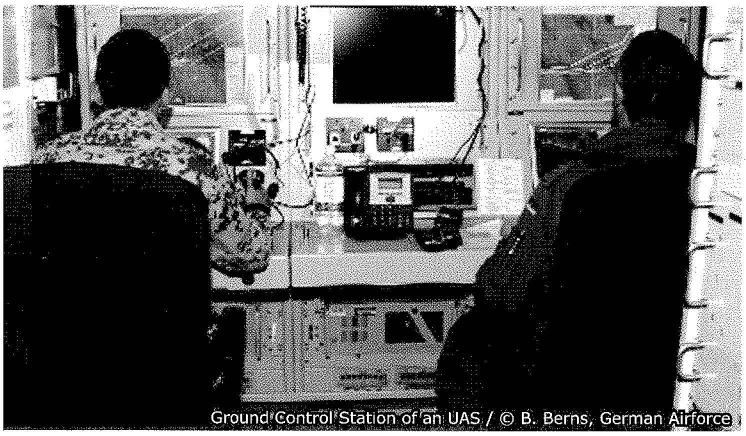
The possibility of undertaking risky missions, such as volcano and hurricane observations, without endangering the lives of aircraft crews underlines the safety advantages of UAVs compared to manned aircraft. Thus, MUAVs can be used in regions, such as volcano craters, which are not reachable by manned aircraft. Research missions over the poles or across the open ocean, where an emergency landing would entail considerable risk for a pilot, are especially well-suited for a UAS.[35] Additionally, the additional flexibility offered by UAS is very important, as unmanned vehicles can be employed relatively independent of weather conditions. Furthermore, the examples cited above illustrate that, in the scientific area, it is necessary to collect data over a long, continuous period of time. Here, MALE and HALE systems represent an important option, due to their better endurance compared to manned vehicles.



Ground Control Station of an UAS / © B. Berns, German Airforce

In regard to their sensor capabilities, modular, unmanned reconnaissance systems also represent a more advanced option for collecting data when compared to satellites, which can make important contributions to research. The collection of atmospheric data in the air column itself using instruments installed in UAVs also offers a broader basis of data than collecting the information from above, via satellites. The automated processing of imagery also facilitates the analysis of the results.

All in all, UAS represents a very promising tool, especially for researchers in the earth and atmospheric sciences. Regardless of the size of the platform, its endurance, or its specific capabilities, there will always be scientists who will use UAS and who will demand new developments in this field.[36] Smaller systems are also well suited for temporary use in research in small, predefined, spatially-limited areas.

Because of their high endurance, MALE and HALE UAS are of great interest to researchers in situations in which these systems can offer a view into largely unresearched areas, enabling us to gain new insights in atmospheric science.

4.2 Disaster Prevention and Management

The use of UAS to prevent disasters and help address them once they have occurred is of particular value. For example, UAS can be used in natural disasters such as forest fires, floods, earthquakes and dangerous storms to observe and analyze the situation. At the same time, they support specific search and rescue operations, for example searching for survivors of shipwrecks or airplane crashes or for victims buried in avalanches or other disasters. UAS can also be used to gather information in other types of disasters, for example ABC accidents or oil spills. In the past, the use of UAS in disaster situations has proven to be very helpful. As in the previous chapter, a number of practical examples will be cited which will then be evaluated against existing alternatives.

In October 2007, the UAS *Ikhana*, mentioned previously, was used for reconnaissance operations during the disastrous forest fires in California.[37] Using specially installed thermal imaging sensors, it was possible to pass the exact coordinates of the flames on to the fire-fighting aircraft, making it possible to better fight the fires. When compared to satellites, the UAS' capability to capture dynamic images at a higher resolution proved to be very beneficial for the firefighters. Their high endurance and the minimal risk to pilots are two leading criteria which support the use of UAS in forest fires. While the *Ikhana* was carrying out its successful mission in support of the firefighters, sensors it was carrying were also collecting a very large amount of data about the fire itself. Later, it was possible to use these data sets in research, an example of two different fields benefiting from a single UAS mission.

UAS can not only be helpful during large forest fires, but can also support smaller, more limited firefighting missions. For example, since 2007 Britain's *West Midlands Fire Service (WMFS)* has employed the *Incident Support Imaging System (ISiS)*, which uses a German md4-200 MUAV, to observe the development of fires from the air. For example, during a fire event at a university in October 2008, ISiS was used by the WMFS to provide the firefighters at the fire with thermal imagery of the development of the fire on the roof of the building. With the help of these live images, it was immediately determined that the roof was in a much weaker condition than expected and required special attention from the fire service.[38] This made it possible to direct the action against the fire in a way that the risk to the firefighting personnel was minimized.

