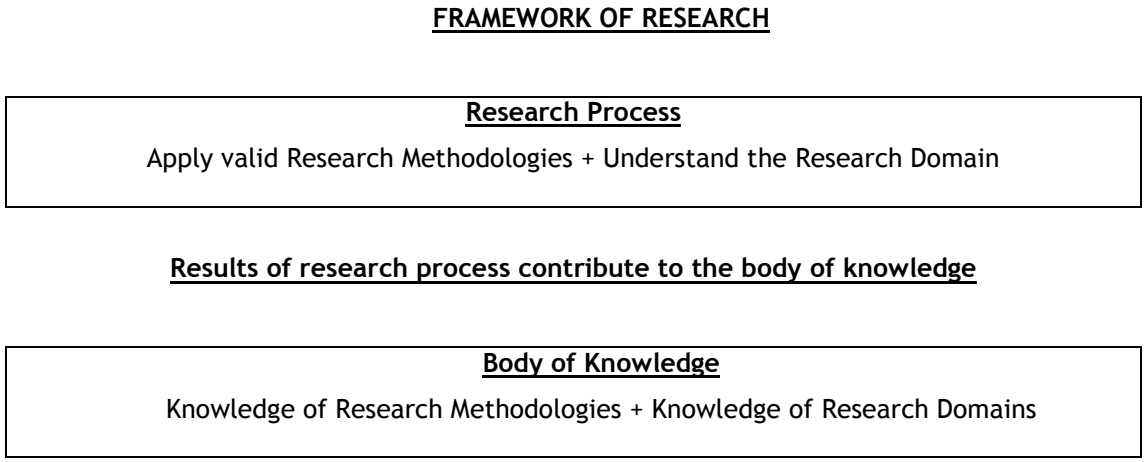

Figure 6. Framework of Research (adapted from Nunamaker et al. 1990-91)

Researchers are expected to report sufficient contextual and environmental conditions to enable judgment of limitations. It is extremely important, that other research methodologies are employed to support systems development efforts. In this case for example information system by itself is not sufficient to prove anything scientifically relevant. (Nunamaker et al. 1990-91.) Utilizing different research methodologies in development is very important and the development is the hub of the research. It interacts with other research to form an integrated and dynamic research program. Any research methodology is preeminent and where multiple research methodologies are applicable, they appear to be complimentary, providing valuable feedback to one another. (Nunamaker et al. 1990-91.)

In reference to Nunamaker et al. (1990-91), discussing about research issues in design science, in constructing a conceptual framework it is important to state a meaningful question, investigate the system functionalities and requirements and understand the system building

processes and processes. It is also important to study relevant disciplines for new approaches and ideas. In system developing it is vital to develop a unique architecture design for example extensibility and modularity. It is useful define functionalities of system components and interrelationships among them. In analyzing and designing the system it is important to consider designing the database and knowledge base schema and processes to carry out system functions. It is also important to develop alternative solutions and choose one solution of these. (Nunamaker et al. 1990-91.)

Nunamaker et al. (1990-91) state also that, in building the system it is very important to learn through system building process about:

1. Concepts
2. Framework
3. Design

In this process, it is important gain insights about the problems and the complexity of the system.

In observing and evaluating the system it is important to observe the use of the system by experiments, case studies and field studies. The system must be evaluated by laboratory or field experiments. New theories and models can be developed based on the observation and experimentation of the system`s usage. It is also important to consolidate learned experiences. (Nunamaker et al. 1990-91.) Nunamaker et al. (1990-91) also argue, it must be always remembered, that building a system in and of itself does not constitute research. Design science is credible as a research methodology among other methodologies.

As a result of my earlier research I have made a framework, which I present in this study (Figure 11. and table 3.). That framework illustrates categories and dimensions of UAS challenges. This framework can be used both in the national and international level. This framework facilitates anyone to understand how different issues are related to the unmanned aviation and how they relate to each other. Framework will facilitate the further research on the subject and in some ways it can be considered as the “cornerstone” of unmanned aviation.

2.3 Research process

Hevner et al. (2004) consider as a basis for research the business environment which consists of people, business organization and technology. The targets of research in their view are human form of roles and competencies as well as the organization's strategies and processes, and technologies which support these. Hevner et al. (2004) and Järvinen & Järvinen (2004) state also, that investigators need to understand the target environment, its requirements, and also the subject to the investigation of the problem. Becker & Whisler (1967, 469) point out, "*In any other area of research, empirical work must stem from and relate to theoretical analysis.*"

Table 1. Design science research guidelines. (Hevner, March, Park and Ram, 2004)

Guideline 1: Design as an Artefact	Design science research produces a viable artefact in the form of a construct, a model, a method or an instantiation
Guideline 2: Problem relevance	The objective of design science research is to develop technology-based solutions to important and relevant business problems
Guideline 3: Design evaluation	The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods
Guideline 4: Research contributions	Effective design science research must provide clear and verifiable contributions in the areas of the design artefact, design, foundations and/or design methodologies
Guideline 5: Research rigor	Design science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact
Guideline 6: Design as a search process	The search for an effective artefact requires utilizing available means to reach desired end while satisfying laws in the problem environment
Guideline 7: Communication of research	Design science research must be presented effectively to both technology-orientated and management-orientated audiences

Guideline 1: Design as an Artefact

In reference to Hevner et al. (2004) the first guideline, the artefact of design science research, produces the answer to an identified problem. This research can produce different kinds of artefacts and those artefacts are not often ready to use in real world. Those artefacts can be ideas, practices and technical capabilities. It is important, that the information that artefact creates, is reusable.

The main target of this research was analyzing and assembling a clear summary about the theme by utilizing different kind of data. Clarifying the implications for different organisations, where UAS is applied in the future, was succeeded. Research objectives were successfully and in research questions were received answers. From this research, the needs for UASs can be seen and also social general ignorance of UASs civilian use. The analysis of documents and other sources of evidence created a deeper understanding of the subject of this research.

Guideline 2: Problem Relevance

Hevner et al. (2004) points out that the objective of research is to produce knowledge and understanding for the use in the future. This research has to generate information for those researchers who plan, manage, and implement information systems and also for the use of those researchers, who are planning, managing and implementing technologies, used in their development and implementation. Several sources of this research revealed growing needs for UASs. Research findings showed the importance to continue the research of UASs. Further research can address the overall commercialization and business models of UASs. This theme will be much more explored in the future. Technical and operational developments of UASs are very interesting. The future is going to show, what will happen for the use of UASs.

Guideline 3: Design Evaluation

The third guideline states that the utility, quality and efficiency of a design artefact must be rigorously demonstrated via well-executed evaluation methods. Those artefacts can be evaluated in terms of functionality, completeness, performance, reliability and by using other relevant quality attributes. Hevner & Chatterjee (2010, 112) state that, regardless of when,

where, and how evaluation is done, all evaluation studies have specific structure in common. The structure of an evaluation study is shown in figure 7.

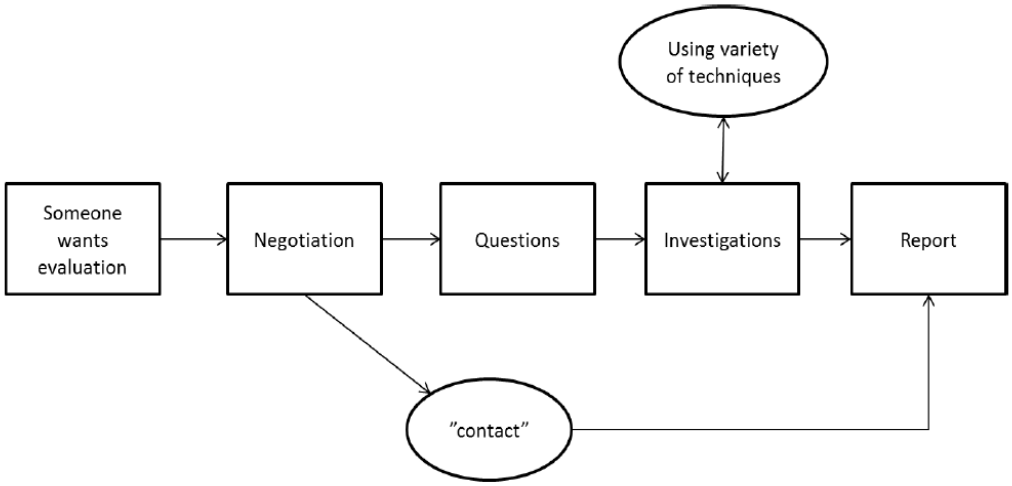

Figure 7. Structure of an evaluation study (Hevner & Chatterjee 2010, 112)

Design science research can be described in two phases: the development of the artefact and its evaluation. A design researcher is not only designing an artefact that provides utility but also provides evidence that this artefact can solve a real problem. Evidence-based artefact evaluation is crucial in design science research. There are several evaluation methods that have been outlined by researchers, including observation, analytics, experiments, testing or descriptive analysis and now also action research. (Hevner & Chatterjee 2010, 122.)

Designing evaluation for this kind of service innovation is in an important and challenging role for three reasons; 1) various actors need to be able to meet the demand of the right way, 2) it must give a special attention for many different needs, and 3) because of the inadequate aerial legislation as for unmanned aviation. Deficiencies of the law and regulatory measures prevent the industry from building business plans and launching the developments required to answer civil customer needs. This has also a negative impact on the industry and, indirectly, on UAS manufacturers, end users, research institutions and R & D companies. The importance of cooperation in UAS usage is highlighted because a number of different actor, need the same kind of services. The service provider needs to be able to meet the demand in the right way. In selecting a right product for many different needs must therefore give special attention.

In a small country, with limited resources, one player is unable to cope on its own for systems implementation, evaluation and use of it. Network creation is vitally important and it obtains

synergies from a wide scale deployment of the UAS. Prior researches have revealed a need for networking between different authorities with regard to cooperation of implementation of Unmanned Aircraft System (UAS).

Guideline 4: Research Contributions

Hevner et al. (2004) state, that research must provide clear contributions in the researched area. This research can produce design artefacts, foundations or methodologies. The most important thing is that research process is adding new information to the already existing knowledge base. On the basis of earlier research, I have developed a framework, which illustrates the categories and dimensions of the challenges in the field of UAS. This framework describes and facilitates the role of the different actors and activities on the same "playing field". In my view, such framework has never been done before, and it is unique. That framework shows how much the unmanned aviation has actors, how they are relating to each other and the interaction between their relationships. By the attached diagram and the construction of this framework, it can be said there are surprisingly lot of issues related of unmanned aviation. Overall, they are all strongly related to each other.

Guideline 5: Research Rigor

The fifth guideline Hevner et al. (2004) state, the design science research must use rigorous methods in the construction and evaluation of the design artefact. Lee (1999) points out that overemphasis on rigor in behavioural IS design research has frequently resulted in a corresponding lowering of relevance. Hevner et al. (2004) argue also, that along with behavioural IS researchers (Applegate 1999), it is possible and necessary for all IS research paradigms to be both rigorous and relevant.

In reference to Hevner et al. (2004) designed artefacts are often components of a human-machine problem-solving system. For those artefacts, knowledge of behavioural theories and empirical work are necessary to construct and evaluate such artefacts. Constructs, models, methods, and instantiations must be exercised within appropriate environments. The principal aim is to determine how well an artefact works, not theorizing or proving anything, why the artefact works. In this matter design-science and behavioural-science researchers must complement one another.

Hevner (2007) points out that a key insight can be gained by identifying and understanding the existence of three design research cycles in any design project. That structure is shown in figure 8.

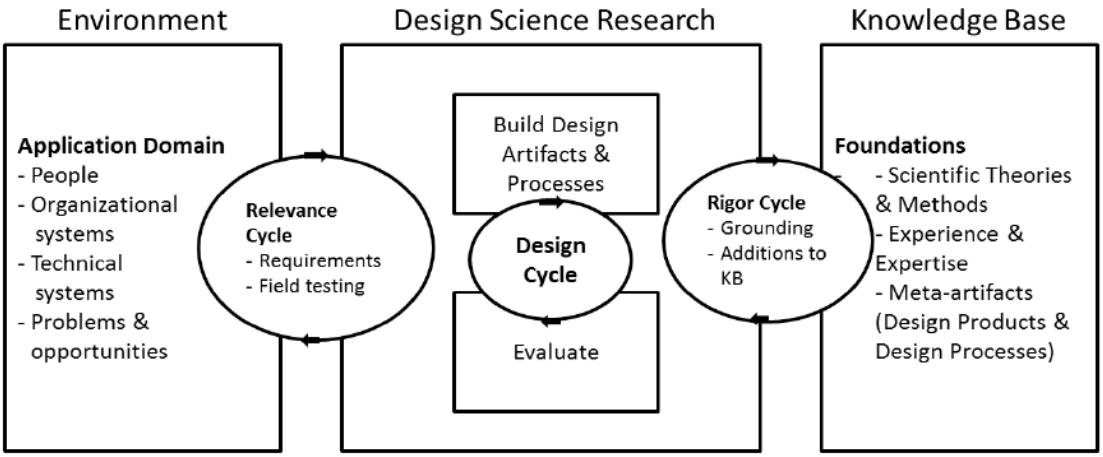

Figure 8. Design science research cycles

The Relevance Cycle bridges the contextual environment of the research project with design science activities. The Rigor Cycle connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that informs the research project. The Design Cycle iterates between the core activities of building and evaluating the design artefacts and processes of the research.

Iivari (2007) states, *"The essence in Information Systems as design science lies in the scientific evaluation of artefacts."* Hevner & Chatterjee (2010, 19) continue by saying, that artefacts must accurately and thoroughly tested in laboratory and experimental situations before they are released into field testing along the relevance cycle. This is called for multiple iterations of the design cycle in design science research before contributions become as outputs into the relevance cycle and the rigor cycle. Hevner & Chatterjee (2010, 11) state that technological advances are the result of innovative, creative design science processes. A key to this is a complementary research cycle between design science and behavioural science to address fundamental problems faced in the productive application of information technology.

Technology and behaviour are not dichotomous in an information system. They are inseparable and they are inseparable also in IS research. The practical relevance of the research outcome should be valued equally with the rigor of the research performed to achieve the results. (Hevner & Chatterjee 2010, 11-12.)

In this research was used multiple methods. One method for collecting data in research for theory building was interviews. The structure of Convergences of Evidence is shown in figure 9.

Figure 9. Convergences of Multiple Sources of Evidence (Yin 2009, 117)

Publications [P1] and [P4] are made by using case study research and in publications [P2] and [P3] is used design research as a method. The material for theory building in this research was collected by interviews, scientific publications, collected articles and literary material. Tri-angulation of different data sources were used to assure the credibility and validity of the results.

Guideline 6: Design as a Search Process

Hevner et al. (2004) points out that design science is inherently iterative and heuristic search strategies produce feasible, good designs that for the business environment. Design is a search process discovering an effective solution to a problem. Abstraction and representation of appropriate means, ends, and laws are crucial components in the design-science research.

Those factors are problem and environment depending and invariably involve creativity and innovation. Means are the set of actions and resources available in constructing a solution. Ends are representing goals and constraints of the solution. Laws can be seen as uncontrollable forces of the environment. Effective design requires knowledge of both of those domains, application (e.g., requirements and constraints) and the solution (e.g., technical and organizational). The use of heuristics in finding good design solutions is opening the main question - how goodness can be measured? Different problem representations are providing different kind of techniques for measuring how good design solution is. One way to approaching, is to prove or demonstrate that a heuristic design solution is every time in close proximity of the optimal solution.

The results of this research prove that the market has a huge economic promise for RPASs and services utilizing them. Benefits by using RPASs cannot be achieved by any other means. The social benefits are significant when RPASs are used in enabled services. The markets can be seen as a catalyst for the development of technology in many areas.

Guideline 7: Communication of Research

The last of these guidelines state, that design-science research must be presented both to technology-oriented as well as management-oriented audiences. Technology-oriented audiences need important details for the use of the artefact within an appropriate organizational context. Management-oriented audiences need sufficient information to determine, if the organizational resources should be committed to constructing and using that artefact in their organization. (Hevner et al., 2004). Publications [P1], [P2], [P3] and [P4] have been published in international journals and research findings of those have been presented in international conferences to academic audience. During the studies, research findings have been presented also to research colleagues.

3 Results

This chapter presents the research findings. In this study, triangulation of data sources is used to analyze the research findings. Results are based on the answers got from interviews, survey, participation-observation, collected articles, literary material and scientific publications. In a theoretical framework, scientific publications were examined. In table 2. is presented the summary of publications.

Table 2. Summary of Publications.

