The Droning of the Drones
The increasingly advanced technology of surveillance and control

By Volker Eick

The use of unmanned aerial vehicles (UAVs) or drones has increased in recent years, but not only in the military and intelligence fields. These re-usable vehicles are increasingly used in the civil sector, an expression of the increasing convergence between military, intelligence and civil security policy, economy, technology and research.

Drones are technological systems that operate unmanned (guided by the US Global Positioning System, GPS, for example) or by remote control. Unmanned aerial vehicles (UAVs) or systems (UVS) can be as small as an insect or as large as a charter flight. [1] Despite their multiple uses, the market for UAVs is still relatively small although it has a high growth potential. A recent market study by the US-based *American Teal Group*, for instance, predicted the production of 3,328 UAVs globally in 2009, implying 28,658 newly produced UAVs by 2018 and an equivalent increase in turn-over from the current 4.4 billion USD to 8.7 billion USD. [2] In 2007, 259 companies produced UAVs for 42 countries. [3] The same year, 108 companies built about 200 similar vehicles in Europe (56 in France, 45 in the United Kingdom and 31 in Germany). German producers include AirRobot GmbH, Diehl BGT Defence Ltd., EADS, EMT, Imar Navigation, Mavionics, MicroDrones, Rheinmetall Defence, SIM Security and UAV S&S. [4]

In the international arena, the UAV market [5] is dominated by Israel which, according to the Stockholm-based International Peace Research Institute (SIPRI), is responsible for around 68% of the global trade. [6] However, the Teal group study indicates that the USA will take over 70% of the future market because of an increasing interest by the US military, which in turn is linked to a "general trend towards information warfare". The study finds that "UAVs are a key element in the intelligence, surveillance, and reconnaissance (ISR) part of this revolution". [7]

Murder at the click of a mouse

Experiments with military UAVs started as early as World War One. [8] Their mass deployment, however, began in the 1960s and 1970s in North Korea, China and especially during the Vietnam war. In 1982, drones were used in the

Table 1: Deployment areas of military UAVs (1993-2009)

Deployment area	Suppliers (UAV system)
Bosnia, 1993-1996	France (Crecerelle), United Nations (Fox AT), USA (Gnat 750, Pioneer, Predator)
Kosovo, 1998-1999	Germany (CL-289), France (CL-289, Hunter), United Kingdom (Phoenix), USA (Hunter, Pioneer, Predator)
Australia, 2001	USA (Global Hawk)
Afghanistan, 2001-	Australia (ScanEagle), Germany (Aladin, LUNA), France (SIDM, Skorpio), United Kingdom (DesertHawk, Herti, Predator B), Canada (Sperwer, SkyLark, C 170 Heron), Netherlands (Sperwer, SkyLark, Aladin), USA (Dragon Eye, Global Hawk, Pointer, Predator, Shadow 200), United Arab Emirates (S-100)
Yemen, 2002	USA (Predator)
East-Timor, 2002	Australia (Aerosonde III)
Iraq, 2003-	Australia (ScanEagle, SkyLark), United Kingdom (DesertHawk, Hermes 450, Phoenix), Italy (Predator), Japan (RMax), Romania (Shadow 600), USA (Desert Hawk, DragonEye, Global Hawk, I.Gnat, Hunter, Pioneer, Predator, Puma, Raven, ScanEagle, Shadow 200, SilverFox, SnowGoose, Tern, Wasp)
South Korea, 2003	USA (Shadow 200)
Solomon Islands, 2003	Australia (Aerosonde III, Avatar)
Angola, 2003-	Israel (Aerostar)
Ivory Coast, 2004	Israel (Aerostar)
Kosovo, 2005	Belgium (Hunter)
Congo, 2006	Belgium (Hunter)
Lebanon, 2006	Belgium (Hunter), France (Sperwer)
Ivory Coast, 2006	France (Skorpio)

Source: Author's compilation

Israeli invasion of Lebanon to gather intelligence on the position of Syrian bases in the Beqaa valley. [9] They were also deployed in Soviet-occupied Afghanistan and Yemen (compare further deployment areas in Table 1).