UAS can also support observations of flooding. Because of their high endurance, they make it possible to continuously collect information about the situation as it evolves, both during the day and at night. Flyover inspections of dikes can be conducted at regular intervals and critical points can be immediately identified. The ability to quickly provide information about the scene and to observe the development of the flood is essential in catastrophe management, so that the population can be warned early enough to escape to safety.

Above all, it is UAS' abilities to quickly produce aerial imagery of a disaster area and to measure the levels of contaminants in the area which make it so well-suited to disaster management. Two days after the strong earthquake in Haiti in January 2010, the *Global Hawk* was utilized for fourteen straight hours to collect data on the extent of the catastrophe. Using the high-resolution photographs obtained during the mission, it was possible to locate usable takeoff and landing areas of helicopters and relief aircraft. This was one of the *Global Hawk's* first disaster relief missions in the Caribbean.[39] After the earthquake and subsequent tsunami in Japan in March 2011, the Fukushima Daiichi nuclear power plant suffered heavy damage. Here too, a HALE-UAS was flown over the disaster area and the power plant to take pictures of the building and the flooded coastline. Using high-resolution infrared sensors, it was possible to determine that overheating was occurring within the power plant buildings and to transmit these to the disaster response teams in real time. Through repeated flights by the unmanned system, the changes in the heat source could be observed and the success of the attempts to cool the reactor measured.[40] Similarly, in April 2011, the VTOL-UAV RQ-16 *T-Hawk*, mentioned above, was deployed directly at the reactor site to take pictures of the damaged facility and measure radiation levels. Thus, through the use of large and small unmanned reconnaissance systems, it was possible to observe and better understand the dangers posed by the reactor, without endangering the lives of the response crews by subjecting them to radiation.


EuroHawk landing in Manching / © EADS

After the Indian Ocean Tsunami of 2004, the *Heron* MALE-UAS was used to locate missing persons and victims buried in rubble. A Swedish study has also shown that smaller UAS systems can be used to effectively find people in a simulated disaster.[41] In this instance it is important to distinguish between the search for missing or buried people in a disaster area and the specific search for a single missing person. Because a disaster usually extends over a well-defined area which must be covered in any search, UAS can be helpful in such instances. The value of UAS in the search for a single missing person in a large area which cannot be well-defined is viewed more critically. While smaller unmanned systems with thermal imaging cameras can be used to support such operations from the air, teams on the ground with search dogs are more effective and thorough in such cases.[42]

For search and rescue missions in crisis zones, aerial vehicles' high endurance and ability to flexibly observe a large area are decisive, especially for maritime accidents on the open ocean. Thermal cameras make deployment possible at any time of day or night and can especially helpful for alpine avalanches. However, to actually get aid to the person in danger, a combination of UAS and rescue personnel in helicopters or other vehicles is necessary.

The use of UAS in disaster management and relief is a very current topic which is currently being investigated and discussed in various research projects. Since July 2008, the *German Federal Ministry of Education and Research (BMBF)* has been funding the AirShield (*Airborne Remote Sensing for Hazard Inspection by Network-Enabled Lightweight Drones*) project, which intends to develop a system which can collect data about a hazardous situation from the air. In this project, smaller, autonomous mobile aerial robots with lightweight sensors are used that, for example, can be used in an urban fire to determine and predict the threat posed by the fire. The intent is to use these unmanned systems to provide public authorities and other organizations with information collected from the air to support them in their decision-making, so that they can better enable fulfill their security responsibilities.[43] In addition to Germany, the United States and the United Kingdom, many other countries, such as South Korea and France, are also interested in the development of unmanned reconnaissance systems for disaster management.

UAVs can also be a useful technical tool for relief organizations. For the *Technische Hilfswerk (THW)*, for example, smaller systems are of particular interest, as they can use thermal imaging to locate buried victims and provide an overall picture of the situation in a disaster. Especially following a severe earthquake, UAS would be more effective than manned helicopters, because helicopters' strong downdraft can lead to the collapse of buildings which have been heavily damaged by the quake.[44] Therefore, MUAVs can essentially be flown in very close to an operations site and to damaged buildings in the disaster zone, without endangering rescue personnel. But it is not just smaller UAVs which are of interest for aid organizations. MALE systems would also be useful in principle, as they could be used as communications platforms in disaster zones, representing a more economical alternative to satellites and therefore reducing communications costs.