Publication	Introduction	Main Results
Title: How and why Unmanned Aircraft Vehicles can Improve Real-time awareness? --- **Method:** Case Study Research --- **Authors:** Tikanmäki I., Tuohimaa T. and Rajamäki J. --- **Published:** March 2011	The goal for the publication was improving the situational awareness and real-time picture by using UASs in organizations. The research question was, how situational awareness, can be improved by using UASs.	The research showed the needs for UASs, and a social general ignorance of it. Publication focuses on improving real-time awareness by using UASs. UASs are one of the most important ways, making of situational awareness and real-time picture for many organizations.
Title: The strategic management challenges of developing Unmanned Aerial Vehicles in public safety organizations. --- **Method:** Design Research --- **Authors:** Tuohimaa T., Tikanmäki I. and Rajamäki J. --- **Published:** March 2011	The goal of this publication was to address the importance of networks and networking. This research showed that a smooth and seamless cooperation between different spheres of government contributes UASs implementation for public needs for improving and speeding up situational awareness and creation of real-time picture.	Networking and common management is very important for the development of UASs to the use in a small country like Finland with limited resources. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. It is important to create network, and obtain synergies from a wide-scale deployment of the UASs.
Title: Cooperation challenges to public safety organizations	The goal for this publication was to address the challenges	Persons acting on the ground, their leaders and

on the use of unmanned aircraft systems. --- **Method:** Design Research --- **Authors:** Tuohimaa T., Tikanmäki I. and Rajamäki J. --- **Published:** May 2011	of strategic management in public organizations for improving situational awareness and a real-time picture. Unmanned aircraft system (UAS) is a tool for improving situational awareness and creation of a real-time picture. This research showed that many counter parties must participate in UASs development activities.	other decision-makers should be able to exploit a real time picture of the situation when making decisions. Many organisations have the need for the situational real-time picture. The main challenge is ministries fragmented budgets, a lack of common practices of the new system of exploitation and the lack of cultural activities.
Title: Developing a Service Innovation Utilizing Remotely Piloted Aircraft System. --- **Method:** Case Study Research --- **Authors:** Tikanmäki I. & Tuohimaa T. --- **Published:** May 2012	The goal of the publication was to address, how services can be produced by using UASs, what obstacles are there in the operational point of view and to explore is it possible and how it can be done by using UASs. This study clarifies the implications for UASs and the needs for it, but also a social general ignorance.	The market has a huge economic promise for UASs, services utilizing them, and a catalyst for the development of technology in many areas. A good system is made in co-operation with the manufacturers and end users. Increased co-operation is needed. Research and development is in a key position at first step.
Thesis --- **Title:** Studies of Unmanned Aircraft Systems from the Perspective of Operational Use ---	Main goal of this thesis is to gain knowledge to understand by using categories and dimensions the “players” and the challenges of UASs, why networking is so important,	On the basis of earlier studies I developed a framework to describe and facilitate the role of the different actors and activities of UASs /

Method: Design Science Research --- **Author:** Tuohimaa T. --- **Published:** June 2014	why people and public opinion are in so big role? I try to find a possible solution, help to increase general awareness of UASs / RPASs for many parties.	RPASs. This framework shows how much the unmanned aviation has both "visible" and "invisible" actors, how much they relate to each other, and what is the interaction between their relationships.

3.1 Unmanned Aircraft Systems and real-time awareness

Publication [P1], "How and why Unmanned Aircraft Vehicles can Improve Real-time awareness?" was published on International Journal of Circuits, Systems and Signal Processing Issue 5, Volume 5, 2011. Focus in this publication is, how to improve real-time awareness by the use of UASs. UASs have been in use in the military forces in improving situational awareness and real time picture. Now the role of UASs is getting more and more attention worldwide. There are many reasons explaining of this process and in this publication is presented the importance of this theme. The value of real time picture and situational awareness produced by UASs is very important for people making decisions in different kind of operations. In this publication the research material was collected by interviews, scientific publications, different articles and video material. In the research process was noticed, that the majority of the scientific publications are concentrating in a way or another on the technical elements of UASs.

The method of this publication was case study research and the main research question was: How situational awareness and real time picture can be improved by the use of UASs? The importance of the author's expertise in this theme was also shown during the research process. In this research was clearly shown the needs for UAS for many parties and also general ignorance how UASs can be used in different cases. The need for networking was one of the main results in this research and it is very important for example in developing these systems. Networking is very important also for economical reasons, because these systems can be too expensive for one party. In the interview of this publication, all of the informants emphasized, 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 and an accurate real-time picture is necessary to transfer in real-time.

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."*

Informants highlighted the importance of needs for real-time picture: *"Management needs real-time image and even the continuous live image."* Informants also highlighted 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. Informants suggest that UAVs should be concentrated to one user group to maximize the benefit of the devices. In reference to informants there is limited operating experience in Finland.

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."*

Informants pointed out concern in resistance to change of new concepts and systems for dismounting the traditional way of operating hampers implementation of UAS. *"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."* 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 a conclusion one of the informants said: *"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."*

The aim of this research was to analyze and assemble a clear summary about the issue by utilizing different kind of data. The needs for UASs can be seen, as well as social general ignorance how UASs could be exploited in civilian use. Several sources in this study revealed growing needs for UASs. Research findings showed the importance of continuing the scientific research in the field of UASs.

3.2 The strategic management challenges

Publication [P2], "The strategic management challenges of developing Unmanned Aerial Vehicles in public safety organizations", was presented on March 2011 at 10th World Scientific and Engineering Academy and Society's (WSEAS) International Conference on communications, electrical & computer engineering in Spain and it was published by WSEAS Press. Publication addresses the challenges of strategic management in public organizations of developing UAVs. The unmanned model planes are used mainly for different military purposes. There are several reasons why UAVs role has received more attention and interest in wider. On the civilian use of UAVs 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.

Management teams are a prerequisite for long-term and lasting change. Management teams are ready to recognize the importance of this aspect, but they are not usually very well aware of how these objectives will be defined or achieved. Careful planning of more opportunities increases learning and growth strategies successfully. Developing a multi-authority security circumstances tactics and training by adding to the exploitation of common resources and expertise in the use of various authorities in identifying opportunities and means to support the goal should be taken in the account. 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.

By identifying various authorities' opportunities and means to support operations, the best results are achieved. When establishing a national strategy for UAS, this defines and clarifies the responsibilities of authorities and their roles of UAS operations. Developing and expanding operational cooperation aims practical co-operation and mutual interaction between the authorities, which will improve the situational picture. By exploring official actions and academic efforts factors that influence a real-time picture and current situation in Finland, government may organize authorities' training and a wide-ranging co-operation between authorities.

The government should plan to take into account the existing research dealing with UAS and if necessary initiating new research projects. The aim is that the requirements and opportunities to pursue UAS activity to improve a real-time picture and support the UAS-based activities will strengthen. 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 is essential. Joint research, education and training activities related to authorities' communication, as well as the authorities' partnerships between the public authorities by ensuring management, situational picture and messaging systems for compatibility and possible integration contribute to the goal.

On this basis networking and common management is very important for the development of UASs in Finland. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. That is why it is vitally important to create network, and thereby obtain synergies from a wide-scale deployment of the UASs. The development of UASs for operational activities and to maintain situational awareness constitutes strategic network management in many respects. The importance of networks and networking in the world today can not be overstated. A smooth and seamless cooperation between different spheres of government contributes UASs implementation for public needs for improving and speeding up situational awareness and creation of real-time picture. Our environment and the whole world are constantly changing and that's why there is a growing need of common UASs for many parties.

3.3 Cooperation challenges

Publication [P3], "Cooperation challenges to public safety organizations on the use of unmanned aircraft systems (UASs)", was published in International Journal of Systems Applications, Engineering and Development, Issue 5, Volume 5, 2011. Focus in this publication is the importance of networks and co-operation between different actors. Networking is in a big

role for UASs, especially because of economical situation. This publication addresses, that there are many challenges in strategic management of different organizations to improve their situational awareness and a real-time picture. Unmanned aircraft systems (UASs) can be used as a tool of management, in improving situational awareness by creating a real-time picture. In many situations strategic management needs real-time picture for understanding large-scaled complexes in operations. It is said, that the main focus of the strategy is in the future and it is also the most important part for searching.

There are many parties needing situational awareness and a real-time picture in their strategic management by using UASs. This publication also shows the importance of cooperation between different actors. One of the main findings was the importance of cooperation with the businesses of different organizations. Research and design is in very important and challenging role. Creating a network and co-operation in many ways is in challenging role. In this economical situation in developing UASs activities, it is very important, that many parties take part in the development of UASs. The need for collaboration and networking among many actors exists. A real-time situational picture is used to form a picture of the threat or disaster situation. A picture of the system is geared to produce pre-analyzed information on accident persons acting on decision-making. In reference to (Astrov & Pedai, 2010.) situation awareness refers grammatically to the awareness of the situation and situational awareness refers to awareness that only happens sometimes in certain situations.

A network management develops knowledge for the professionals in its field. Networking can be understood in different sectors, areas and levels to take place. Sectorial networking means in the same field of networking. Regional networking refers to particular geographic area co-operation. Different levels of networking means to cooperation between organizations: performing a similar task teams to cooperate, or individual experts formed a collaborative network. 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 is essential. Joint research, education and training activities related to authorities' communication, as well as the authorities' partnerships between the public authorities by ensuring management, situational picture and messaging systems for compatibility and possible integration contribute to the goal.

On this basis networking and common management is very important for the development of UASs in Finland. Funding for such a large system of the whole does not succeed in a one public organization measures. That is why it is vitally important to create network, and thereby obtain synergies from a wide-scale deployment of the UASs. The development of UASs for op-

erational activities and to maintain situational awareness constitutes strategic network management in many respects. The importance of networks and networking in the world today can not be overstated. A smooth and seamless cooperation between different spheres of government contributes UASs implementation for public needs for improving and speeding up situational awareness and creation of real-time picture. Our environment and the whole world are constantly changing.

3.4 Developing a service innovation

Publication [P4], "Developing a Service Innovation Utilizing Remotely Piloted Aircraft System", was published in International Journal of Systems Applications, Engineering and Development, Issue 4, Volume 6, 2012. The starting point of this publication was trying to find out how services can be produced by using Unmanned Aircraft Systems (UAS), and what obstacles are there in the operational point of view. This research process was started by a desire to explore is it possible and how it can be done by using Remotely-piloted Aircraft System (RPAS). Remotely-piloted Aircraft System (RPAS) means the same as the Unmanned Aircraft System (UAS). The theoretical part in this publication focused on theory building of case study research and how it can exploit in this research.

The purpose of this research was in analyzing and assembling a clear summary about developing a service innovation utilizing RPASs by using different kind of data. The research succeeded to clarify the implications for many different organisations when RPASs are used in the future. Research objectives were successfully reached and the research questions were answered. This research shows the needs for RPASs, but also a social general ignorance on how RPASs can exploited in civilian use.

Recent advances have allowed future RPASs users to scale down sizes of uninhabited aerial platforms, and to perform mission profiles which are not possible for conventional aircraft. One advantage of UAVs is the possibility to reach hostile and inaccessible areas without exposing humans to hazards and dangerous situations. (Sanna, A. & Pralio, B., 2005.) The importance and power of networks and networking cannot be overstated. A smooth and seamless cooperation between different spheres of actors contributes to RPAS's implementation for public and private needs and for improving and speeding up the preparation and inception of legislation of RPASs.

Based on the results of this publication, the market has a huge economic promise for all RPAS MTOM classes and services utilizing them. When using RPASs such benefits may be achieved

that cannot be achieved by other means. The social benefits are significant when using RPASs enabled services. This research show, those RPASs would significantly increase the number of the biggest priorities of safety, security and environmental issues. These markets are a clear catalyst for the development of technology in many areas, which have significant spin-off potential. The joint use of RPASs, civilian and military, is a key condition for non-military government applications. These RPASs may be applied by applications where the use of aircraft or helicopter is too expensive to perform a task or there is a risk for human life.

The UASs are reportedly the fastest-growing form of aviation. Operations have started by the Military Forces and civilian markets are now waking up to the operation. As pointed as a result of this research; a good system regards the end user, and it is made in co-operation with the manufacturers and end users. Increased co-operation is needed. Legislation must be in line with the international and national levels. RPA systems are going to be the business of future, and it is said that the RPA systems can be equated with the early days of aviation. Research and development is going to be in a key position at first step.

3.5 New framework

As a result of my research findings of publications [P1], [P2], [P3] and [P4], I have made a framework, which I present in this study (Figure 11. and table 3.). This framework illustrates categories and dimensions of different challenges related to UASs and it can be used both in the national and international level. This framework facilitates anyone to understand how different issues are related to the unmanned aviation and how they relate to each other. Framework will also facilitate the further research on the subject.

Design in information technology is not simple. Most of the problems in real world are not simple and often there are no correct solutions. Design can be seen as a social process in which people design things to be used by people and the whole process should use people. Design is a result of the qualities and activities and of the creative individual; the designer is operating in a larger social scale. Interaction with other people and things often leads to complex and controversial design considerations. (Hevner & Chatterjee 2010, 79.) In reference to Helakorpi (2006, 1), the challenge of a knowledge-based approach rises and the economy relies on knowledge. Information technology will make this technically possible and social capital is a social facilitator - both are needed. The economy is in constant change of thinking and flexible organizations. This work culture is called as the confidence and expertise working culture. In working skills are emphasized collaborative skills, independent decision making and continuous development.

In the current dynamic business environment, customer needs, quality management and production control are still important, but not to the same extent as before. In their place have now become a renewal and innovation, courage and strategic decision-making speed. Innovation and adaptability are essential to the company's competitive capabilities. One innovation is not enough. You must be capable of continuous innovation. The real source of value is the knowledge and expertise. Innovations are not created from scratch, but the basis is always a high level and broad-based expertise. (Ståhle & Laento 2000, 18.) Managing complexity (technical, human, and societal) in the development, operation, and evolution of software-intensive systems is an overriding challenge. Research for rethinking of IS complexity can be inspired by using models in other scientific fields, both physical sciences and social sciences. Model designing and methods for managing complexity requires creative ideas for new information technology (IT) abstractions, representations, and languages. (Hevner & Chatterjee 2010, 75.)

Helakorpi (2006, 3-4) states that the rapid development and continuous renewal of organizations require new skills, and they must be learning organizations. In the private sector, the learning organization ideology-related changes have occurred quickly, but the public sector changes will require time. Public organizations have been accused of inconvenient to use, bureaucratic and inflexible to be ineffective, costly and fragile providing services. The reason for this is seen as the administrative machinery and rigid practices. Public services have been taken to highlight the effectiveness and economic thinking, and customer responsibility. Public organizations need in reference to Helakorpi (2006, 4), an entirely new approach and work culture, which is a challenge for both employers and employees. Skills are becoming increasingly more diverse and require continuous learning, skills and qualifications of the maintenance and development.

Future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach. Public organizations have traditionally alienated this approach, especially independent strategic flexibility and individual responsibility in its creation and its exploitation. Strategy is an essential part of the future. Public organizations should continuously evaluate their strategic position and it should be a natural part of normal activity. (Määttä & Ojala 2000, 39.)

In reference to Ståhle & Laento (2000, 25), the competition is driven by an integrated knowledge which is generated by a variety of partnerships and value networks. Helakorpi (2006, 6) states, that in the management of complex situations is required innovative thinking and knowledge management. With the newest ideas and tools it is possible to respond sensitively

and spontaneously, and to combine things, that are completely new. The question is also about the hidden knowledge in the organization and experience-based knowledge management. Common knowledge of knowing is no self-reflection, but through the joint.

Lumijärvi (2009, 62) states that strategic management represents a prioritization of key success factors in the selection of strategic objectives, indicators, and the use of objective awareness, flexibility in structure and adaptability to environmental changes, which will be closely monitored, and in which react in advance. Whittington (1993, 55) points out that being a good strategist might not be enough. Leadership is more than a strategy to match action with the environment. It is self-adjustment to social environment. Whittington (1993, 99) states also that the problem of strategy is the fact that organizations are literally "crazy."

Previously, in expertise was enough in reference to Helakorpi (2006, 7), a versatile and robust sense of reality, now is also needed the opportunity to realize. The expert must be able to cross both organizational and discipline boundaries. Ståhle & Laento (2000, 33) state that an innovative organization is able to generate constantly new. It is able to exploit such potential, which is not yet part of the company's global knowledge base, and therefore does not yet reflected in its well-established processes, practices or systems. The personnel's expertise will be the company's common expertise. It consists of various policies, processes or systems that store and accumulate continuously generated new know-how. The individual's skills grow throughout the organization's expertise. This is also the most permanent and secures knowledge capital for the company as the competency of individuals. Joint performance of the organization is the foundation for the company's value in which it is based. (Ståhle & Laento 2000, 30.)

Kaplan & Norton (2002, 104) point out that learning and growth strategy deal with the intellectual property which is needed in organization's activities and customer relationships for continuous improvement. This aspect relates to three areas:

1. Strategic knowledge: strategic knowledge and skills that workers need to support the strategy.
2. Strategic technology: information systems, databases, tools and network required to support the strategy.
3. Operating Atmosphere: corporate cultural changes that are required to carry out a strategy to motivate staff, to empower and to adapt.

Määttä & Ojala (2000, 45) state need for a new kind of strategic thinking, and - working tools, which emphasize the following starting points:

1. Instead of making and analysing strategy attention should move to it, how to create strategies for action in practice
2. Strategy must based on the organization's right to exist and to express the common will of the desired future
3. The strategy process must geared towards strengthening the organization's skills and continuous learning
4. Strategy process should be based on participation and interaction
5. The success of the strategy requires constant communication

Kaplan & Norton (2002, 104) state that learning and growth strategies are a prerequisite for long-term and lasting change. Management teams are ready to recognize the importance of this aspect, but they are not usually very well aware of how these objectives will be defined or achieved. Careful planning of more opportunities increases learning and growth strategies successfully.

3.5.1 An activity framework

Venable (2006, 16) *"asserts, that theory and theorising should play a key role in Design Science Research. Theory can be seen as the link between researchers and different kind of research activities"*. IT is applied to new areas which were not previously believed to need IT support. In this process, new kinds of systems and development methods are created. (Markus et al. 2002, 180.) In construction problems this can also mean building a new artefact out of previously unrelated materials (Van Aken 2005, 24). In reference to Ståhle & Laento (2000, 121) all change, development, growth and innovation are based on the rapid outflow of information and enrichment. One of the main characteristic is that knowledge must spread rapidly. Information exchange and the quantity and spontaneity keep activities alive. Helakorpi (2006, 1-2) states that special pressures are focused to management: different knowledge management and knowledge management ideologies have risen alongside affairs and managing people.