The German army and air force were (and are still are) involved in many of these UAV deployments. The air force has five UAV systems at its disposal [10]:

- the Aladin (*Abbildende Luftgestützte Aufklärungsdrohne im Nächstbereich*, i.e. airborne reconnaissance drone for close area imaging for "urban reconnaissance and surveillance of individuals"),
- the CL-289 (commonly developed by Germany, Canada and France),
- the LUNA drone (*Luftgestützte Unbemannte Nahaufklärungs-Ausstattung*, i.e. unmanned airborne reconnaissance system),
- X-13 (which enables the expansion of surveillance over the horizon), and
- the Fan-Copter (a German military UAV that is not steered via GPS). [11]

Flight operation under the Medium Altitude Long Endurance (MALE) UAV system 'Heron TP', which was developed for the German SAATEG (*System zur abbildenden Aufklärung in der Tiefe des Einsatzgebiets*, i.e. imaging system reaching far into deployment areas) military programme by Rheinmetall Defence and the Israel Aerospace Industries, [12] commenced in March 2010. [13] The Barracuda UAV project is still in the testing phase. [14] The "airborne divisions" of the German army use the Mikado and KZO systems (*Kleinfluggerät Zielortung*, i.e. small aircraft for target location). [15] The latter is also produced by Rheinmetall Defence but is in the testing phase. [16] The German air force's deployment of UAVs predominantly occurs during missions abroad and has doubled in recent years (2006: 1,494; 2007: 2,115 and 2008: 3,471). In 2008, the Aladin system was used in 75% of all cases. [17]

The "3-D missions", described by Air Force Inspector Lieutenant-General Klaus-Peter Stieglitz as the "dull, dirty and dangerous ones," [18] began with "the arrival of hunter-killer UAVs." [19] Their (deadly) missions are directed against alleged militant Palestinians (since the 1980s), alleged Islamic fundamentalist in Afghanistan, [20] Pakistan [21] and Iraq [22] as well as any resident civilians in those regions. Several studies have argued that UAV's will take on an even more "deadly design" [23] and there is speculation about the arrival of an "ethical fighting robot". [24] In 2009, [25] UAVs such as the US 159 Predator or Reaper were guided by pilots who, while steering their drones over combat zones, were sitting behind computers half an hour's drive from Las Vegas. [26]

The cited advantages of UAVs over manned reconnaissance flights are of a military and budgetary nature: it is argued that soldiers do not have to risk their lives, that the systems are quicker and cheaper than airplanes or helicopters and that they can move inconspicuously, especially in mountainous and urban areas. The psychological effect of UAVs on their victims is also highlighted: the feeling of being detectable at any moment, it is argued, compels enemy forces to remain constantly on the move thereby weakening their fighting strength. [27] As one US military representative put it: "They can run, but that just means they are going to die tired." [28]

Probably more important for the military industry, however, is the fact that UAVs represent a new source of income, especially in the civilian market. In February 2006, Ronald D. Sugar, director of *Northrop Grumman*, told his board of directors that the decline in demand for manned aircraft posed a serious challenge for the company's future. They decided to rebuild the company from the ground up: "As the line continues to blur between defence and domestic security, traditional defence companies must be versatile, offering systems and capabilities that have applications in domestic security and even general "non-security" markets." [30]

UAVs are dual-use technologies that can be used for deployment by the military as well as the civilian sector, and they are advertised as such by the industry. For example, the RAND corporation claims that "commercial UAVs could be used to monitor resources such as forest and farmland, wetlands, damns, reservoirs, wildlife (e.g., in nature reserves); fight fires or direct environmental remediation, with influence on food, land, water, environment, and economic development." [31]

Pilotless populism

Civil use in Western Europe and Germany usually means the deployment of UAVs by regional and federal police forces. Police use includes surveillance and intelligence gathering (at events, inside and outside of buildings, raids, border and port controls), evidence gathering (solving crimes, documenting crime scenes), documenting troublemakers, searches (during threat scenarios and for missing persons), observation (of objects and persons), surveillance of VIPs and buildings, traffic control measures, transport missions and technical support. [32]

The CannaChopper UAV is deployed in the fight against cannabis smokers within the framework of "organised crime" in the Netherlands and Switzerland. [33] Since November 2007 the drone has served in the surveillance of football fans, particularly during the European football championship in June 2008. [34] During the NATO summit in April 2009 it was used to intercept "troublemakers" at French borders. [35] In the UK they have been used by police since mid-2007 to monitor rock fans, [36] and also for the enforcement of Anti-Social Behaviour Orders. In the Netherlands UAVs were used in February 2008 to support the police in the eviction of a squat. [37] Belgium, France and Italy have used them to target undocumented workers, demonstrators ('crowd control'), waste collection, undocumented migrants and other marginalised groups and their communities. Austria controls its eastern borders with drones. [38] The German police acquired Aladin and FanCopter UAVs for the surveillance of urban areas, while the Saxony and North-Rhine Westphalia regional police forces deploy the AirRobot. In Saxony, the UAV has been used for the surveillance of alleged hooligans since early 2008. [39] In other words, there is hardly a marginalised group that is not targeted by UAVs. For 190 euro per hour it is even possible to rent one's own drone at www.rent-a-drone.de. Compared to the rest of Europe, however, Germany is still lagging behind in UAV deployment.