All-in-all, UAS represent an important additional tool for disaster prevention and management. Even today, these examples make it clear that unmanned systems hold great potential for use in civilian disaster management and to reduce the information gap in civil defense. UAS' advantages in security, flexibility, instant availability and endurance support their use in disaster and crisis situations.

4.3 Protection of Critical Infrastructure

An additional field of application for UAS is their use in protecting critical infrastructure. This includes the protection of oil and gas pipelines, electrical grid, the observation of rail and highway transportation, and of maritime routes, e.g. against piracy.


Camcopter S-100 / © Schiebel Corporation

Europe's natural gas pipeline system extends over 300,000 km (186,400 miles). It is essential that this large network, with its many branch lines, be constantly monitored to prevent accidents and uncontrolled gas leaks, so that the energy supply can be secured and the safe operation of facilities can be guaranteed. Oil and gas pipelines in regions with extreme weather conditions, such as Russia, Alaska and Africa, must also be monitored and inspected regularly to minimize supply risks. Pipeline systems are threatened by two different factors: natural hazards on the one hand, and man-made threats on the other. To minimize these risks, it is necessary to get an understanding of the natural and man-made hazards which exist along the entire length of the pipeline and with 20 meters (66 feet) of it. Furthermore, all transportation activities and other work undertaken with 200 meters (660 feet) of the pipeline must be registered if these may affect or endanger the pipeline.[45] The natural hazards include uncontrollable ground movements as well as flooding. Man-made dangers may arise through cable- or pipe-laying activities, drilling, and many other activities. Furthermore, international oil and gas pipelines are increasingly threatened by war or terrorist attacks.[46] Theft by the diversion of gas or oil from the pipeline also endangers the security and functionality of pipelines. All of these dangers may lead to explosions which can result in considerable property damage or loss of life in densely populated areas.

The monitoring and inspection of energy infrastructure currently takes place primarily with helicopters, smaller manned aircraft and foot patrols and is very expensive in certain regions. The aforementioned threats have led to a sharp increase in the amount spent by governments and private companies to secure oil and gas networks in recent years. For pipeline operators, a reliable and cost effective method of observing gas and oil lines would be extremely important. Smaller, unmanned systems, as well as MALE-UAS, offer an appropriate platform for such a continuous observation system.[47] Once again, UAS' high endurance is the critical argument supporting the use of UAS for monitoring pipelines.

The use of satellites as an alternative is problematic, as their availability to observe the territory needed is currently very limited and very expensive. Furthermore, their ability to collect data may be limited by clouds.[48] In this respect, UAS offers the advantage of flexibility, because it can operate at different altitudes and is always available to observe the territory in question. For the protection of critical infrastructure, then, the advantages of high endurance and flexibility are decisive, because the monitoring of gas and oil pipelines can thus be carried out continuously and at any time necessary. Despite these advantages, unmanned systems are currently rarely used for monitoring pipelines owing to their lack of permission to operate in civilian airspace. Israel's *Aeronautics Defense Systems* had demonstrated that this application is possible and can be put into practice. The company uses the UAS *Aerostar* to protect and monitor *Chevron Texaco's* pipelines in Angola.[49]