The structure of an Activity Framework for Design Science Research is shown in figure 10.

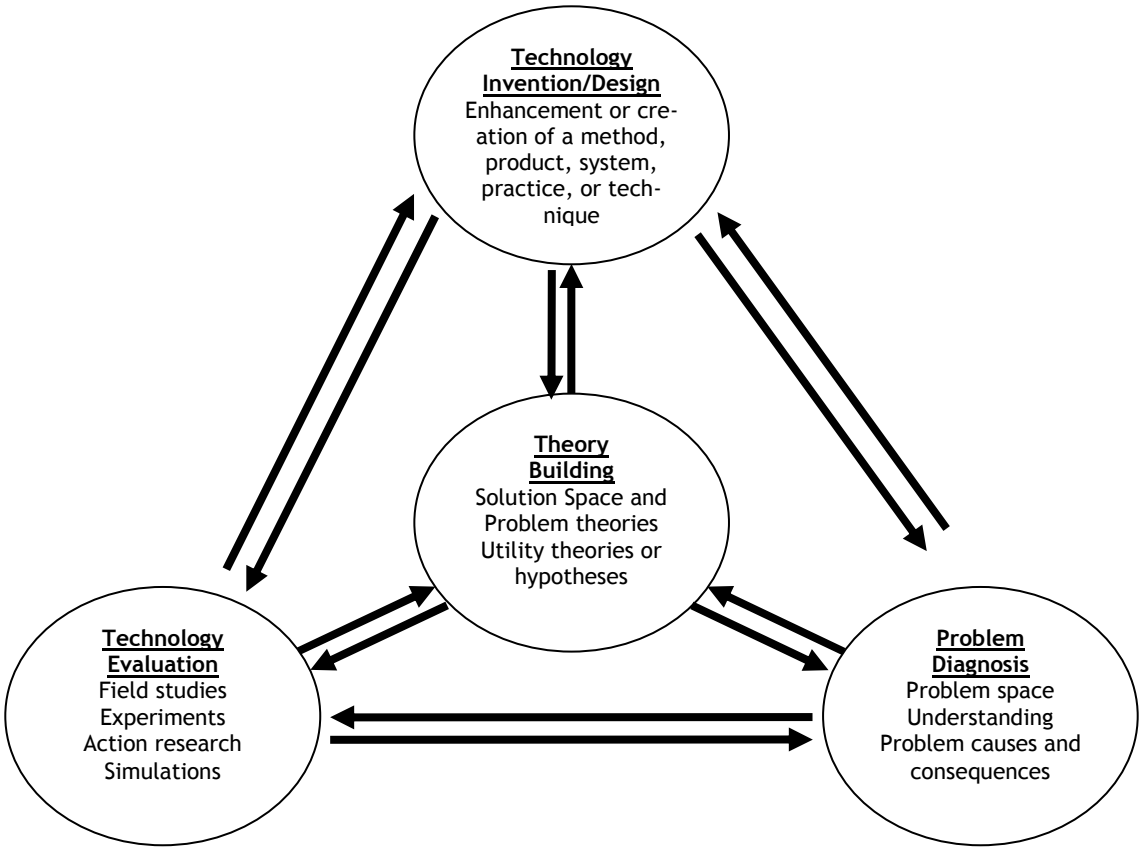

Figure 10. An Activity Framework for Design Science Research (Venable 2006, 17)

3.5.2 Theory building

Venable (2006, 16) states, *"theories are proposed by someone and analysed, validated, refuted, modified, enhanced, evolved, and, hopefully, accepted and adopted over time by*

many". They may be modified several times in a single Design Science Research project. Theorising or theory building can be seen as a central activity binding together various areas of research. Venable (2006, 17) points out also, that *"Design Science Research must not leave theory and theorising to the natural and social (empirical) sciences. Instead, Design Science researchers should engage in theorising – before, during, and as a result of Design Science Research work"*.

In my framework, shown in figure 11. and in table 3., theorising and theory building can be seen as a central activity binding together various areas of research in next categories, which have different dimensions:

1. Legislation
2. Political
3. Big Brother
4. Economical
5. Tactical
6. Research and Design
7. Air Safety
8. Technical

3.5.3 Problem diagnosis

Venable (2006, 16) also states *"while problem diagnosis and technology evaluation may be undertaken in the empirical domains of natural and particularly social / behavioural sciences, theory building is the necessary link between them all"*. In figure 11. is showed, how theory building can be seen as a central activity, which is related to problem diagnosis, technology invention or design (solving problems), and technology evaluation. In my framework problem diagnosis and technology evaluation can be undertaken in the empirical domains of natural and particularly social / behavioural sciences and theory building can be seen the necessary link between them all. Theory building is a central activity of my framework and it can be seen also in figure 11. and in table 3. Theory building in this framework is related to problem diagnosis and solving problems. On the basis of this, framework is also related to technology invention and technology evaluation.

For example publication [P4] shows that good RPAS regards the end user, and it is made in co-operation with the manufacturers and end users. Because of this increased co-operation is needed and also legislation must be in balance with the international and national levels. Research and development is in a key position in theory building. Also in this case theory build-

ing walks hand in hand with problem diagnosis, technology invention, design (solving problems) and technology evaluation.

3.5.4 Technology evaluation

In April 2011 was held the first official Finnish UAS –course in Kemijärvi. In that course, UAS related activities were generally divided into three sections; business, training and end users. This kind of course can be seen in publication [P4] as the beginning for networking and collaboration of the abovementioned parties. One of the main findings in publication [P2] was also the importance of cooperation with the businesses of different organizations. Research and design is also in very important and challenging role. This is also, why creating a network and co-operation in many ways is in very challenging role. In this economical situation in developing UASs activities, it is very important, that many parties take part in the development of UAS.

In publication [P1] can be seen the needs for UASs, as well as also social general ignorance how UASs could be exploited in civilian use. Several sources in this publication [P1] revealed growing needs for UASs. This publication also showed the importance of continuing the scientific research in the field of UASs.

3.5.5 Technology invention and design

In reference to Venable (2006, 17), "*sufficient detail and clarity be attached to all three parts of a utility theory – the problem space, the solution space, and the nature of the utility that links them. These details are necessary because of the differences in viewpoints that prohibit them from being left implicit. The details also ensure that we are communicating theory in a way that it can be understood by practitioners and by the Design Science researchers who will work to improve the theory. Theory and theorising /theory building are then seen as a central research activity, in common with all research approaches*".

As a result of my research findings of publications [P1], [P2], [P3] and [P4], I have made a new framework, which I present in this study (Figure 11. and table 3.).

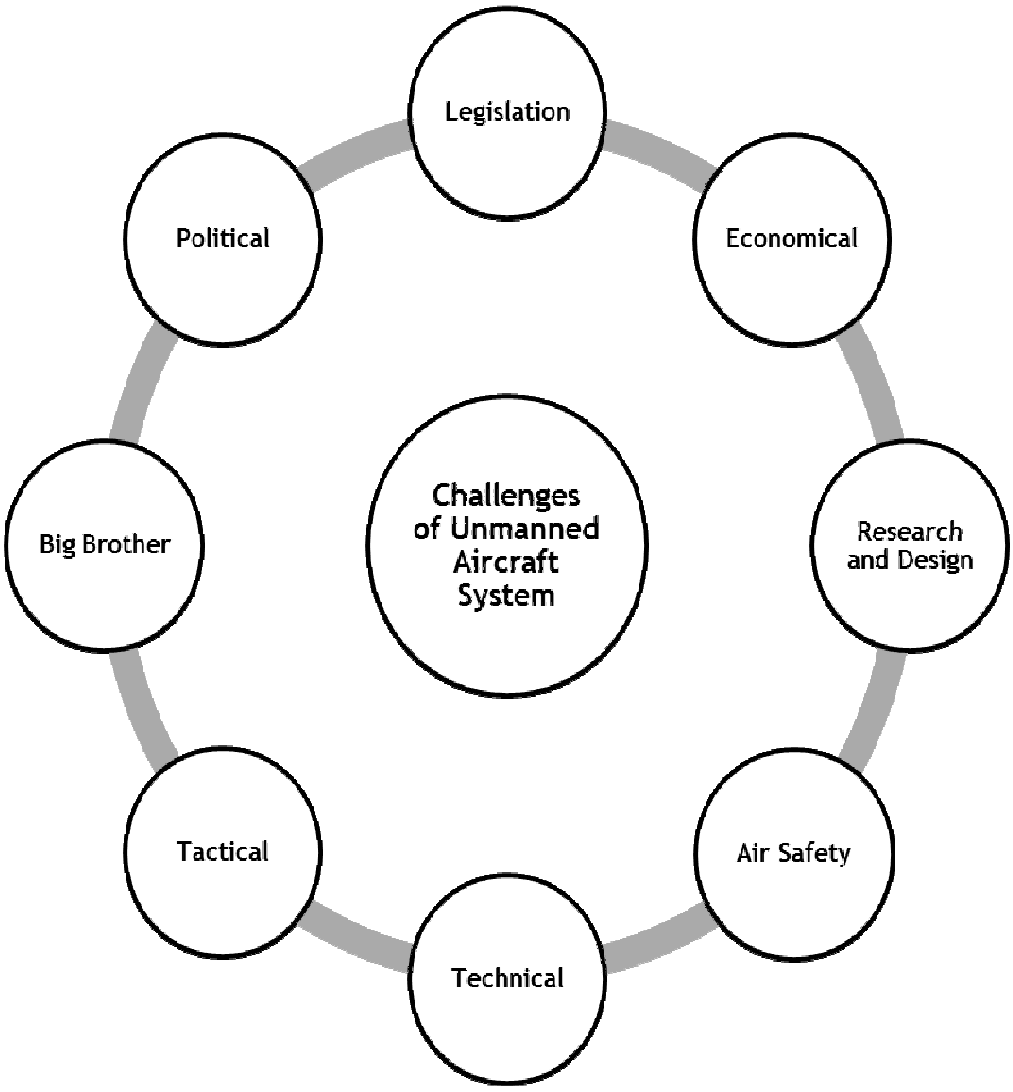

Figure 11. Categories of UAS Challenges

This framework illustrates categories and dimensions of challenges related to UASs. This framework can be attached to all three parts of a utility theory – the problem space, the solution space, and the nature of the utility that links them all. These details are necessary because of the differences in viewpoints that prohibit them from being left implicit and this framework can be used both in the national and international level.

In table 3. I point out different dimensions of UAS challenges. In my framework, there are presented 8 different categories, which all together affect in these challenges.

POLITICAL ➢ Media ➢ NGO ➢ General Ignorance ➢ Public Opinion ➢ People ➢ Political Pressure ➢ ICT	**LEGISLATION** ➢ Aviation Regulation ➢ EASA ➢ ICAO ➢ BLOS ➢ VLOS ➢ Responsibility ➢ Radio Frequencies ➢ ICT	**ECONOMICAL** ➢ MTBF ➢ Business ➢ ICT ➢ Smaller and cheaper systems ➢ Networking ➢ Rapid Development of Systems ➢ New Applications of UAS and RPAS ➢ New Users
BIG BROTHER ➢ Privacy ➢ Surveillance ➢ Data Protection ➢ Data Material ➢ Drone ➢ LEA ➢ ICT ➢ Media ➢ Aviation Safety ➢ General Ignorance ➢ Audio	Challenges of Unmanned Aircraft Systems	**RESEARCH AND DESIGN** ➢ Simulation Training ➢ Data Link ➢ Data Protection ➢ Autopilot ➢ Payload ➢ ICT ➢ Image Stabilization ➢ Performance of Systems
TACTICAL ➢ Different End Users ➢ Risk Analysis ➢ Aircraft Accident ➢ Weather Condition ➢ Turbulence ➢ Data Protection ➢ Data Link ➢ Message- and Radio system ➢ ICT	**TECHNICAL** ➢ Aviation Background ➢ Image Transfer Technology ➢ ICT ➢ Data Protection ➢ No Formal Categories ➢ Airworthiness of systems ➢ Civilian models are growing ➢ Smaller and cheaper systems ➢ Autonomy	**AIR SAFETY** ➢ Accident prevention ➢ Controlled and Uncontrolled Airspace Eurocontrol ➢ Aviation Safety ➢ Aviation Skills ➢ Aviation Knowledge ➢ BLOS ➢ VLOS ➢ ICT

Table 3. Categories and dimensions of UAS Challenges

The details of this framework ensures that we are communicating theory in a way that it can be understood by practitioners and by researchers who will work to improve the theory. This framework also ensures anyone to understand the theory, how different issues are related to the unmanned aviation and how they relate to each other. Theory and theory building by this framework can be seen as a central research activity, in common with all research approaches and it will also facilitate the further research of this subject. In some ways this framework can be considered also as "An Activity Framework" of unmanned aviation.

In table 4. I point out by using SWOT – analysis the challenges of Unmanned Aircraft Systems.

STRENGHTS	**WEAKNESSES**
• Performance • Technical development • Technical know-how • Technical level • The speed of technological development	• General ignorance • Legislation • Tactical ignorance • Technical safety
OPPORTUNITIES	**THREATS**
• Utilization • Tactical Methods • Openness • Advertising	• Is Big Brother watching You? • Public opinion • Advertising • General ignorance • Privacy • Technical safety

Table 4. SWOT Analysis of challenges of UAS

Lumijärvi & Jylhäsaari (2000, 215) point out that the SWOT analysis is a typical strategic planning process. Strategic planning is a part of strategic management. Strategic planning constitutes the framework for the design aspects, tactics, to identify the criteria or the constraints that must be taken into account in operational planning. The current status is reflected forward and backward. In strategic management strategy is selected before the specific operational decisions or development action. By monitoring and evaluation can the implementation of strategies ensured.

The main features of this framework have the ability to concentrate on the essentials, the ability to take account of new perspectives, the ability and courage to face and manage the conflicts and confrontations as well as the ability to learn from crises. (Lipasti 2007, 306.) Only with this information we have the potential to succeed in a challenging and demanding task. We already know that, knowledge is power and in this framework we have a significant challenge for developing knowledge-intensive activities. Balanced success strategy, a key value and goal, is the participation of different parts of the organization's various departments and personnel. Critical success factors must be to communicate, to be discussed and questioned. Participatory and inclusive work is a challenge for many parties. (Määttä & Ojala 2000, 142.) We can also say that the development in this framework is a journey - not a destination. Future success must be established – not expected.

4 Discussion and Conclusions

It has been said, that the legislation and the general ignorance are the main challenges for implementation of UASs. It should also be noted, that these issues do not prevent the whole activity. I strongly believe that from the basis of my framework and including the related follow-up research, we can expect promising results in many ways of exploiting of UASs. Networking is the key factor in the model I build. Networking takes place in many directions and it is good to have many different parties around "the same table".

As I have already said, on the basis of earlier studies I have developed a framework, which is being illustrated in figure 11. and table 3. This framework aims to describe and facilitate the role of the different actors and activities on the same "playing field". In my view, such model has never been done before, and it is unique. That framework will show, how much the unmanned aviation has both “visible” and “invisible” actors, how much they relate to each other, and what is the interaction between their relationships. By the attached diagram and the construction of this framework, it can be said that there are unmanned aviation-related issues surprisingly lot - and they are all strongly related to each other.

All of the described matters in figure 11. and in table 3. are regulating the entire UAS - activity and those matters are closely related to the relevant strategic management, network management, protection of privacy, aviation safety, information security, etc. Can we even think so that these themes will provide the foundation, for the preconditions under which we can go up into the air? The relevant legislation forms an own entity, and it is also an important part of this theme.

People need to generally know the purpose, for which these UAVs are being used, and most of all - why? By masking and concealing this matter will turn against itself – also politically. This will also influence to the legislation and various regulations. A very interesting thing, about the future, is going to be, who or which party will in practice be monitoring the flight operations. In this context I don`t mean only activities of public authorities, but anyone who will use these UAV - devices.

Doyle et al. (2012, 356) state that *"more we develop systems and devices that communicate seamlessly with one another and the more these systems become embedded and networked within our infrastructure, the further we encroach upon the sanctity of private space. When these technological developments herald tremendous advances in efficiency and convenience, they impose an ever-increasing burden of vigilance with respect to the release of personal information. We must be on guard to limit the varied devices we carry to ensure that they are not unwittingly broadcasting our personal secrets, responding to the myriad sensors and pathways that have come to exist throughout our urban and suburban landscapes. This world of technical ubiquity affords us great freedom of movement and information exchange, while at the same time threatening to link us inexorably to the physical and the quotidian."*

In reference to Lyon et al. (2006, 291) *"positive values in modern society such as privacy, civil liberty, democracy and freedom presuppose that society would realize a kind of pretermined harmony as Adam Smith´s "invisible hand". Management of the population with surveillance in modern history proves society has shown various contradictions. Anonymity is a basis of freedom but it is a formidable difficulty for the management of the population."* Lyon et al. (2006, 291) state also, that the technology of governance has been creating management of the population while people have been struggling for their freedom. The idea about e-government is a key issue for what the present surveillance society is. People should consider more deeply how to strengthen the right to control technology. Hevner & Chatterjee (2010, 179) point out that one approach to achieve more relevance is to conduct research using appropriate research methods which balance the interests of researchers and practitioners.

Goold et al. (2009, 34 – 35) state that there is still a time to strengthen our shared commitment to privacy by using the law, and to construct the sorts of forward-looking, technologically enhanced regulatory frameworks that will be necessary as surveillance becomes even more ubiquitous. Unless we take this opportunity, there is a danger we can find, that we are living in a society that simply lacks the legal and technological tools required to stem the rising tide of surveillance, or to protect what might be left of our privacy in next years.

Zureik et al. (2005, 14) point out that *"we see less public concern over the invasion of privacy and less support for governmental and organizational openness. Pressures to cross personal borders in order to protect organizational and national borders have greatly increased. Many in government argue that the privacy and openness of recent decades, and the unrestricted use of new technologies such as encryption and the web, undermine national security. Contrary to the trend of recent decades, many social borders are now more difficult to cross – whether entering another country, a neighbourhood or a building, seeking immigrant or asylum status, or accessing information – while some individual borders are easier to cross as a result of new laws such as the Patriot act."*

It is true that in the use of UASs, the difference between good and evil depends on who is using these systems and for what purpose. People should always take account of the fact that criminals or anyone can acquire these systems. Some of these UAVs can fly inside the buildings and almost anywhere. The industry of UASs is becoming a huge business and the biggest winners in this game are for sure the manufacturers of UASs.

The overall management of UASs requires much more than knowing just the technical characteristics or knowledge of performance. It is said, that the unmanned aviation is going through similar periods of time like in the early days of manned aviation. In one way this is true, but people and technology and also the world around of us are more than 100 years evolved tremendously. I think that the action of UASs should be seen as wholeness and not in pieces apart from one another. Different types of networks and their activities, as well as the importance of the management will rise to the very important role of thinking about UASs in many ways. UAS – activities are related to ICT - world and a variety of computer systems are faced with major challenges. The size of UAVs continue to decrease and so will also happen in the sensor world. Developers of the ICT - systems are forced to know the UAS - world as well as manufacturers vice versa.

It is obvious, that after the first larger accident will be assessed and examined the different aspects of aviation safety issues, especially specific for the unmanned aviation. Certainly, it can be said that the aviation safety is for sure going to be one of the key factors in unmanned aviation. I think in this case, as well as many unsolved themes of unmanned aviation must be solved by using various networks.

Many of the publications and journal articles focus on various threat scenarios related to the privacy or other strong public opinion in the UAS - theme. It is true, that an unmanned aviation may cause anxiety in people. This is certainly affected by the fact, that the

spectacular news coverage and press articles are creating the impression of killing machine, that can almost appear out of nowhere for anyone to the "back yard".

Related to the future, the world will have a broad economic crisis for a long time, and it is certain that public organizations alone are not able to acquire the systems and they need networking. For example hardware manufacturers and other actors are forced to adapt to this situation. In practice this will mean, that the size of UAVs will decrease and the price will drop. All actors are forced to adapt to this situation. Unmanned Aviation needs open-minded and unencrypted approach to create a general climate, ready for this theme. Different types of networks will rise to the very high value. Networks must be involved in a variety of different actors so that the “smoke screen” of this theme can dissipate. Open communication and public transparency will certainly contribute in creating a good atmosphere of unmanned aviation.

4.1 Answers to the research questions:

4.1.1 The main challenges, categories and dimensions

The goal of the research was to find out the challenges, main categories and main dimensions of UASs. In figures 2. and 11. and in table 3. I point out by using different categories and dimensions, the “players” of UASs and how they involve and affect together.

The research showed the needs for UASs in different parties, but also a social general ignorance of its use. The research also addressed the challenges of strategic management in public organizations for improving situational awareness and a real-time picture. Unmanned aircraft system (UAS) can be used as a tool for improving situational awareness and creation of a real-time picture. This research also showed that many counter parties must participate in UASs development activities.

The main challenges are ministries fragmented budgets, a lack of common practices of the new system of exploitation, social general ignorance and cultural differences. These challenges concern with the same way the UAS - device manufacturers, operators, end-users, customers, and citizens. An essential part of all aviation is transparency. The people need to be openly told what is done in the air. I believe that transparent information and transparency helps the people to understand what the UAS / RPAS - actions are, and it will not be seen only as a threat to citizen's privacy.

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. Cooperation must be strengthen 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.

Today people are usually only staring at the UASs performance. It should be remembered that "the civilian environment", sets mainly entirely new challenges in military used systems. One of the main goals will be the different perceptions of the people. Can military systems be imported at all to the civilian world? This will certainly be one of the major topics of discussion. Another interesting thing will be how much public opinion is already so much against UAS - activities that it interferes with the whole operation.

Flying UAVs is not having fun, but series of different serious actions, what requires professional skills and discipline. Air traffic regulations and provisions must rigorously be followed. UAS operation is part of the aerial work, and that must be kept constantly in mind when these activities are exercised. Safety regulations are very important part of all kinds of aerial work. For UAS - action attitude will definitely affect who or which organization is in operational role, the end-user or customer. In this issue will also certainly influence, whether it is some authority, and its tasks include various control functions or whether it is a non-profit entity. I believe that which authority utilizes the system will affect surprisingly lot in public opinion.

4.1.2 The importance of people, public opinion and privacy

The goal for the research was to find out, how important it is to increase general awareness of UASs. People are increasingly worried about their privacy and how UASs are being used and especially, who uses these systems and for what purpose?

In reference to Leukfeldt et al. (2012, 86) "*privacy is closely related to data protection but also embraces spatial and corporeal dimensions. It represents a social value that is safe-*

guarded in the European Charter for Fundamental Rights. Cited and appropriate tools for safeguarding privacy are privacy by design and privacy enhancing technologies. These present a starting point that reconciles privacy requirements with requirements posed by homeland security. Though often positioned as a trade off (more privacy means less security or more security means less privacy) the alternatives presented show that privacy and security can be reconciled. This leads to the following conclusions: Privacy requires a multidisciplinary perspective: technological, social and legal perspectives should be integrated." Leukfeldt et al. (2012, 86) state also that "*new information technologies have generated many more opportunities for gathering and using data; not only has this had an impact on privacy; it also requires a broadening of scope to include spatial and corporeal dimensions. Over the past decades new approaches to protecting privacy such as privacy by design have emerged, which reconcile seemingly opposing interests."*

Bauman & Lyon (2013, 19) point out that the unmanned drones, performing the spying and striking tasks for which the Predators have become notorious, are about to shrunk to the size of birds, but preferably insects. Bauman & Lyon (2013, 20) continue by saying that the new generation of drones will stay invisible while making everything else accessible to be viewed; they will stay immune while rendering everything else vulnerable. The next generation drones will see all while staying comfortably invisible – literally as well as metaphorically. There will be no shelter from being spied on – for anyone. The "*new and improved*" drones will be programmed to fly on their own, following itineraries of their own choice at times of their own choice. The sky is the limit for the information they will supply once they are put into operation in the numbers planned. Bauman & Lyon (2013, 20-21) point out also that this is the aspect of the new spying and surveilling technology, armed as it is with the capacity to act at a distance and autonomously, that most worriers its designers.

Bauman & Lyon (2013, 23) ask *"what conclusion can be drawn from the meeting between the drone operators and the Facebook accounts operators? Between the two kinds of operators acting apparently at cross-purposes and activated by ostensibly opposite motives, yet nonetheless cooperating closely, willingly and highly effectively in bringing about, sustaining and expanding what you have, so felicitously, dubbed "social sorting"?* The old panoptical stratagem (*"you should never know when you are being watched and so newer be unwatched in your mind")* is being unstoppably brought to well-nigh universal implementation. The old panoptical nightmare (*"I am never on my own")* now recast into the hope of *"never again being alone",* the fear of disclosure has been stifled by the joy of being noticed. (Bauman & Lyon 2013, 23.) Bauman & Lyon (2013, 23) state also, that the two developments, and especially their reconciliation and cooperation in promoting the same task, were made possible by

exclusion being substituted for incarceration and confinement in the role of the most awesome threat to existential security and the major source of anxiety.

It should be always remembered that the silence and the secrecy related to UASs can turn things against itself. It should also be remembered, that the new things always scare people in a certain way. If things are done improperly, it is done either deliberately or accidentally, but the end result is always the same. The issue will turn against itself. This issue can also be seen as a matter of education. But who is it or which party will take responsibility of this matter? Do we need a whole new organization to train operators, end users, customers, etc.? If the development leads to this point, so these instructors must definitely be professionals of aviation – not any pusher, who thinks to be a professional.

A very important point before starting flight operations is to consider, what kind of (UAS) system is used and what kind of sensors are used. These things will inevitably affect, inter alia, for the manufacturing of UAS - equipment and product development. When the environment and public opinion is taken into account, I think the environment is more favorable for the UASs operations in the "civilian world". It is also important to consider thinking standardization of the different systems, which is much more important than a single technical feature. I think these issues must be considered before UAS - action gets out of hand.

4.1.3 The importance of research and development

The goal for the research was to find out, how important research and development is in developing UASs. Research pointed out that the market has a huge economic promise for all RPAS MTOM classes and services utilizing them. Benefits using RPASs may not be achieved by other means. The social benefits are significant when using RPASs enabled services. These RPASs would considerably increase the number of the biggest priorities of safety, security and environmental issues.

The markets are a catalyst for the technology in many areas. Civilian and military use together, is a key condition for non-military governmental applications. For example, where the airplane's or helicopter`s use is too expensive to perform a task or there is a risk for human life, RPASs can be used efficiently and economically. UASs are a fast-growing form of aviation. Civilian markets are now waking up to the operation. A good RPAS regards the end user, and it is made in co-operation with the manufacturers and end users. Increased co-operation is needed and legislation must be in balance with the international and national levels. Research and development is in a key position at first step.

I am sure, that research and development will become in very important role of UASs. You must be able to see large entities, consider the meaning of networking and the meaning of these for the profitable business. There is no shortcut to happiness. If we think this matter from the point of view of manufacturer and end-user, the importance of expertise becomes to extremely important position. For example, if they have no previous experience in the practical flight operations, so what will happen for the aviation safety? There are already now warning examples, when matters did not go as expected. Aviation accidents are not conducive to a positive business or public opinion.

When designing products consumers want, it is necessary to deeply understand what consumers want, their values, cultures, and environment. A research technique called ethnography that originated in anthropology has become a central practice in design research. In anthropology is studied human behaviour, how people experience and make sense of what they themselves and others do. In order to understand how design influences us and the relationship between design research and social science, we must study a research method - ethnography. Designers have adopted qualitative design research methods in order to understand customers. (Hevner & Chatterjee 2010, 81.)

4.1.4 The main threats and weaknesses

The goal of the research was to find out by using SWOT - analysis different challenges concerning UASs. The research pointed out that it is evident that eye-catching headings in media will affect to the public opinion and also to the political climate. Political influence can be seen in legislation and in other regulations concerning UASs. Political, economical, technical and tactical challenges walk hand in hand and they have influence to each other. The public opinion is in very important role of these challenges. People are nowadays increasingly worried about their privacy and how “Big Brother” is watching them. One of the main research findings in this thesis was general ignorance of UASs.

In table 4. I point out by using SWOT – analysis the challenges of Unmanned Aircraft Systems. In that table can be seen the main threats and weaknesses, in developing UAS – action:

1. Is Big Brother watching You?
2. Public Opinion
3. Advertising
4. General Ignorance
5. Privacy
6. Technical Safety
7. Legislation

8. Tactical Ignorance

A good example of threats and weaknesses is general ignorance. This affects especially to public opinion and through this, how people are concerned of their privacy. There already now exists many articles in media of “Is Big Brother watching You?” or drones in the skies. From this point of view openness and transparency is very important issue of UASs. It is evident that people already know that UASs are used for different purposes. There is no need for concealment. Technical safety and tactical ignorance play also an important role of threats and weaknesses in the development of UASs. For example the end-user must be aware of aviation safety and different limitations in the use of UASs.

4.2 Further research

In my thesis I present the final results of the four publications. UAS - world is evolving very quickly, which is the reason for my great emphasis in research of this subject also in the future. Theory and theory building of my framework can be seen as a central research activity, in common with all research approaches and also facilitating the further research of this subject.

The details of my framework are ensuring communication of theory between practitioners and researchers in a way that it can be understood by people who are working in improving this theory. My framework is also ensuring in understanding the theory, how different issues are related to the unmanned aviation and how they are relating to each other. As I earlier pointed out, this framework can be considered also as “An Activity Framework” of the unmanned aviation.

Määttä & Ojala (2000, 39) point out that the future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach. Strategy can be seen as an essential part of the future.

It has been said, that the legislation and the general ignorance are the main challenges for implementation of UASs. It should also be noted, that these issues do not prevent the whole activity. I strongly believe that from the basis of my framework and including the related follow-up research, we can expect promising results in many ways of exploiting of UASs. Networking is the key factor in the framework. Networking takes place in many directions and it is good to have many different parties around "the same table”.

Already now it is available to get light UASs starting from price range of few hundreds of dollars. Payload-carrying capacity of these UASs can be several pounds. In practice this means, that such Unmanned Aerial Vehicle can be armed, or it can carry, for example payload of explosives, chemical or radioactive materials. In the future, this is going to mean how to defend against or to protect against of these UAVs. And how can such flight data link and the operator of this UAV tracked? Or is it even possible? Is it already now necessary to think about and discuss about the unmanned aviation-related air combat? It remains to be seen.

Large carriers have also made proposals to start carrying cargo by using unmanned aviation. Related to this matter, flight safety will surely be an important issue. There is also another side to this. How strongly the data link is protected and how easily it can be captured? If people have been able through the history of the manned aircraft for skyjacking, the same holds true for the unmanned aviation, but in different ways. The vulnerability of information systems will surely cause "gray hair", as well as for equipment manufacturers and systems developers. There are always weaknesses in information systems, and they must be recognized.

UASs can be used very efficiently to a different inquiry, and these systems can be used, in principle, by anyone. The UAVs can be equipped with any kind of sensor to see, hear, smell, identify, measure, etc. Practically, we can say that there is no longer anything protected or in safe. It can be said, "What you do not want others to see, do not show it!" It should be also noted, that the UASs are business also for many different parties. For example, in media is shown news about the things that will increase sales and the viewing figures. After the “explosion” of the market, it must be taken into account, that the media or anyone else can come to the scene by flying and send different kind of data around the world in a few seconds delay.

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Appendix 2: Publication [P2], The Strategic Management Challenges of Developing Unmanned Aerial Vehicles in Public Safety Organizations

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Publication P[1]

I. Tikanmäki, T. Tuohimaa, J. Rajamäki, How and why Unmanned Aircraft Vehicles can Improve Real-time awareness?, International Journal of Circuits, Systems and Signal Processing, Issue 5, Volume 5, 2011, pp. 469-477.

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

Ilkka Tikanmäki, Tuomo Tuohimaa and Jyri Rajamäki

***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."*

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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)

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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The Strategic Management Challenges of Developing Unmanned Aerial Vehicles in Public Safety Organizations

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Abstract: This paper deals with the challenges of strategic management in public organizations for improving situational awareness and real-time picture. A significant strategic management tool for operational activities is situational awareness including real-time picture creation. In this paper we use, unmanned aircraft systems (UAS) as an example for improving situational awareness and real-time picture creation. Persons acting on the ground, their leaders and other decision-makers should be able to exploit a real time picture of the situation when making decision. E.g. police, border control authorities, customs and fire departments need real-time picture of the situation. For decision-makers and their assistants, situational awareness means understanding about events, circumstances affecting these events, the objectives of various parties and possible options, which are needed to make decisions on a specific item or the whole thing. In society, the efficient use of resources is a sensible, economical and appropriate target. Strategy work requires a new perspective where actors must have the ability to see large complexes. Different entities interact with each other and strategic decisions require courage. Successful organizations create a successful strategy, implement it and are able to renew their strategies with the latest requirements.

Key-Words: Strategic management, Unmanned Aircraft Systems (UAS), Unmanned Aerial Vehicle, (UAV) Public organizations

1 Introduction

This paper deals with the challenges of strategic management in public organizations for improving situational awareness and real-time picture. As an example, we use Unmanned Aircraft Systems (UAS). Most of the scientific publications from the subject concentrate on building, planning and technical properties of UAS [1], [2], [3].

The unmanned model planes are used mainly for different military purposes at the moment. There are several reasons why UAV's role has recently received more attention and interest in wider. Technique, which was not available a few years ago, is now developed.

UAV's 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 [4].

UAV's classification with regard to altitude and weight is presented in Fig. 1.

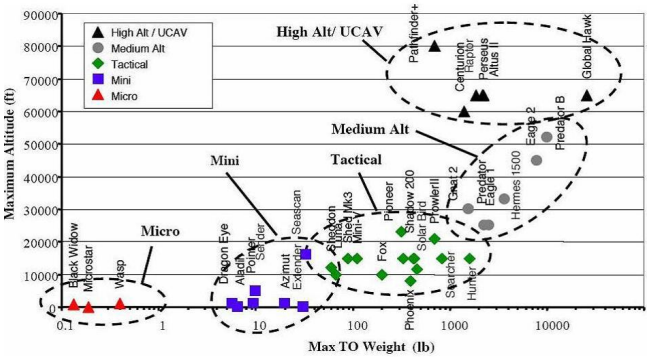

Fig 1. Altitude and Weight Classification of Current UAV's [5]

Depending on the maximum total weight and maximum altitude, UAV's can be divided into five categories; micro, mini, tactical, medium altitude and high altitude.

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2 Problem Formulation

2.1 Theoretical framework

A new artifact is always based on one concept [6]. This means the concept of technical, human, or informational resource or a combination thereof, recovery [7]. Idea can also be based on a new theoretical invention.

When an artifact is placed in some environment, the significance of the expertise is emphasized. Expert knowledge of design science helps to implement appropriately designed artifacts and eliminate unwanted side effects [8]. Meetings of the professionals of the different field are considered as situations which are valuable and produce many innovations [9].