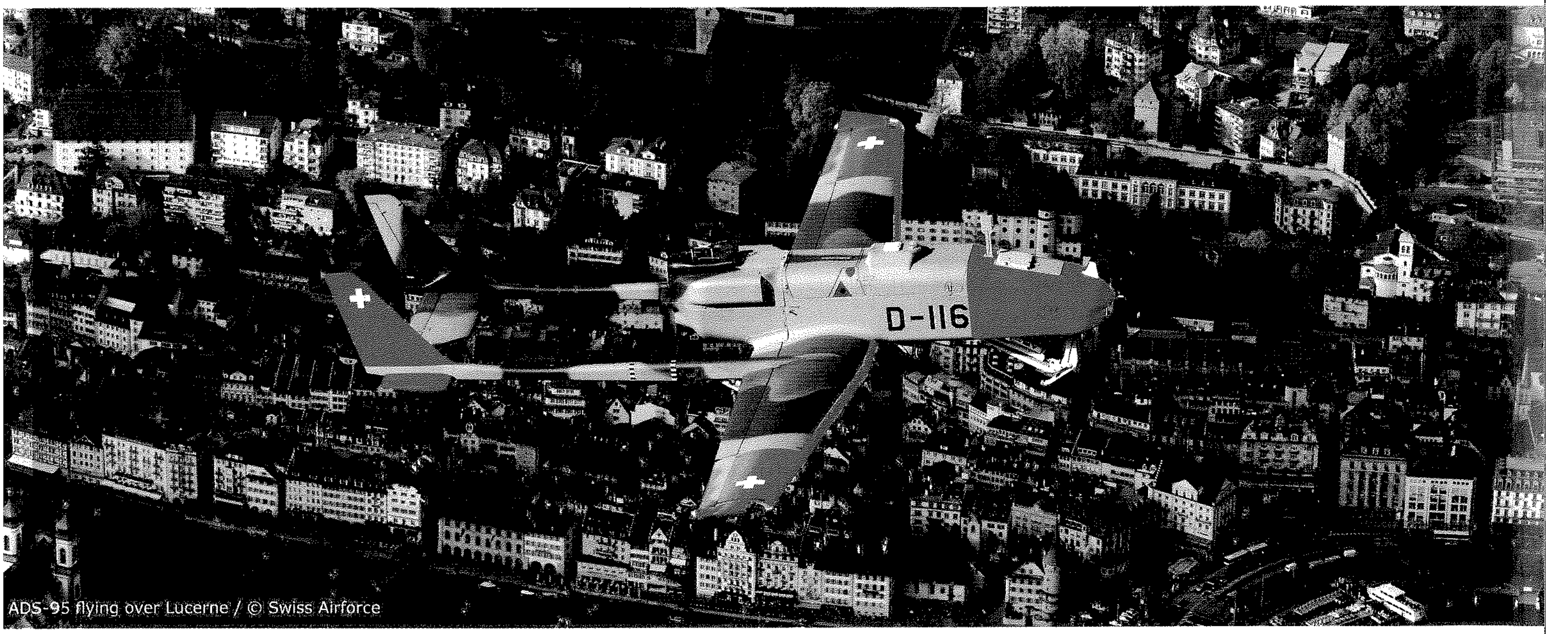
In all, fewer UAS systems than manned systems are required to provide the necessary coverage of oil and gas pipelines, meaning that, in principle, cost savings could be achieved through the use of such systems. The costs of a UAS mission would have to be under $15 (US) per kilometer of pipeline for them to be interesting for energy infrastructure providers.[50] So far, it has not been possible to calculate UAS' actual costs per kilometer, because of a lack of legal frameworks. To the extent that cost advantages over manned systems can be realized, UAS has great potential to support pipeline monitoring.

The use of UAS for the observation and protection of the highway transportation system is an additional field of application which has been studied in different research projects, and which is still undergoing study. Test flights in these studies are usually conducted with a MUAV. The spectrum of applications for unmanned aerial systems in the transportation sector is very diverse. UAS can be used to observe the general situation and road conditions in normal road traffic, can offer support during accidents, or can be used for scientific research on transportation. By continuously observing traffic flows, UAS can collect data about the volume of road traffic and road congestion.[51] This especially during peak times, such as for heavily-used highways during rush hour. The information collected about traffic volumes can also be provided to drivers themselves, who can use them to avoid heavily-travelled routes, relieving congestion. Such a pool of information could not only be used for transportation management, but would also be very useful for transportation research, reflecting the economies of scale of UAS.

To date, video cameras and induction loops have primarily been used to monitor and collect information about traffic flows. However, helicopters are also used by the police and other institutions to monitor traffic. Compared to fixed instrumentation, unmanned systems have the advantage of flexibility, because they can be flow into out of the way locations, where they can monitor traffic which results from drivers' attempts to avoid congestion. Compared to helicopters, UAS missions can be conducted without additional personnel expense and can be conducted almost independently of duration limits, allowing them to be flexibly deployed to monitor roadways. It is also conceivable that a UAS could be used to overfly a region in advance of a road construction project, to conduct information for land-use and cost benefit analysis purposes. The use of a helicopter for such specialized purposes would not be cost effective. However, the use of smaller, unmanned systems is sometimes dependent on weather conditions. Thus, for example, a UAS test for the *Washington State Department of Transportation*, carried out for traffic observation purposes, had to be aborted due to high turbulence which affected the mini-UAV.[52] If the platform is large enough, and therefore more weather resistant, UAS can provide information about current traffic situations without significant time delay.

Unmanned aircraft are also well-suited to monitoring roadways which are subject to avalanches or landslides. Because of the many positive results of experiments using unmanned systems, and their overall advantages, it is generally broadly recognized that UAS can be very helpful and successful in monitoring transportation.[53] However, the integration of such platforms in the road transportation sector is only possible if the legal basis for this is established.

The protection of critical infrastructure also includes the protection of maritime traffic against piracy. In the last four years, the number of pirate attacks on shipping has increased significantly.[54] The waters off the coast of Somalia have been especially affected. Here too, UAS can be applied in the civilian sphere and are already being used for reconnaissance purposes after pirate attacks. Because of their high endurance, MALE and HALE systems make it possible to observe a very large area of the affected region for a continuous period, so that quickly-approaching pirate vessels can be seen as early as possible.



ADS-95 flying over Lucerne / © Swiss Airforce

In closing, it can be said that the protection of critical infrastructure is an important civilian task which can be accomplished with the help of UAS. Depending on the type of mission in question, different platform categories can be used as reconnaissance tools. Smaller systems with low payloads and relative low operating altitudes are best suited for observing road traffic. Both larger and smaller unmanned vehicles can be used to monitor pipelines. For monitoring maritime transportation, on the other hand, larger MALE and HALE systems are likely to see the most use.

4.4 Use in Homeland Security

UAS can also be used in homeland security. This civilian field of application overlaps somewhat with the protection of critical infrastructure and is the one which is most heatedly debated in society and political circles. Civilian tasks related to homeland security include, in this case, border protection and control, monitoring the coastline and providing security for large public events. The use of unmanned observation systems in homeland protection is especially relevant for state institutions and is already in heavy use in some countries. Using a number of practical examples, the use of UAS in homeland security will be illustrated and critically evaluated in the following section.

For several years, the *US Department of Homeland Security* has been investing considerable sums in the acquisition of UAS for border protection. In fiscal year 2010 alone, $32 million were used to purchase two additional unmanned aerial vehicles for *US Customs and Border Protection (CBP).*[55] Currently, the CPB has six *Predator* UAS that are used in support of border operations on the southwestern and northern borders of the US. An unmanned reconnaissance vehicle is used in Europe as well. Since 2006, the Swiss company *RUAG* has used a *Ranger* UAV to monitor the Swiss border. The German federal police have been considering the subject of using unmanned aircraft for border protection and other uses since about 2005. Research projects and test flights being used to investigate UAS' potential as a tactical tool which can be used to support of existing resources.[56]

In border protection, it is essential that a very large area is covered over an extended period of time. Because a MALE-UAS can operate in the air as much as ten times longer than a manned helicopter, for example, the advantage of endurance is again the crucial argument in support of unmanned vehicles in border protection. Although the operational costs of UAS are currently higher than those of manned vehicles, the capabilities of UAS in respect to its long in-air flight time must be taken into consideration in cost comparison.[57] Especially the reduction of the number of systems in use could result in a cost savings for border patrol operations over the medium term. Thus, for example, only one MALE system is capable of carrying out a 30-hour monitoring mission, which would otherwise require ten helicopters.

The advantages in flexibility and sensors are also critical in this civilian field, because it is essential to get an exact, dynamic picture of the situation along the border, where the terrain in question may vary widely. In light of these arguments, it is easy to understand why FRONTEX, the European agency created for operational cooperation between EU member states in border security, is considering the use of UAS in border monitoring. The necessity to continuously observe the Schengen area's southern border (i.e. the Mediterranean) is especially obvious in light of the current political situation in North Africa. It can be said that unmanned MALE systems represent a very good addition to the other tools used in border security and that the integration of these existing tools and systems is the trend for the future.

Monitoring large, mass events is a further potential application field for UAS. In Switzerland, the aforementioned *Ranger* reconnaissance system was used during the 2008 Soccer World Cup to observe the security situation in Basel, Bern and Zürich. The direct transmission of live images to security management team made it possible to determine in which direction crowds were moving, where larger numbers of people were building up, and how traffic flows in the areas near the games were progressing.[58]

Similarly, in the United Kingdom, a smaller MUAV has been used by the police in its operations for the past few years. Following Switzerland's example, the United Kingdom also intends to use a larger UAS for reconnaissance and for ensuring security at large sporting events during the 2012 Olympics.