An instantiation is to understand an artifact in its environment. Instantiations implement constructs, models and methods. The Information Technology (IT) systems need to be instantiated using the experience and intuition. Design Science consists of two features: building and evaluation [10].

Design science will play an increasingly important role in the Information System (IS) profession. Challenge for the design-science researchers in IS is to inform leaders of the capacity and the impact of new IT objects (artifacts) [11].

Design science takes often a simplistic where designed artifacts must function. The design of an artifact, and an assessment of its utility, compared with competing artifacts, is an essential design-science research [11]. Technological logic of the rule is, if you want to achieve Y in situation Z, then do X action. X is a general solution concept for a type of field problem. Solution concept can be an act, a series of acts, but also a process or system [12]. In construction problems this can also mean building a new artifact out of previously unrelated materials [12].

Strategic management represents a prioritization of key success factors in the selection of strategic objectives, indicators, and the use of objective awareness, flexibility in structure and adaptability to environmental changes, which will be closely monitored, and in which react in advance [13].

2.2 Problem formation

The SWOT analysis is a typical strategic planning process. Strategic planning is a part of strategic management [13]. Strategic planning constitutes the framework for the design aspects, tactics, to identify the criteria or the constraints that must be taken into account in operational planning.

Public organizations can be generally divided into three categories, how they see their future: (1) drifted into the future. (2) adapted to the future and (3) the future makers [14].

Future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach. Public organizations have traditionally alienated this approach, especially independent strategic flexibility and individual responsibility in its creation and its exploitation. Strategy is an essential part of the future. Public organizations should continuously evaluate their strategic position and it should be a natural part of normal activity [14].

According to Whittington being a good strategist might not be enough [15]. Leadership is more than a strategy to match action with the environment. It is self-adjustment to social environment.

There is a need for a new kind of strategic thinking, and - working tools, which emphasize the following starting points [14]:

1. Instead of making and analysing strategy attention should move to it, how to create strategies for action in practice
2. Strategy must based on the organization's right to exist and to express the common will of the desired future
3. The strategy process must geared towards strengthening the organization's skills and continuous learning
4. Strategy process should be based on participation and interaction
5. The success of the strategy requires constant communication

According to Kaplan & Norton [16] learning and growth strategy deal with the intellectual property which is needed in organization's activities and customer relationships for continuous improvement. This aspect relates to three areas:

1. *Strategic knowledge: strategic knowledge and skills that workers need to support the strategy.*
2. *Strategic technology: information systems, databases, tools and network required to support the strategy.*
3. *Operating Atmosphere: corporate cultural changes that are required to carry out a strategy to motivate staff, to empower and to adapt.*

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3 Problem Solution

It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge [17].

Everlasting 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 which were not previously believed to need IT support. In this process, new kinds of systems and development methods are created [18].

Hevner et al [11] created information systems research framework which is presented in Figure 1.

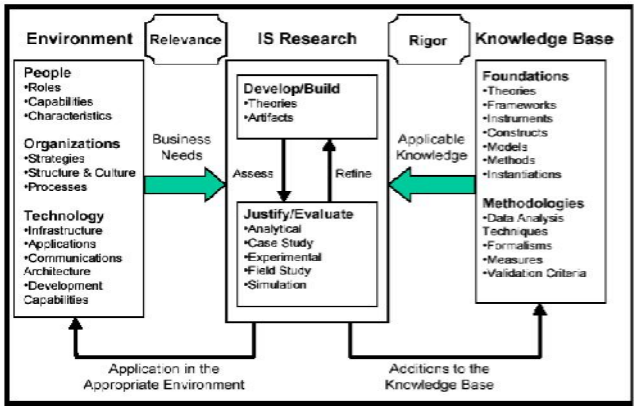

Fig. 2 IT Systems Research Framework [11].

Hevner et al consider as a basis for research the business environment which consists of people, business organization and technology [11]. The targets of research in their view are human form of roles and competencies as well as the organization's strategies and processes, and technologies which support these.

Unmanned aircrafts are currently used mainly for various military purposes. On the civilian use of UAV's 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.

Unmanned Aircraft System (UAS) international aviation regulations might be ready 2012-2015, 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 UAV's, including Finland [19].

Visions and objectives of the Finnish aerospace and aviation fields of technology professionals as UAS / UAV-systems will create the ability to develop and maintain these systems, and marketing abilities profitable 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].

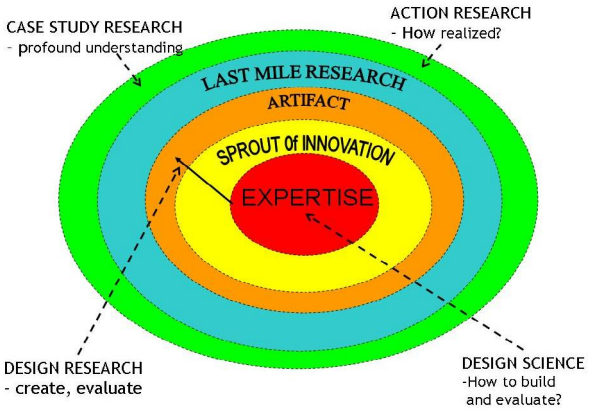

Fig. 3 Body of Knowledge.

In figure 3 we show, how the knowledge helps doing things also in strategic management [21].
Strategic management problems and, above all obstacles to the realization of strategies in public administration are [14]:

- strategies are in the air and do not interfere with everyday life, because it is not known, propagates the organization in the direction of strategy
- lack of vision and action ideas
- management of the budget process is over exaggerated, a strategy process is not connected to the annual operational and financial planning and monitoring
- management systems and attitudes do not sufficiently support the implementation of the strategy required for the interaction, but rather daily reactive management
- loose strategy elements (personnel, communications, information management, service, quality strategies, etc.) that are linked to common strategic disadvantage
- the majority of staff and middle management internalizes badly strategy and its importance
- staff participation in the strategy process is the exception rather than the rule
- implementation of the strategy are not monitored or revised systematically

There is a need for a new kind of strategic thinking, and - working tools, which emphasize the following starting points [14]:

1. Instead of drawing analysis of strategy attention should move to it, how to create strategies for action in practice
2. Strategy must be based on the organization's right to exist and to express the common will of the desired future
3. The strategy process must be geared towards strengthening the organization's skills and continuous learning
4. Strategy process must be based on participation and interaction
5. Successful process of strategy requires constant communication

Learning and growth strategy of intellectual property are needed in organization's activities and customer relationships for continuous improvement [16]. This aspect relates to three areas

1. Strategic knowledge: strategic knowledge and skills that workers need to support the strategy.
2. Strategic technology: information systems, databases, tools and network required to support the strategy.
3. Operating Atmosphere: corporate cultural changes that are required to carry out a strategy to motivate staff, to empower and to adapt.

Exporting strategy into practice mean that the management and staff are committed into following issues [14]:

- Vision and strategy are communicated to staff and it is connected to learning, action planning, rewarding and performance evaluation as part of management and values in implementation.
- Set a strategy for the operational objectives, the coordination of development projects, ensuring resources and define milestones unit-level strategies.
- Clarify connection of strategy and our own work to your personal level of performance and development discussions.
- Strategy objectives will be monitored regularly and respond quickly for good and poor accomplishment

Learning and growth strategies are a prerequisite for long-term and lasting change [16]. Management teams are a prerequisite for long-term and lasting change. Management teams are ready to recognize the importance of this aspect, but they are not usually very well aware of how these objectives will be defined or achieved. Careful planning of more opportunities increases learning and growth strategies successfully.

4 Developing cooperation

Developing a multi-authority security circumstances tactics and training by adding to the exploitation of common resources and expertise in the use of various authorities in identifying opportunities and means to support the goal should be taken in the account. 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.

By identifying various authorities' opportunities and means to support operations, the best results are achieved. When establishing a national strategy for UAS, this defines and clarifies the responsibilities of authorities and their roles of UAS operations. Developing and expanding operational cooperation aims practical co-operation and mutual interaction between the authorities, which will improve the situational picture. By exploring official actions and academic efforts factors that influence a real-time picture and current situation in Finland, government may organize authorities' training and a wide-ranging co-operation between authorities.

5 Conclusion

The major focus of strategy will be in the future and it is the most important and most essential thing to seek and find. Strategic thinking requires the ability to think by using of different concepts, but the final strategy must be very practical and applicable. A good strategy will ensure that the right things will be done and by doing different kind of operations, will ensure that things are done correctly. You could say that the strategy is eternal and it must be controlled. Finding the truth is the beginning of wisdom also to the strategies.

The importance of cooperation between UAS's in use is highlighted because the services are needed when a number of different industries such as the Ministry of the Interior under the auspices of actors, including police, rescue, customs and border control authorities. The service provider must be familiar with the various actors needs to be able to meet the demand of the right way. Selecting a product for many different needs of operators should therefore be given special attention.

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None of the authority is solely responsible for certain activities, because there is an exemplary cooperation between public authorities. For example, police, securing international meeting does not need to acquire tanks or airplanes. Police may ask for official assistance from Defence Forces when in need of special equipment or expertise. When something happens, it is decided the responsible party who is responsible for operations, but which receives support from other public authorities.

The government should plan to take into account the existing research dealing with UAS and if necessary initiating new research projects. The aim is that the requirements and opportunities to pursue UAS activity to improve a real-time picture and support the UAS-based activities will strengthen.

For example, the Ministry of Interior could set up a cross-administrative co-operation center that concentrates for maintaining the real-time picture. Center should be responsible for coordination and monitoring of progress and support for other authorities. Securing an adequate amount of resources, who have skills required for the task to manage UAS. Verification on Aviation Legislation and authorities' adequate and up-to-date means for the use of UAS in operations must ensure. Ministries will prepare the plan for implementation for their own responsibilities in respect. Ministry of Interior collects the plans, reconcile and coordinate the implementation-related issues. Plans will be updated at regular intervals.

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 is essential. Joint research, education and training activities related to authorities' communication, as well as the authorities' partnerships between the public authorities by ensuring management, situational picture and messaging systems for compatibility and possible integration contribute to the goal.

On this basis networking and common management is very important for the development of UAS to the use in a small country like Finland with limited resources. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. That is why it is vitally important to create network, and thereby obtain synergies from a wide-scale deployment of the UAS.

We believe that the development of UAS for operational activities and to maintain situational awareness constitutes strategic network management in many respects. The importance of networks and networking in the world today can not be overstated. A smooth and seamless cooperation between different spheres of government contributes UAS's implementation for public needs for improving and speeding up situational awareness and creation of real-time picture. Our environment and the whole world are constantly changing and that's why there is a growing need for authorities common UAS-system and command center.

We believe that the UAS's future implementation activities will benefit both the situational awareness and real-time picture improvement, not to mention the importance of appropriate expertise. We can wait promising results in the future in creation of strategic network between authorities.

We also believe it has not been paid enough attention to common management between different authorities and experts concerning UAS's use in public safety duties. We understand the importance and the meaning of strategic networking and cooperation between authorities. Challenge is to reconcile the needs of different authorities under common management. In the future, this topic is covered much more to explore, and it will be interesting to watch, will developing and the use of UAS's raise or what will happen.

Balanced success strategy, a key value and goal, is according to Määttä & Ojala the participation of different parts of the organization's various departments and personnel [14]. Critical success factors of strategy must be to communicate, to be discussed and questioned. Participatory and inclusive strategy work is a challenge for the entire organization. Balanced success strategy is a journey - not a destination.

Future success is not based on the same kind of operation than today's success. In strategic knowledge and leadership must be able to combine the strategic success factors for each other. The future must be established – not expected.

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Cooperation challenges to public safety organizations on the use of unmanned aircraft systems (UAS)

Tuomo Tuohimaa, Ilkka Tikanmäki and Jyri Rajamäki

Abstract—This study deals with the importance of networking for co-operating authorities and their duties. As an example, we will dissect unmanned aircraft system (UAS) utilization for improving and speeding up a situational awareness and a real-time picture. Networking is emphasized between cooperation with national authorities, because the players are under the supervision of different ministries. Inter-ministerial co-operation is already in a good shape, but given the relevant persons in the mutual interaction may be scarce. In this point of view, the challenge for UASs use include ministries fragmented budgets, a lack of common practices of the new system of exploitation and the lack of cultural activities. It has revealed a need for networking between the authorities in cooperation of implementation of UAS. Different levels of networking means to cooperation between organizations: performing a similar task teams to cooperate, or individual experts formed a collaborative network. UAS cooperation with the authorities will act in all of the above (sectored, regional, level) mention areas.

The importance of cooperation between authorities has discovered an important subject to be developed. The Finnish Government's Security and Defense Policy states that the close cooperation between the authorities achieves synergies between overlap functions by cutting and support functions to enable efficient use of. Situational awareness and government collaboration will be developed both nationally and internationally. Efficient use of resources in society is a sensible, economical and appropriate. Therefore, in UAS development activities, must participate many part-sides (Police, Fire and Rescue Services, Border Guard, Customs, etc.). Strategy work requires a new perspective and you must be able to see large complexes. Different entities interact with each other and strategic decisions require courage. Successful organizations create a successful strategy, implement it and they are able to renew their strategies with the latest requirements.

Keywords—Public safety, UAS, UAV, Unmanned aircraft system, Unmanned air vehicles

I. Introduction

THIS paper deals with the cooperation challenges in public safety organizations for improving situational awareness and real-time pictures. As an example, we dissect unmanned aircraft systems (UASs). At the moment, the unmanned types of planes are mainly used for military purposes. There are several reasons why unmanned air vehicles (UAVs) role has recently received more attention and interest; uppermost being the development of new technology, which was not available a few years ago [1], [2], [3].

In the past years, UAVs have extensively been applied in such areas as reconnaissance, intelligence and border security. In those specified missions, UAVs are required to operate at a high accuracy. The dynamic modeling and especially the automatic control system design are playing very important roles [4].

Scientific and technological developments in mobile communications, sensors, drive systems and other areas are rapidly making it possible to develop UAVs with advanced technology [5]. In the past, UAVs might have received more attention, if 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 UAVs were adopted, meant that the advanced technology for UAVs has become available [6].

UAVs classification with regard to altitude and weight is presented in Fig. 1. Depending on the maximum weight and altitude, UAVs can be divided into five categories; micro, mini, tactical, medium altitude and high altitude [7].

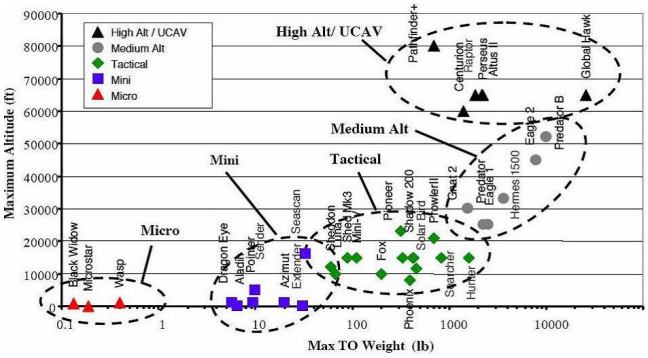

Fig. 1. Altitude and Weight Classification of Current UAVs [7].

The outline of the paper is as follows. First, the issue is presented and the theoretical framework is formulated in Chapter II. Then, in Chapter III the method applied in this paper is presented. Chapter IV presents problem formulation and Chapter V shows the problem solution. Chapter VI illustrates developing cooperation between public safety authorities and Chapter VII presents the results. Finally, on Chapter VIII the most important conclusions are drawn.

II. Theoretical Framework

Strategic management represents a prioritization of key success factors in the selection of strategic objectives, indicators, and the use of objective awareness, flexibility in structure and adaptability to environmental changes, which will be closely monitored, and in which react in advance [10].

As shown in Fig. 2, end-users of UASs can generally be divided into two sections; private and public. This study

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concentrates in using UASs on public sector. Naturally, private and public sector already cooperate in many ways and development of that cooperation continues growing.

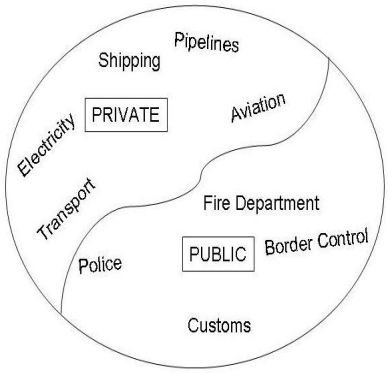

Fig. 2. Examples of UAS End-users.

The importance of cooperation between authorities has discovered an important subject to be developed. The Finnish Government's Security and Defense Policy states that the close cooperation between the authorities achieves synergies between overlap functions by cutting costs and support functions. According to [11], situational awareness and government collaboration will be developed both nationally and internationally.

In network of multilateral cooperation, companies are looking for cooperation in providing solutions to challenges and problems when their own resources are insufficient [12]. Networking is the process where the knowledge, values and skills of corporate combine the added value of productive activity, aiming at the promotion of competitiveness in the longer term [13]. Good experiences create confidence. Confidence is paving the way for information exchange, joint projects, especially joint learning [12]. Trust, however, requires a lot of open discussion. The key to building trust is a gradual increase in transparency. Transparency applies to all activities. Subjects must learn to consider both by your company's as well as network's point of view.

Networking means multilateral cooperation, with joint work to seek solutions to the challenges and problems which can solve their own resources are insufficient. The initial operation of the network is based on precise rules while later will be needed flexibility enabled by trust [12]. Networks of two or more independent companies for the long-term cooperation relationship with the companies will jointly implement the business to achieve stronger competitive positions. Networking is the process where the knowledge, values and skills of corporate combine the added value of productive activity, aiming at the promotion of competitiveness in the longer term [13].

A network construction is simpler when there is a focal company available. Such action, however, requires a common understanding of the advantages of the network; develop mutual trust and a common way to understand the issues and a shared vision [12]. Processes like networking cooperation are planned together with networked companies. Key elements of activities are trust, commonly recognized values and flexibility [13]. Key Network Management (KNM) is a systematic way to manage key networks. According to [14], key network is a set of actors mobilized by the focal company to realize an opportunity. In the case of UAS use within several authorities for their needs, it is necessary to designate the focal organization which takes control of managing the UAS.

Already long time, networking has been one of the key elements of Finland's defense construction. Networked defense know-how and performance abilities will be utilized in cooperation with partners. Interagency cooperation is essential that various actors have sufficient knowledge of others concepts, measures, resources and plans [15]. Collaboration is central to the local and regional settlement. Interagency co-operation aims at the cost savings that increase the efficiency [16].

For example, large public events in support of the police leadership have been set up command centers for general and field management. Command centers have liaison officers of different actors that allow coordination of actions. Command centers have usually represented by the police, event organizer, rescue services, border guards, customs and military representatives. Depending of the nature of the event design and operation also other public authorities may be presented. Authorities in the future will join the increasingly interconnected. For example, law on the Defense Forces, Rescue act and the Police act define the cooperation between the authorities and other authorities to support very important tasks [16].

External and internal securities are linked closely together. Preparedness and response for security threats require Finland to a strong national and international co-operation, a pre-agreed arrangements for cooperation between the authorities, business and NGOs [17]. One of the statutory duties of the Defense Forces is to support other agencies.

Assistance is requested from another authority in situations where the responsible authority in the resources for the performance to be reached or is missing from a particular sub-region. In addition to Defense Forces' normal development of capabilities related tasks, Defense Forces develops the ability to support other agencies. Defense Forces provide assistance of about 500 times a year to other authorities, so the ability to cooperate and manage leadership develop as well [18].

Vital functions of society and the responsibility of division between ministries and sectors is defined in the functions vital to society security strategy. The Homeland Security program sets a cross-administrative targets, strategic guidelines and measures in different sectors of government to achieve the objective [19]. A Cross-administrative entity in principle is shown in Fig. 3.

Condition is influencing the future development of cooperation, because individual operators have limited ability to influence global and diverse in society [19]. Each administrative domain is responsible for the administration in the exercise of its functions. Resource sharing, fraud coordination and authorities' joint planning are prerequisites for the wide comprehensive security concept under the new threat images [19]. Important issue is the flow of information between the authorities and availability of the mobile real-time picture.

Functioning management system is based on a reliable real-time picture. In addition to real-time situation picture it is

needed to a proactive and comprehensive environment for analysis. Securing the Functions Vital to Society as part of the implementation of the strategy will be a real-time picture of the Government in parallel with the sectored development of a real-time situational picture [19]. The Ministry of Finance, Ministry of Interior, Ministry of Defense, Ministry of Transport and Communications and the Ministry of Foreign Affairs are co-developing safety net, which will be used for military, police, border guard and rescue needs. Developing network environment allows for a later stage the development of the common real-time picture for the authorities [18].

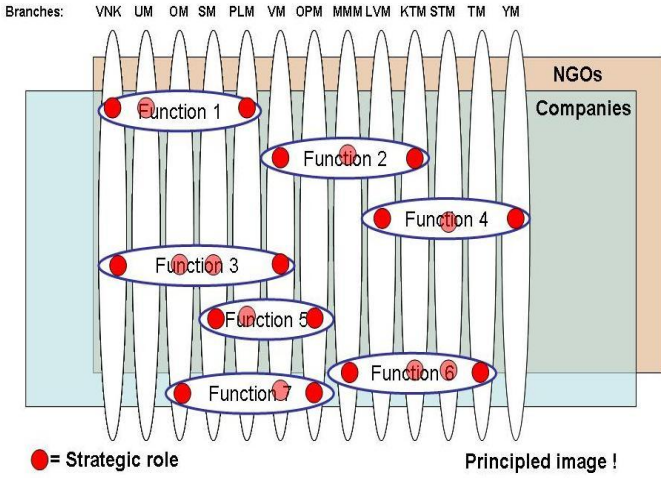

Fig. 3. A cross-administrative entity [19].

III. Method

Design science often takes a simplistic view according which designed artifacts must function. Designing of an artifact, assessing of its utility and comparing it with competing artifacts are essential tasks of design-science research [8]. The applied technological logic of the rule is that if you want to achieve Y in situation Z, then do X action. X is a general solution concept for a type of field problem. Solution concept can be an act, a series of acts, but also a process or system. In construction problems this can also mean building a new artifact out of previously unrelated materials [9].

In this study, we apply case study research method. The research report has an attempt 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 apply a case study approach, which is generally recommended as a suitable research design for theory-building [20], [21]. Design knowledge is to be applied by people who have received formal education in that field [22].

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 [23].

The development is learning by doing. The information obtained by development process, can be integrated into case study. Researchers who construct case study often participate in the development or implementation of the system they are researching [24]. 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 [25].

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 [21].

There are six sources of evidence for case studies; documentation, archival records, interviews, direct observation, participation-observation and physical artifacts. All mentioned case study sources have their weaknesses and strengths. It is recommended to researchers to use multiple sources of evidence in case study [20].

Interesting research topic in the information system (IS) field is how to effectively develop new systems. This is interesting because information technology (IT) is developing and technical knowledge is growing. IT is applied to new areas, for example UASs, which were not previously believed to need IT support. In this process, new kinds of systems and development methods are created [26].

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. 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 [27], [28].

Case study has mentioned to be one of the least systematic research methods methodologically. There are three areas where case study researchers should pay attention to. These areas are; design issues, data collection and data analysis. They also highlight the apparent lack of rigor that is one area where qualitative, including case study, research should improve [29].

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. 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 [21].

Researchers see the advantages of doing research in team. In our case team-work adds value and brings different point of views to research [29]. Examiners' prejudices should be avoided. 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 [23]. Unit of Analysis in our case study was 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.

IV. Problem Formulation

The SWOT analysis is a typical strategic planning process. Strategic planning is a part of strategic management [10]. Strategic planning constitutes the framework for the design aspects, tactics, to identify the criteria or the constraints that must be taken into account in operational planning.

Public organizations can be generally divided into three categories, how they see their future: (1) drifted into the future. (2) adapted to the future and (3) the future makers [30]. Future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach. Public organizations have traditionally alienated this approach, especially independent strategic flexibility and individual responsibility in its creation and its exploitation. Strategy is an essential part of the future. Public organizations should continuously evaluate their strategic position and it should be a natural part of normal activity [30].

Being a good strategist might not be enough. Leadership is more than a strategy to match action with the environment. It is self-adjustment to social environment [31]. Strategic management problems and, above all obstacles to the realization of strategies in public administration are [30]:

1. strategies are in the air and do not interfere with everyday life, because it is not known, propagates the organization in the direction of strategy
2. lack of vision and action ideas
3. management of the budget process is over exaggerated, a strategy process is not connected to the annual operational and financial planning and monitoring
4. management systems and attitudes do not sufficiently support the implementation of the strategy required for the interaction, but rather daily reactive management
5. loose strategy elements (personnel, communications, information management, service, quality strategies, etc.) that are linked to common strategic disadvantage
6. the majority of staff and middle management internalizes badly strategy and its importance
7. staff participation in the strategy process is the exception rather than the rule
8. implementation of the strategy are not monitored or revised systematically.

Learning and growth strategy deal with the intellectual property which is needed in organization's activities and customer relationships for continuous improvement. This aspect relates to three areas [32]:

1. Strategic knowledge: strategic knowledge and skills that workers need to support the strategy.
2. Strategic technology: information systems, databases, tools and network required to support the strategy.
3. Operating Atmosphere: corporate cultural changes that are required to carry out a strategy to motivate staff, to empower and to adapt.

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 [33].

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 might be ready 2012-2015, after which the scheduled tasks as a government, as well as scientific research work can probably be implemented.

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 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.

V. Problem Solution

It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge [35]. Everlasting interesting research topic in the IS field is how to effectively develop new systems [26].

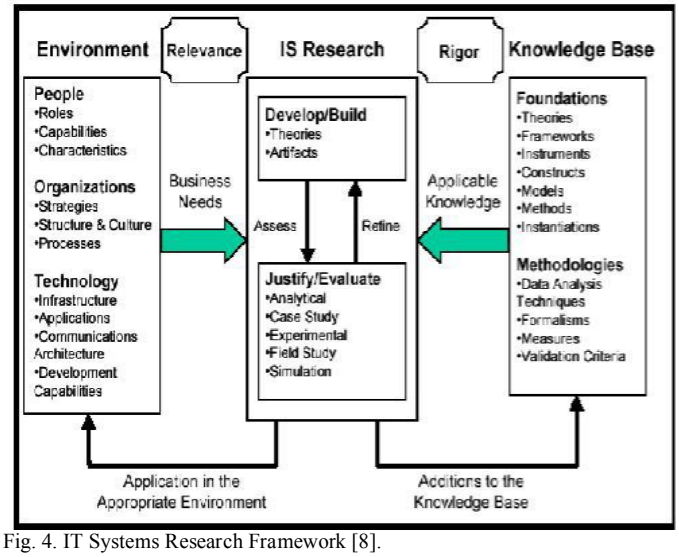

Fig. 4. IT Systems Research Framework [8].

Information systems research framework is shown in Fig. 4. Reference [8] considers as a basis for research the business

environment which consists of people, business organization and technology. The targets of research in their view are human form of roles and competencies as well as the organization's strategies and processes, and technologies which support these.

Unmanned aircrafts are currently used mainly for various military purposes. On the civilian use of UAVs 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.

Unmanned Aircraft System (UAS) international aviation regulations might be ready 2012-2015, 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 [36].

Visions and objectives of the Finnish aerospace and aviation fields of technology professionals as UAS / UAV-systems will create the ability to develop and maintain these systems, and marketing abilities profitable 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 [33].

There is a need for a new kind of strategic thinking, and -working tools, which emphasize the following starting points [30]:

1. Instead of drawing analysis of strategy attention should move to it, how to create strategies for action in practice.
2. Strategy must be based on the organization's right to exist and to express the common will of the desired future.
3. The strategy process must be geared towards strengthening the organization's skills and continuous learning.
4. Strategy process must be based on participation and interaction.
5. Successful process of strategy requires constant communication.

Learning and growth strategy of intellectual property are needed in organization's activities and customer relationships for continuous improvement [32]. This aspect relates to three areas

1. Strategic knowledge: strategic knowledge and skills that workers need to support the strategy.
2. Strategic technology: information systems, databases, tools and network required to support the strategy.
3. Operating Atmosphere: corporate cultural changes that are required to carry out a strategy to motivate staff, to empower and to adapt.

Fig. 5 shows how the knowledge helps doing things also in strategic management. Exporting strategy into practice mean that the management and staff are committed into following issues [30]:

4. Vision and strategy are communicated to staff and it is connected to learning, action planning, rewarding and performance evaluation as part of management and values in implementation.
5. Set a strategy for the operational objectives, the coordination of development projects, ensuring resources and define milestones unit-level strategies.
6. Clarify connection of strategy and our own work to your personal level of performance and development discussions.
7. Strategy objectives will be monitored regularly and respond quickly for good and poor accomplishment.

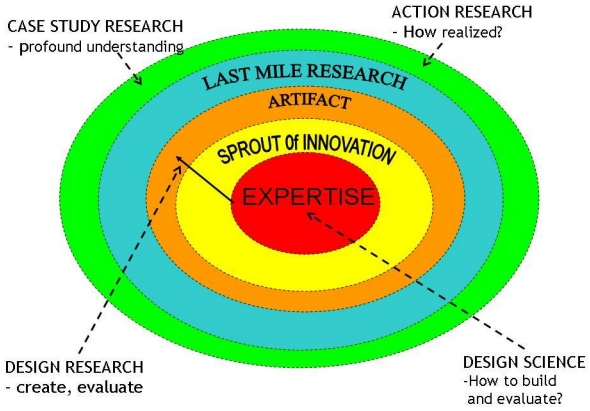

Fig. 5. Body of Knowledge [34].

Learning and growth strategies are a prerequisite for long-term and lasting change. Management teams are a prerequisite for long-term and lasting change. Management teams are ready to recognize the importance of this aspect, but they are not usually very well aware of how these objectives will be defined or achieved. Careful planning of more opportunities increases learning and growth strategies successfully [32].

VI. Developing Cooperation

Developing a multi-authority security circumstances tactics and training by adding to the exploitation of common resources and expertise in the use of various authorities in identifying opportunities and means to support the goal should be taken in the account. 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 is carried out by activating the authorities to participate by using the shared resources.

By identifying various authorities' opportunities and means to support operations, the best results are achieved. When establishing a national strategy for UAS, this defines and clarifies the responsibilities of authorities and their roles of UAS operations. Developing and expanding operational cooperation aims practical co-operation and mutual interaction between the authorities, which will improve the situational picture. By exploring official actions and academic efforts factors that influence a real-time picture and current situation in Finland, government may organize authorities' training and a wide-ranging co-operation between authorities.

Inspection of various terrains, in case to find the target of

interest, is a task that can be combined for example with various civil and military activities. Possible applications are the search and rescue mission, which aim to find the missing, injured or persons who have been in any kind of danger. These operations can last several days and they require a large and diverse group of technical support. Therefore, also the need for substantial funding exists [37].

It can be said that an image processing subsystem is a necessary and important part of an efficient and complete search and rescue system. It is surprising, that there are not many articles or literature about this area of interest [37].

Management should be an effective expression of will, cooperation, collaboration, interaction, operability and interoperability in depressed or disaster areas of trans-national extent. Modern crisis are difficult to predict and plan. All surprises are possible. This intuition provides improvement of situation awareness, because technological capacity may be not sufficient for all situations. International, crisis- and emergency response management preparedness is possible, in information exchange. Successfully solved interoperability brings more positive effects in cooperation and collaboration of operational entities. Operational processes must act integrally in different tasks and in different sectors [38].

E.g. Cofin project was carried out in Italy in 2004. The project aimed to design and develop a platform for environmental monitoring, involving fire detection and prevention, industrial areas reconnaissance, and natural disaster monitoring. An aerial platform of as small size and weight as compatible to mission requirements was chosen to carry on-board sensors and cameras to provide the user real time picture and information about the area. The mission requirements included capability of remotely piloted flight and autonomous flight [39].

There are many scenarios, where wireless access to heterogeneous information sources would be very valuable. For example law enforcement, access to medical information from an ambulance and major disaster management such as Tsunami. The disaster management personnel need a fast and reliable access to many information sources already before crisis occur. Not to mention what kind of need for different kind of information exists during the crisis and afterwards [40].

VII. Results

We will use UAS as an example of the use of networking in order to bring out the importance of interagency cooperation and a need for common real-time situational picture. The need for collaboration and networking among many actors exists.

A real-time situational picture is used to form a picture of the threat or disaster situation. A picture of the system is geared to produce pre-analyzed information on accident persons acting on decision-making. Grammatically situation awareness refers to the awareness of the situation and situational awareness refers to awareness that only happens sometimes in certain situations [41].

Nowadays different authorities have their own situational pictures for their own purposes. For example, rescue authorities use the picture of the situation to guide the rescue operations; police may by the situational picture help determine evacuation areas and efforts to limit the right places. 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. Networking benefits of government activities are emphasized, because the authorities do not need a duplication of resources.

Authorities mention as weakness 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 they suggest that UAVs should be concentrated to one user group to maximize the benefit of the devices. The economic challenges are the development and dissemination costs. Procurement and development have been tried to do in previous years, but the government financial situation prevents to invest in development projects [30].

A network management develops knowledge for the professionals in its field. Networking can be understood in different sectors, areas and levels to take place. Sectoral networking means in the same field of networking. Regional networking refers to particular geographic area cooperation. Different levels of networking means to cooperation between organizations: performing a similar task teams to cooperate, or individual experts formed a collaborative network. UAS-cooperation with the authorities will act in all of the above (sectoral, regional, level) mention areas [42].

The work culture related to networking is called the confidence and expertise working culture. Networked professional skills are emphasized collaborative skills, independent decision making and continuous development. Previously, expertise was enough a versatile and robust sense of reality, now is also needed to sense of prospect. The expert must be able to overcome both organizational and discipline boundaries [42].

Specific pressures, direct to management: the former issues and the management of people have raised alongside different knowledge management and knowledge management ideologies [42].

We need a new approach, the networking, which ensures rapid flow of information and expertise in the unification. Organizational boundaries are blurred, services and products in a multi-enterprise collaboration. These generated virtual networks, capable of individual companies (authorities) are more competitive because of its speed and its real-time [43].

Network-like organizational action creates the necessary flexibility and speed, as well as the opportunity for continuous data integration, a new creation, and foster innovation [43]. The networks activity is based on partnership, which means the actors, organizations and individuals' co-operation and new forms of co-design. Networked co-operation relates to the strong principle of reciprocity. All these partners will prosper and develop. Common context and objectives provide a framework to stimulate experience-sharing [42].

Network management will play an increasingly important role in interagency cooperation. The manager has a key role of a development and change management. Network Management and modification are not only a leader role; it is a common task and then it has the potential to succeed [42].