As already mentioned in Chapter 3, Germany also uses smaller VOTL-UAVs in homeland security. Thus, the police of the State of Saxony last year purchased a quadrocopter for use in support of security operations, especially for the monitoring of large public events such as football games, after a two-year test phase. It is expected that, despite its higher purchase price, the use of the UAS will be more cost-effective over the long term than the use of helicopters.[59]

Whereas the use of smaller MUAVs in support of homeland security operations in Switzerland and Britain are already accepted as routine, in Germany their use runs up against problems of societal and political acceptance, which has already been mentioned as a limitation of UAS. The civilian use of unmanned observation systems for large public events in Germany must be openly discussed, especially to address issues of data privacy. The ongoing observation of a large public event can been perceived negatively by those under observation, if the participants have the sense that they are under "general suspicion" and that their rights are not being protected. But to achieve the necessary societal and political acceptance, it is also important that citizens recognize the additional benefit of using a UAS. It must be clarified, and guaranteed, that the reason for using an unmanned system is to increase the security and safety of the population and only data needed for this purpose will be collected and used.

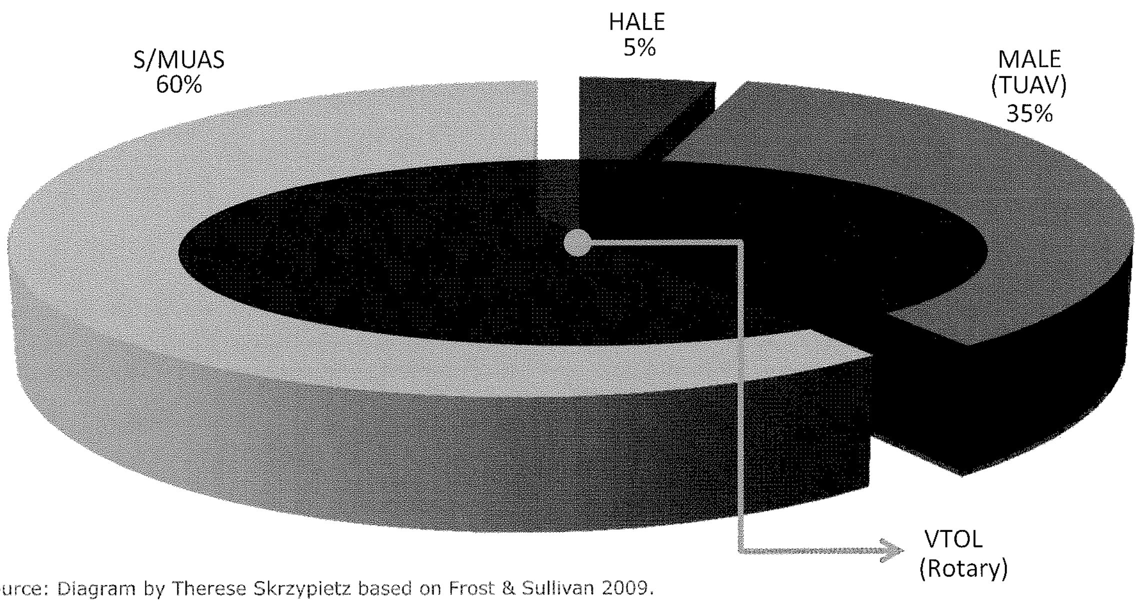
The examples listed here illustrate that UAS is already used for ensuring the security of large public events, and that it will play an ever greater role in these kinds of missions in the future. However, such missions do not require the high endurance characteristic of a large UAV; about six hours is usually sufficient to observe a large public event. Therefore, it is expected that public institutions will utilize smaller UAS for this kind of task. Finally, MUAVs could lead to cost savings compared to manned aircraft or helicopters, making it possible for police authorities to increase security and safety at large events.

5 Potential of the Civilian UAS Market

The preceding analysis has shown that the use of UAS for civilian missions is already taking place and is likely to increase in the future. Because existing unmanned aircraft systems possess a wide variety of characteristics and features, a correspondingly wide variety of applications are conceivable, in which UAS could create considerable market value. Provided that the legal framework for the integration of UAS into general air traffic is created by 2015, it is widely expected that the European market for civilian UAS will grow quickly and steadily.[60]