VIII. CONCLUSION

The major focus of strategy will be in the future and it is the most important and most essential thing to seek and find. Strategic thinking requires the ability to think by using of different concepts, but the final strategy must be very practical and applicable. A good strategy will ensure that the right things will be done and by doing different kind of operations, will ensure that things are done correctly. You could say that the strategy is eternal and it must be controlled. Finding the truth is the beginning of wisdom also to the strategies.

The importance of cooperation between UASs in use is highlighted because the services are needed when a number of different industries such as the Ministry of the Interior under the auspices of actors, including police, rescue, customs and border control authorities. The service provider must be familiar with the various actors needs to be able to meet the demand of the right way. Selecting a product for many different needs of operators should therefore be given special attention.

None of the authority is solely responsible for certain activities, because there is an exemplary cooperation between public authorities. For example, police, securing international meeting does not need to acquire tanks or airplanes. Police may ask for official assistance from Defence Forces when in need of special equipment or expertise. When something happens, it is decided the responsible party who is responsible for operations, but which receives support from other public authorities.

The government should plan to take into account the existing research dealing with UAS and if necessary initiating new research projects. The aim is that the requirements and opportunities to pursue UAS activity to improve a real-time picture and support the UAS-based activities will strengthen.

For example, the Ministry of Interior could set up a cross-administrative co-operation center that concentrates for maintaining the real-time picture. Center should be responsible for coordination and monitoring of progress and support for other authorities. Securing an adequate amount of resources, who have skills required for the task to manage UAS? Verification on Aviation Legislation and authorities' adequate and up-to-date means for the use of UAS in operations must ensure. Ministries will prepare the plan for implementation for their own responsibilities in respect. Ministry of Interior collects the plans, reconcile and coordinate the implementation-related issues. Plans will be updated at regular intervals.

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 is essential. Joint research, education and training activities related to authorities' communication, as well as the authorities' partnerships between the public authorities by ensuring management, situational picture and messaging systems for compatibility and possible integration contribute to the goal.

Developing a multi-authority security circumstances tactics and training by adding to the exploitation of common resources and expertise in the use of various authorities in identifying opportunities and means to support the goal should be taken in the account. 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.

By identifying various authorities' opportunities and means to support operations, the best results are achieved. When establishing a national strategy for UAS, this defines and clarifies the responsibilities of authorities and their roles of UAS operations. Developing and expanding operational cooperation aims practical co-operation and mutual interaction between the authorities, which will improve the situational picture. By exploring official actions and academic efforts factors that influence a real-time picture and current situation in Finland, government may organize authorities' training and a wide-ranging co-operation between authorities.

On this basis networking and common management is very important for the development of UAS to the use in a small country like Finland with limited resources. One player is unable to cope on their own for systems implementation and use of it. Funding for such a large system of the whole does not succeed in a one public organization measures. That is why it is vitally important to create network, and thereby obtain synergies from a wide-scale deployment of the UAS.

We believe that the development of UAS for operational activities and to maintain situational awareness constitutes strategic network management in many respects. The importance of networks and networking in the world today can not be overstated. A smooth and seamless cooperation between different spheres of government contributes UASs implementation for public needs for improving and speeding up situational awareness and creation of real-time picture. Our environment and the whole world are constantly changing and that's why there is a growing need for authorities common UAS-system and command center.

We believe that the UASs future implementation activities will benefit both the situational awareness and real-time picture improvement, not to mention the importance of appropriate expertise. We can wait promising results in the future in creation of strategic network between authorities.

We also believe that it has not been paid enough attention to common management between different authorities and experts concerning UASs use in public safety duties. We understand the importance and the meaning of strategic networking and cooperation between authorities. Challenge is to reconcile the needs of different authorities under common management. In the future, this topic is covered much more to explore, and it will be interesting to watch, will developing and the use of UASs raise or what will happen.

Balanced success strategy, a key value and goal, is the participation of different parts of the organization's various departments and personnel [30]. Critical success factors of strategy must be to communicate, to be discussed and

questioned. Participatory and inclusive strategy work is a challenge for the entire organization. Balanced success strategy is a journey - not a destination.

Future success is not based on the same kind of operation than today's success. In strategic knowledge and leadership must be able to combine the strategic success factors for each other. The future must be established – not expected.

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Developing a Service Innovation Utilizing Remotely Piloted Aircraft System (RPAS)

Ilkka Tikanmäki, Tuomo Tuohimaa and Harri Ruoslahti

Abstract—Co-operation between authorities is at the beginning of new challenges. When authorities co-operate successfully, this prevents duplication of efforts and increases efficiency. Many public authorities have at the moment and in the future same needs for equipment and systems. Operational and command centers of authorities (for example, police and rescue service), have potential needs to improve continually their situational awareness and a real time picture.

Related research and development (R&D) in public and private sector has an important role already today. Research and development is in a key position at first step. The importance of safety is the key element when operating on the air. A well planned system takes notice of the end user and is made in co-operation with the equipment manufacturers and end-users. One of the main challenges is to accompany manufacturers and end-users.

Public and private co-operation is needed and it must be increased. Legislation must be in line both with the international and national levels. Legislation does not sufficiently or even at all detect the UAS activity. Developing this kind of service innovation is in an important and challenging role for three reasons; 1) various actors need to be able to meet the demand of the right way, 2) it must give a special attention for many different needs, and 3) because of the inadequate aerial legislation as for unmanned aviation.

Keywords— Legislation, public, private, unmanned aircraft system, unmanned aerial vehicle, service provider, service innovation

I. Introduction

This paper converses on designing new applications and services in the field of Remotely Piloted Aircraft (RPA) and objectives to make a service innovation with RPA systems. Prior studies have revealed a need for networking between different authorities with regard to cooperation of implementation of Unmanned Aircraft System (UAS).

Utilizing UAS for routine missions has several obstacles; 1) the aviation laws do not recognize UAS, so there is not sufficient guidance for the use of UAS, 2) UAS is a relatively new "phenomenon", so the potential it generates is not yet been understood, 3) governmental cooperation environment is not sufficiently innovative and forward looking, cooperation should always and in all circumstances be possible and 4) the limited resources of public organizations restrict the introduction of new concepts [1].

Non-military UAS applications are divided into five categories: security (39 sub-categories), safety (35 sub-categories) and scientific & research related applications (31 sub-categories) and contractor supplied flight services (38 sub-categories) as well as civil/military cooperation (34 sub-categories). Civil/military cooperation is also known as 'mutualisation'.

Table 1 shows number of current applications which can be operated by UAS.

TABLE 1 CURRENT UAS APPLICATIONS AND QUANTITY IN EU [2]

	MTOM< 150 kg			MTOM > 150 kg		
	VLOS	BLOS	Total	VLOS	BLOS	Total
Security related	6	8	14	5	6	11
Safety related	6	1	7	1	1	2
Scientific & Research related	14	2	16	1	1	2
Contractor Supplied Flight Services	25	4	29	1	1	2
Civil/Military Cooperation	1	0	1	0	5	5

BLOS= Beyond Line-of-Sight, VLOS= Visual Line-of-Sight, MTOM= Maximum take-off mass

The European Commission allocates UAS into two categories according to their weight: maximum take-off mass (MTOM) below 150 kg and MTOM above 150 kg. UAS' usage is growing in Europe with regard to different security, safety and scientific & research related missions as well as contractor supplied flight services and civil/military cooperation.

With regard to UAS-systems utilization, Finnish aerospace and aviation technology professionals' visions and objectives are to create the ability to develop and maintain these systems. Also, a profitable international business potential is seen. Co-operating intensity is depending on an interaction between private sector strategies and public sector policies and

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institutions. The public and private sectors together promote a favourable environment for this matter [3].

Estimates of the forecasted market are done by comparing results and conclusions from several sources. Potential UAS applications are base on the assumption that the regulatory problems are solved.

Table 2 presents the summary of UAS related projected applications in EU.

TABLE 2 OVERVIEW OF PROJECTED UAS APPLICATIONS IN EU [2]

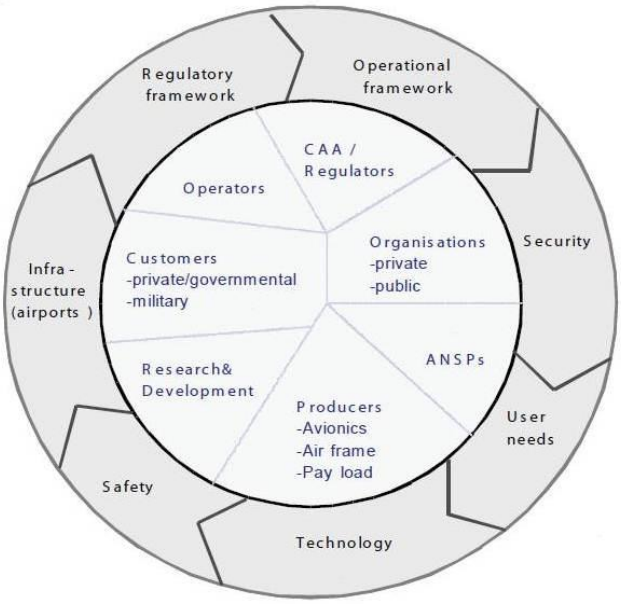
	MTOM< 150 kg			MTOM > 150 kg		
	VLOS	BLOS	Total	VLOS	BLOS	Total
Security related	23	26	49	5	27	33
Safety related	30	27	57	2	29	31
Scientific & Research related	20	20	40	0	21	21
Contractor Supplied Flight Services	35	15	45	0	13	13
Civil/Military Cooperation	1	24	25	0	33	33

European Commissions' (EC) Seventh Framework Program for Research and Technological Development (FP7) includes several UAS projects; Airborne Information for Emergency Situation Awareness and Monitoring (AIRBEAM) being one of them. AIRBEAM proposes a situational awareness toolbox for crisis management over a wide area applying UAVs, UAS and satellite systems. Many UAVs and space-based platforms are available.

These system-related sensors pose new challenges for end-users with an effective emergency management and law enforcement to maintain. AIRBEAM's aim is to provide all authority organisations in each EU Member State to define their own needs and evaluate technical solutions that should be offered by unmanned aerial platforms. AIRBEAM's ambitious goal is to establish close cooperation between industry partners, stakeholders and end users with a realistic workable concept [4].

As Fig. 1 shows, there are several considerations affecting the integration of UAS into a non-segregated airspace. However, main issue will be integration of UAS to Air Traffic Management (ATM) System. Non-adapted legal framework limits UAS potential [2].

FIGURE 1 THE UAS STAKEHOLDER FRAMEWORK [5]



The Innovative Operational UAS Integration (INOUI) project is a part of the European Commission Research Program FP6, Directorate-General for Energy and Transport (DG Tren). INOUI contributes the project results into the Single European Sky ATM Research (SESAR) Development Phase. The goal is to enable the earliest possible use of UAS applications in current and future ATM environment [5].

Deficiencies of the law and regulatory measures prevent the industry from building business plans and launching the developments required to answer civil customer needs. This has also a negative impact on the industry and, indirectly, on UAS manufacturers, end users, research institutions and R & D companies. The impact is particularly apparent in Small and Medium sized Enterprises (SME's) and Small and Medium Industries (SMI's) [6].

A. Structuring of the rest paper

This paper is structured as follows: Chapter II Problem Formulation discusses the theoretical background, and is divided to sub-sections theoretical framework, research method and process and empirical context and target. Chapter III presents developing service innovation with RPAS, and has sub-sections; strategy, scenario, vision, core competence, customers and network partners, and field of activity. Finally, Chapter IV sets out the discussions and conclusions of the study.

II. PROBLEM FORMULATION

A. Theoretical Framework

The importance of cooperation between authorities discovers an important subject to be developed. Finnish Government's Security and Defence Policy state that close cooperation between the authorities create cluster synergy effects by cutting overlapping functions and support functions,

thus enabling an efficient use of resources [7].

Prior studies reveal a need for networking between the authorities with regard to the cooperation of implementation of UAS [8]. Networking benefits of government activities are emphasized, because the authorities do not need a duplication of resources. None of the authority is solely responsible for certain activities, because there is an exemplary cooperation between public authorities. The authority who is responsible for operation receives support from other authorities.

The importance of cooperation in UAS usage is highlighted because a number of different actors, such as police, rescue service, customs and border control authorities need the same kind of services. The service provider must be familiar with the various actors' needs to be able to meet the demand in the right way. Selecting a product for many different needs of operators must therefore give special attention.

Interagency cooperation is essential that various actors have sufficient knowledge of other's concepts, measures, resources and plans. Interagency co-operation aims at cost savings to increase efficiency. Good collaborative practices are a prerequisite for proper functioning [8]. Networking is a process where the corporate knowledge, values and skills combine the added value of productive activity, aiming at the promotion of competitiveness in the longer term [9].

Different levels of networking means that cooperation between organizations is needed; performing a similar task teams to cooperate, or individual experts formed a collaborative network. UAS-cooperation with the authorities will act in all of the above mentioned areas.

For example, large public events have temporary command centers for general and field management, where liaison officers of different actors allow coordination of actions. Command centers usually have representatives from the police, the event organizer, rescue services, border guards, customs and military. Depending of the nature of the event design and operation there may also be other public authorities [8].

Basis of the above, for example, the police command centers' main tasks in Finland are to support police management functions, situational awareness and real time picture, maintaining the pre-trial measures, external and internal information, and support services. Tasks include also working in collaboration with emergency response centers and other authorities' command centers. Cooperating is challenging and leadership rises to the very important role when operating with different authorities' operations.

With regard to the development of UAS services, networking is very important, especially for a small country with limited resources. One player is unable to cope on its own for systems implementation and use of it. That is why network creation is vitally important and obtains synergies from a wide-scale deployment of the UAS.

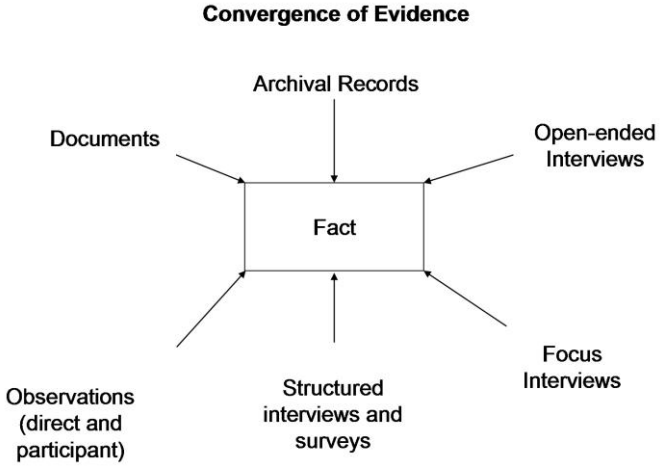
B. Research Method and process

This case study research finds out how services can be produced by applying Unmanned Aircraft Systems and what legal obstacles there are when using UAS in public organizations. The study has attempted to generate a new theory on the basis of existing theoretical constructs to meet organizational needs. As noted in the literature review, this study's specific research aim is a relatively new one.

Therefore, our research approach is a case study that is generally recommended for theory-building [10], [11]. The researchers should understand the implications of their research perspective, and act in ways that reflect that knowledge [12]. Authors of this paper have a long experience in different organizations, where the needs of UAS can be utilized.

In a case study, the usage of a variety of sources is recommended, including interviews and written materials [13], [14]. The evidence collection phase contains many different modes and methods. None of them is unique to a case study and techniques differ greatly [14]. According to [10], case study research may utilize a variety of data-collection methods, such as can be seen from Fig. 2.

FIGURE 2 CONVERGENCE OF MULTIPLE SOURCES OF EVIDENCE [10]



The material collected for this study is based on interviews, international and national aviation regulations, scientific publications, collected articles and literary material. One prominent data collecting method used was focus interviews. The focus interviewees were designated based on their expertise on aviation laws and aviation industry. The interviewees operate in the preparation of aerial legislation as training providers or service providers. This case study uses triangulation of data sources to ensure the credibility and validity of the results

Analysing case study data is the heart of theory building. At the same time, it is the most difficult and the least codified part of the process [11]. The focus of the analysis is the obstacles in the current legislation with regard to UAS. National Aviation Acts differ widely from each other; hence we focus on preparation of international aviation laws. Case study researchers should pay attention to three areas; design issues, data collection and data analysis [15], [16]. During the research process, we paid special attention to above-mentioned

points.

C. Empirical context and target

The biggest challenge for operational use of UAVs is that legislation does not recognise well enough UAV as an aircraft. Training and other requirements are not specified for UAS-operations. Especially, the development of large UAVs is waiting for standardization.

Main obstacles for Light (small) UAS (25 - 150 kg) are varying national certification standards and rules. Norway and UK have basic standards and rules, Czech Republic, the Netherlands and France have nearly ready rules which, however, are not harmonized in European level. 'Sense and avoid' binding funded research is not ongoing or upcoming at the moment [2].

International Civil Aviation Organization (ICAO) has defined 'a pilotless aircraft flight at airspace' as follows [17]: "No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft".

ICAO has also defined 'non-segregated' and 'segregated' airspaces. Non-segregated airspace means "airspace where all traffic, including civil traffic is authorised to fly and where both manned and unmanned traffic will be integrated according to established procedures". Segregated airspace means "airspace that is segregated for exclusive use and into which other traffic is not permitted." [17]

An Unmanned Aircraft Systems Study Group (UASSG) state in their Training Course of Regional Officers on November 2009 that UASSG is the focal point to all issues concerning UAS's within ICAO. In order to prevent UAS issues they should assist the Secretariat in coordinating the development of ICAO Standards and Recommended Practices (SARPS), procedures and guidance material for civil unmanned aircraft systems (UAS), to support a safe, secure and efficient integration of UAS into non-segregated airspace and aerodromes [18].