Unmanned reconnaissance systems would be particularly useful in disaster and crisis management, as well as in scientific research. Furthermore, social and political acceptance of their use would also be highest in these fields. Support for homeland security operations and the protection of critical infrastructure are two additional areas where UAS could be employed. However, to some extent, UAS must still prove itself in these fields and tests are ongoing. Nevertheless, the analysis of the four application fields examined here has shown that potential for using civilian unmanned aircraft systems from all the categories listed in Chapter 2 certainly exists. In its initial stages, the civilian market for UAS in Europe will be determined above all by state institutions, which would use UAS to fulfill security and public safety tasks. The market share for each of the different categories of UAS in the civilian sphere could be divided as follows:

Figure 4: Civilian Market for UAS in Europe by Category 2008–2017

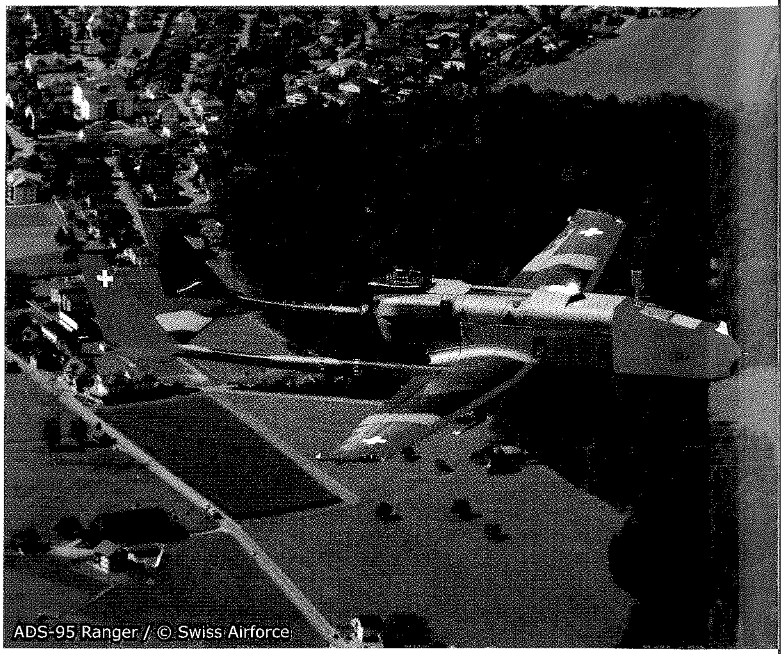


Source: Diagram by Therese Skrzypietz based on Frost & Sullivan 2009.

This prognosis can certainly be regarded as realistic considering the fact that, as mentioned in the introduction, the number of unmanned systems used for civilian applications has quadrupled between 2005 and 2010. In this context is it especially noteworthy that UAS that were originally developed for military purposes are increasingly assuming civilian roles, especially in disaster management.

Figure 4 suggests that above all, it is the smaller, unmanned aircraft systems which will have the greatest potential in the civilian market. This also reflects the current situation of the European UAS market, which is presently dominated by MUAVs. More than a third of the market will be made up by MALE platforms in the future, which are especially well-suited to missions requiring them to stay in the air for long periods of time. It is also clear that VTOL-UAVs, with their special features, will play an important role. Finally, despite the existing barriers which limit the market for the civilian UAS applications, it is clear that the potentials for a civilian market for UAS are much larger than those of the military market.[61]

The clarification of regulatory issues surrounding the use of unmanned reconnaissance systems alongside civilian air traffic by air transport authorities would dramatically lower barriers to market entry for potential producers. Once this step is taken, it is very likely that the civilian use of UAS will become more and more important. Therefore, and because of anticipated technological advances, investment in UAS development will also increase in the future. However, the question of whether UAS will be integrated into civilian air traffic depends largely on political and societal acceptance. It is necessary to find a consensus regarding the extent to which the use of UAS in the above-mentioned civilian fields is beneficial, and the degree to which it is ethically justified and legally protected.


ADS-95 Ranger / © Swiss Airforce

6 Need for Further Study

This study sought to investigate the potentials for the use of UAS to carry out civilian missions. It was possible to illustrate a selection of diverse civilian applications for unmanned reconnaissance systems and to evaluate the advantages of UAS in comparison to existing alternatives. To better understand the economic and societal implications of UAS in the civilian sphere, the following questions should be investigated further:

- For a quantitative determination of the economic advantages of UAS compared to manned aircraft systems, a cost-benefit analysis must be conducted. This should be limited to a specific civilian application field and specific size category of UAS, so as to produce a clear result.