Currently, most military UAV operations in Europe are restricted to run only in the reserved airspace, where UAVs' flying area is separate from other air traffic, or UAVs are flying above the sea, applying special arrangements. If action takes place outside the segregated airspace, there will be various constraints in order to protect other aircrafts using the same airspace [17].

To take full advantage of current and future UAV platforms' capabilities, a training program has to accomplish the safe UAV operations. Military authorities in Europe insist that UAVs can be used in all classes of airspace. Also, they should operate across national borders. This means that UAVs should be used outside of segregated airspace. Furthermore, national level regulations are not conducive to routine operations.

In addition, taking into account the obvious interest, and a lack of similar in the rest of the world, non-European countries could decide to accept the specifications. Specifications may provide a basis for future Air Traffic Management (ATM) for civil UAVs. Aspects outside the jurisdiction of Eurocontrol must be dealt with appropriate bodies. These aspects are e.g. airworthiness, certification, system safety, training and licensing of personnel.

If we look at training from economical point of view, even though UAV is flying in non-segregated airspace, the pilot-in-command does not need to be a classified crew member. The pilot-in-command is required adequate training so that he/she can interact with Air Traffic Control (ATC) and other airspace users. For example, IFR flight requires an instrument flight rating.

Training costs are less expensive than manned aircraft's pilots, but more than the basic requirements for UAV operators. As the specifications require, the air traffic services provided to UAVs should be equal to manned aircraft. Hence, only the controllers would need additional training, primarily in emergency situations, which are unique to UAVs. Air traffic controllers need to familiarize with UAV performance insofar as it relates to control in the rest of the traffic integration. The cost of controller training would be relatively insignificant.

To implement ATM integration of UAS operations, UAS needs: 1) to respond to and communicate with ATC, 2) to navigate, and to monitor air space and air to operate, 3) to sense and avoid collisions, and 4) predict the actions for ATC and pilots. Integration of airworthiness certification requires certification for unmanned aircraft, control station and the command and control links. Operator's certification has to be same as for manned aircraft and operator's documentation has to include manuals and charts. The pilot in charge has to be a licensed pilot [18].

ICAO's ongoing UAS-related tasks are

- to analyze the issues of existing Standard and Recommended Practice (SARPs),
- determine the gaps of unmanned aviation and to explore solutions developed by the individual countries/regions,
- participation to essential panels, workgroups/study groups and Secretariat to modify an existing SARPS which have unique features to UAS.

Conclusions from the Study Group were the basis for the development of SARPS, Procedures for Air Navigation Services (PANS) and development of guidance material. The working group decisions are also a holistic approach to UAS relevant, the partner countries and industry associations and technical specifications performing bodies and multi-year commitment to UAS-tested social matters [18].

The Study Group's development concepts in terminology are; RPA + Remote-controlled Pilot Station + Command and Control links (C2) form the RPAS. According to [19x], RPAS evolved concepts are; a) RPAS is a part UAS, b) RPA requires a registration and Certification of Airworthless (CofA), c) CofA considers the whole system, d) State of RPA design includes a remote pilot station type certificate data sheets, e)

Remote pilot station's state monitoring is essential, f) Defining Quality of Service (QoS) and Required Communications Performance (RPC) for Command and Control links, and g) UAS operator's certificate details must be accurate.

Licensing of the remote pilot is one of the pending issues according to [19]. Should remote pilot licensing qualify by type of the RPA or by remote pilot station? License should anyhow specify both the type of RPA and the remotely piloted station. Remote piloting, in any case, requires new arrangements [19].

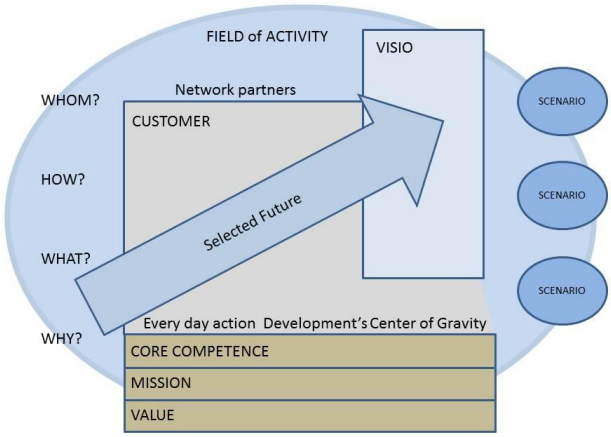
Chicago Convention Article 32 determines Licenses of personnel; Convention incorporates 'pilot' and 'other members of the operating crew' but not the remote pilot [20]. CAP 722 guidance gives criteria as airworthiness, determinations to flying devices, for risk assessment during the flight as well as the flight safety determinations. Instructions can be used to control the UAS systems safety use comprehensive [21].

In the point of view of technology's economic estimate, the economic challenges are the development and dissemination costs. Even if there is some R & D funding, most of the industrial R & D expenses will be directed to UAS operators. Sense and avoid is likely to be highly significant cost factor. Progressing technology extends to all the parts of the UA system, both in the air and on the ground. Data-linking and related needs for the spectrum are other aspects that pose a significant cost, even though it is impossible to estimate how much [17].

III. DEVELOPING A SERVICE INNOVATION WITH RPAS

The strategy is a living, dynamic, comprehensive and progressive tool of the future for the management, managers, and for the entire organization to ensure realization of the vision [22]. As we can see from Fig. 3 below, strategic basis consists of values, mission and core competences.

FIGURE 3 EVERY DAY STRATEGY [22]



The following sub-chapters explain the developing process in service innovation.

A. Strategy

Conceptualization of the future begins by working through the scenario, which outlines the probable, imminent, and a desirable future for five or ten years from now. Vision shall be drawn up by using the scenarios, and it is an image or story of the desired future [22].

Activities in the field response to the question: in what activities we are involved with? Customers can be defined by answering the question: For whom we are here now and in the future? The network partners can be defined by answering the question: For whom the vision is a reality and will it come true? [22].

Future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach [23.

Public organizations have traditionally alienated this approach, especially independent strategic flexibility and individual responsibility for its creation and exploitation. Strategy is an essential part of the future. Public organizations should continuously evaluate their strategic position and it should be a natural part of normal activity [23].

B. Scenario

The future is not ready, but it will arise through today's decisions and activities. Scenario work is already part of creating strategy. When reforming the company's strategy you must look at the top and gaze to the forward. Examination of the future is based on alternative futures, scenarios, and conceptualization [22].

Conceptualization of scenarios provides the basis for the defining for selected future, a vision. At the same time you will also think matters you have not reflected for the future – also unwanted future [22].

Many different authorities are at the present and especially in the future in a common need of equipment and different systems. Operational and command centers of different authorities (for example, police and rescue services), have potential needs to improve their situational awareness and real time picture.

C. Vision

The driving force of strategy is the vision, because it shows the desired state of affairs in the future. Vision must describe what the organization wants to be in a certain moment in the future. Vision answers the question: "Where do we head?" Vision formulation is based on the scenarios, on the basis you select a future, in which you want to go. A good vision is also in-depth for a network partner in a partnership [22].

It should be remembered that UA systems are originally developed for military forces' needs. Now the time has come to use these systems for various civil applications. Related research and development (R&D) is in a very important role in the future and already today. ICAO's role has been very successful in air traffic legislation. The importance of safety is

the key element of operating, which in practice means a license scheme for the systems.

Sharing of the situational picture has challenges. These challenges include the variation of allocation tools, concepts and interfaces in different organizations. Common terminology and concepts are missing, both nationally and internationally, as well as practices that co-operation methods vary greatly between countries. Information produced by various sensors for combination treatment and follow-up measures, and decision support is missing. Communication interfaces must be standardized such a way that a situational picture can be transmitted to the various organizations [24].

The challenges for the situational picture are; identification of action and needs, different users, machine and human interaction, distribution of information, safety requirements, reliability requirements, complex systems, lots of information, support for decision making and integration requirements. Research is only a part of the answer to the challenges outlined above [24].

Development requires international cooperation (EU, UN, NATO, the Nordic countries, Baltic countries). Real-time requirements are growing, development will require international cooperation, and situational awareness is a wide-ranging. Situational picture is formed by the sensor data through data fusion. However, this specific research area is fragmented [24].

D. Core competence

When you are creating a strategy, it is essential to consider with what kind of expertise we can implement realizing our vision. To identify the core competence you must answer to the following question:

What can we do, which:

1. is unique
2. adds more value to our customers
3. creates new possibilities in the future [22].

The identification of the core competence has proven to be one of the most challenging tasks in reforming strategies. Frequently, the core competencies reflection is limited only with a knowledge in which a company or organization has been established. Core expertise consists only through the knowledge of individuals [22].

Legislation does not sufficiently, or even at all, detect RPAS activity. The whole operation and the meaning of commercialization are not understood, and it seems to be blurred. Co-operation between different authorities is just in the beginning. In addition, only a limited number of civil organizations prevent the development of new RPAS services and the EU legislation differs from national legislation. The purpose and challenge of the AIRBEAM project is to bring together manufacturers and end users. Co-operation and working together prevents duplication of efforts and increases efficiency. However, some kind of co-operation already exists and is under development.

E. Customers and network partners

Central part of strategy is to find the answer to the question: "Who do we exist for?" The goal is to understand our customers' current and future needs and to seek continuous improvement. A customer's role in the development of new products and service development is emerging more and more important part. Customer may also be a partner in the creation and operation of the development. The boundary between the network partners is interlaced [22].

The network partners are the key organizations, which we need to implement the strategy, in which are not listed all stakeholders and partners, but to identify the critical partnerships. At its best, the partnership takes place when both parties are feeling that they are getting benefits of the cooperation. It is good to view the network partners from the core competence perspective: whether these partners have such know-how that supports the strengthening of core competencies [22].

The rapid development and continuous renewal of organizations require new skills; organizations must be learning ones. In the private sector, the learning organization ideology-related changes have occurred quickly. On the other hand; the public sector changes will require time. Public organizations have been accused inconvenient, bureaucratic and inflexible to be ineffective, costly and fragile for providing services [25]. The reason for this is the administrative machinery and rigid practices.

Public services have been carried out by highlighting the effectiveness, economic thinking and the customer's responsibility. Public organizations need an entirely new approach and working culture. Skills are increasingly complex and require continuous learning, skills and qualifications of maintenance and development [25]. End users, developers, and potential entrepreneurs who develop business plans for UAS services must work together to attract investors and customers [26].

Cooperation between the public and the private sector for using RPAS need strengthening since services are needed widely. Common service providers in the use of RPAS to the needs of public administration should seriously consider because of the economic and practical reasons. Challenge for cooperation in this particular case is to reconcile the needs of different actors - both in public and private - under common interests.

F. Field of activity

The field of activity constitutes the theoretical framework for the strategy and it impacts on all other strategic choices. The main question regarding the definition in the field of activity is, "In what activities are we involved with and who are our competitors?" A part from the knowledge of the operating environment is the current and future competitive environment analysis. However, a unique competitive advantage can be achieved only through our own action [22].

The operational definition of the field also projects, with who we must work together. Our selection shows, what skills

we need to strengthen. Determining the field of action is a strategic choice, which will strengthen the vision. The field of activity is appropriate to consider through the operating environment and the future. The field of activity is chosen as a part of the wider operating environment, and it should also be viewed from three perspectives:

- the individual
- the organization
- society [22].

From the point of view of the customer, the field of activity is monitored through customers' and end-users' eyes. The key questions are; how does the known future (such as technological evolution) change, and still uncertain details of the future changes affect to our customers / end-user behavior and how this is reflected in the chosen field of activity [22x].

When assessing the activity levels of the organization, it is estimated what kind of changes are expected in the activities of our organization. The main question is: what kind of organization is the most successful in the field of activity? [22].

The third aspect is the level of society. How will these possible factors mentioned above, and the chosen future, affect to actors of society and with whom should we collaborate? [22].

Definition of the field of action is an important part of the organization's renewal. It involves a change of resistance, fear and uncertainty about the future. Definition of the field of activity always includes a risk that you adhere in the old mode of operation. Another risk is that the field of activity will be skipped too quickly without considering more details. For example; how the definition affects other parts of strategy and the same time the entire operation? [22].

RPAS can be used in the Public Sector for different kinds of purposes. Security in mass events like football games and demonstrations could be improved by using RPA. Operational management, situational awareness and security in public events are enhanced by using RPA [23].

Developing Remotely Piloted Aircraft Systems presents big challenges both to the designer and for the end user. New and novel technologies must be developed, tested and implemented for actual missions. Research and development activities must be improved especially between designer and end user [27]. Scientific and technological development in wireless communications, sensor technology, sensors, and in other regions has quickly made it possible to research and develop unmanned aerial systems for different applications [28].

IV. DISCUSSION AND CONCLUSIONS

The starting point of this study was to find out how services can be produced by using Unmanned Aircraft Systems and what obstacles are there in the operational point of view. The research was started by a desire to explore is it possible and how it can be done by using RPAS. The theoretical part focused on theory building of case study research and how it can exploit in this study.

The scientific publications concentrate on the building, planning and on the technical properties of RPAS. Remotely piloted aircrafts are currently used mainly for various military purposes. This study is limited to civilian use of RPAS, which is restricted by the various lacks in legislation. RPAS could be used for many different purposes in both government and civilian activities.

The aim of this research was to analyze and assemble a clear summary about developing a service innovation utilizing RPAS by using different kind of data. The study also succeeded to clarify the implications for different organisations when RPAS is used in the future. Research objectives were successfully reached and the research questions were answered. This study shows the needs for RPAS but also a social general ignorance on how RPAS can exploited in civilian use.

Recent advances have allowed future RPAS users to scale down sizes of uninhabited aerial platforms, and to perform mission profiles which are not possible for conventional aircraft. One advantage of UAV is the possibility to reach hostile and inaccessible areas without exposing humans to hazards and dangerous situations [29].

The best results may be achieved by identifying the various authorities' possibilities and methods. When drawing up a strategy to RPA, identification and clarification of roles of the public authorities in RPA operations must be defined [30]. The situation picture can be improved by developing and expanding operational cooperation and mutual interaction between the authorities. Extensive cooperation between the authorities allows the development of real-time picture and situational awareness [31].

The research reported here attempted to generate new theory on the basis of existing theoretical constructs to meet organizational needs. As noted in the literature review, specific research aim is a relatively new one. Therefore, this study used a case study approach, which is generally recommended as a suitable research design for theory-building [12]. Design knowledge applies to people who have received formal education in that field [32]. It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge [12].

It should be noted that the development of a multi-government tactics and sharing of expertise in matters of safety and training increases the efficient use of joint resources. For complex tasks of planning, designing and coordination, based on multi-government functions, a real-time picture is essential [33].

We believe that not enough attention has been paid to cooperation and networking between different authorities and experts concerning RPA Systems' use in public safety duties. The importance of networks and networking in today's world cannot be overstated. A smooth and seamless cooperation between different spheres of actors contributes to RPAS's implementation for public and private needs and for improving and speeding up the preparation and inception of legislation of RPAS.

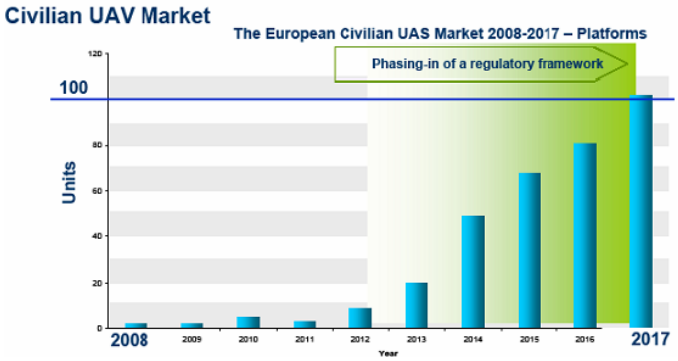
It is important to create a situational picture for managing

and monitoring major disasters and thus build an overview of activities in the field. The use of RPA in accident situations may guide rescue management to prevent additional damages to humans and property by observing the area of interest. RPA may observe large areas at a time and thus allow Law and Emergency Authorities (LEA) to concentrate their efforts on the most important functions [23].

Based on the results of this study, the market clearly has a huge economic promise for all RPAS MTOM classes and services utilizing them. When using RPAS such benefits may be achieved that cannot be achieved by other means. As a result, the social benefits are significant when using RPAS-enabled services. RPAS would significantly increase the number of the biggest priorities of safety, security and environmental issues.

The significant increase in the use of new air services is expected to be occurring in the near future as Fig. 4 shows.

FIGURE 4 CIVILIAN UAV MARKET, NEXT FIVE YEARS? [34]



These markets are a catalyst for the development of technology in many areas, which will have significant spin-off potential. RPAS joint use, both civilian and military, is a key condition for non-military government applications. RPAS may be applied by applications where the airplane's or helicopter's use is too expensive to perform a task or there is a risk for human life.

The European Commission's AIRBEAM project is one possibility to the EU level co-operation aimed at improving situational awareness by using opportunities of Remotely Piloted Aircraft Systems. In April 2011 was held the first official Finnish UAS -course. In that course, UAS related activities were generally divided into three sections; business, training and end users. This kind of course might be seen as the beginning for networking and collaboration of the above-mentioned parties.

UAS systems are a fast-growing form of aviation. Operations have started by the Military Forces and civilian markets are now waking up to the operation.

As pointed earlier; a good system regards the end user, and it is made in co-operation with the manufacturers and end-users. Increased public and private co-operation is needed. Legislation must be in line both with the international and national levels. RPA systems will be the business of future, and it has been said that the RPA systems can be equated with the early days of aviation. Research and development is in a key position at first step.

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