- The acceptance of UAS within the general population must also be investigated more intensely. In addition to the elimination of legal barriers, this is a central criterion for the widespread civilian use of UAS. Such an investigation must determine the public's true attitudes towards unmanned aircraft and what information these attitudes are based on. A survey of such attitudes must distinguish between "potential individual users" and "the affected population", so as to reveal asymmetric information and to make political recommendations.


Heron 1 of the German Airforce / © M.Bertram, German Airforce

- So far, the quickly growing market for unmanned reconnaissance systems has been dominated by American and Israeli systems. In the future, Europe wants to do more than just have access to already existing platforms - it wants to develop its own systems. This study about the use of UAS for civilian applications shows that high development costs are required, especially for complex systems. Therefore, we must also consider the implications of investments in new unmanned platforms for industrial policy, as well as whether these are economically justifiable.

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7.1 Interviews Conducted

Date	Type of Interview	Interview Partner and Location
December 20, 2010	Informational meeting	EADS and Cassidian, Berlin
January 10, 2011	Telephone interview	EADS and Cassidian, Potsdam
February 11, 2011	Expert interview	Technisches Hilfswerk, Technology Section, Potsdam
February 18, 2011	Informational meeting	Cassidian, Potsdam
May 10, 2011	Expert interview	German Federal Police, Section 61, Law Enforcement Technology, Materiel Management, Potsdam
May 27, 2011	Expert interview	Cassidian, Berlin
July 6, 2011	Informational meeting	Cassidian, Berlin

ABC	Atomic, Biological, Chemical
AirShield	Airborne Remote Sensing for Hazard Inspection by Network-Enabled Lightweight Drones
ANDROMEDA	The Application of Drone-Based Aerial Photographs - Mosaic Creation, Rectification and Data Analysis
ATTAS	Advanced Technologies Testing Aircraft System
BMBF	German Federal Ministry of Education and Research
CBP	U.S. Customs and Border Protection
CRS	Congressional Research Service
DFRC	Dryden Flight Research Center
DHS	Department of Homeland Security
EADS	European Aeronautic Defence and Space Company
EDA	European Defence Agency
ERAST	Environmental Research Aircraft and Sensor Technology
FRONTEX	The European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union
GCS	Ground Control Station
HALE	High Altitude Long Endurance
IAI	Israel Aerospace Industries
ISiS	Incident Support Imaging System
LuftVO	German Air Traffic Regulations
MALE	Medium Altitude Long Endurance
MIDCAS	Mid Air Collision Avoidance Systems
MTOW	Maximum Take-Off Weight
MUAV	Mini Unmanned Aerial Vehicle
NASA	National Aeronautics and Space Administration
NEAT	North European Aerospace Test Range
NOAA	National Oceanic and Atmospheric Administration
SAR	Synthetic Aperture Radar
THW	Technisches Hilfswerk, a German civil defense and disaster relief organization
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
UVS	Unmanned Vehicle System
VTOL	Vertical Take-Off and Landing
VUSIL	Validation of Unmanned Aircraft Systems Integration into the Airspace
WASLA-HALE	Weitreichende Abstandsfähige Signalerfassende Luftgestütze Aufklärung (Long-Range and Distance Air Supported Signals Reconnaissance) – High Altitude Long Endurance
WMFS	West Midlands Fire Service

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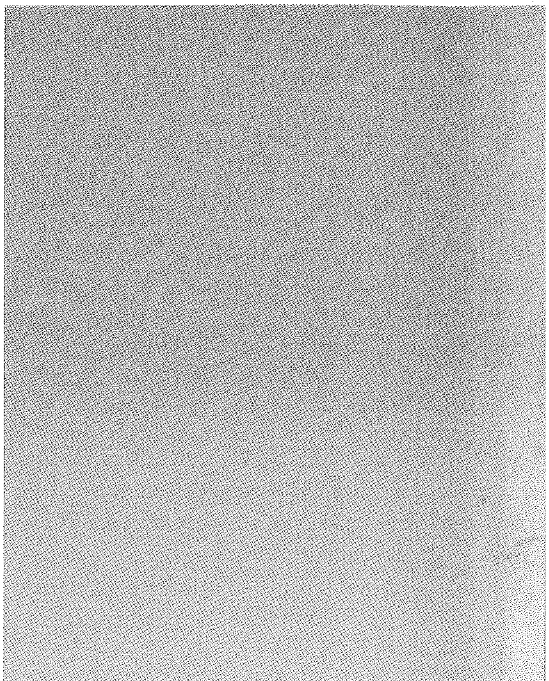

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