In July 2009, the German government conceded that "There are currently no regulations at the European or national levels for the commercial use of Unmanned Aerial Vehicles". [40] The lack of regulation is a barrier to their airborne deployment: UAVs generally have to be deployed in non-controlled airspace, at a weight of under 5 kilograms (micro or mini-UAVs), be in sight of the pilot (around 2.7 km distance) and fly at a maximum height of 20 metres, although there are exceptions for police and military "special tasks". [41] To date, only Saxony regional state has issued a general flying permit under the Air Traffic Act or rather the Air Traffic Regulation for private persons. [42] Questions posed by researchers, lobby organisations and UAV producers regarding their legality and security remain unanswered. The Institute for Futures Studies and Technology Assessment (IZT) describes a "paradoxical situation" in which "Germany is in an excellent position [to develop] this future technology, which it should retain and extend...Yet, it is non-existent in science, technological development and practice" [43]. The reasons, according to the Institute, are a "narrowly-led technology community" and "partially faulty development strategies that immediately aim at mass markets and big technologies." [44]

Flight research

Research cooperation in the UAV business follows the same logic as that of other research areas in the military and commercial security sector at the national, European and international levels. It should be noted that technology acceptance research on UAVs is not very developed due to the lack of regulations governing their production, operation and use. [45] This lack of definition results in (aviation) regulatory gaps [46] as well as technical and technological problems over deployment (mutual recognition, "see/sense&avoid"). [47] Commercial security research underlies the same four dominant innovation-political aims that currently apply, namely: 1) inclusion of end-users (state, private), 2) comprehensive multi-disciplinary issues (engineering, the natural and social sciences and humanities), [48] 3) the creation of leading markets (interlocking of security, economic and innovative politics) and 4) acceptance (societal dialogue). [49]

So far, three UAV research projects have been financed by German federal ministries. Two projects were funded by the transport ministry: one in 2006, on mutual recognition and one in 2007 on the integration of UAVs in civil managed airspace. In 2009, the interior ministry contracted the Federal Police (*Bundespolizei*) for a project "to validate UAVs for their integration into airspace (Validierung von UAS zur Integration in den Luftraum, VUSIL)". [50]

Two more projects are financed by the Federal Ministry for Research programme on "Research for civil security". With around one million euro per annum each, the three-year projects are looking into, firstly, two civil deployment possibilities for UAVs in emergency situations. This project is carried out by a number of technical universities, the microdrones GmbH, GIS Consult GmbH and GfG Gesellschaft für Gerätebau mbH companies, as

well as the Institute for Fire Fighting and the city of Dortmund's Rescue Technology Unit. The second research project (Emergency Rescue at Mass Casualty Incidents, or '*Sofortrettung bei Großunfall mit Massenanfall von Verletzten*', SOGRO) focuses on the use of UAVs for relaying information about accidents to the rescue services (the participating organisations are the German Red Cross, Stuttgart, Paderborn and Freiburg Universities as well as the Siemens AG and Andres Industries AG companies). [51]

In the various EU Framework Programmes (FP) and their predecessors, [52] UAVs play a role in (automated) border control, regaining control over security in emergency scenarios and the development of integrated platforms. The larger programmes include: Border Security Unmanned Aerial Vehicles (BSUAV), Civil Applications and Economic Effectiveness of Potential UAV Configurations (CAPECON), Innovative Future Air Transport Systems (IFATS), Innovative Operational UAS Integration (INOUI), Transportable Autonomous Patrol for Land Border Surveillance (TALOS), Unmanned Aerial Vehicles Network (UAVNET), UAV Safety Issues for Civil Operations (USICO), Wide Maritime Area Airborne Surveillance (WIMAA) and Micro Drone Autonomous Navigation for Environment Sensing (µDRONES). Between four and 20 million euro are distributed among European research networks, which regularly include companies and institutes from Israel (see Table 2).

It is becoming evident that this research is exclusively appliance-oriented and directed by (major) private military contractors. The number of leading companies is small and the participating research and development departments are located in Israel and Core Europe (KernEuropa); police organisations play no role. [53]

Lofty lobbying

Despite these dilemmas, the aviation and space industry syndicates have developed a timeline [54] for the comprehensive penetration of UAVs, particularly in the commercial arena, which they intend to enforce with a series of events, trade shows, fora and informal meetings.

From the end of the 1990s onwards, several working groups, were set up, such as the German Aerospace Industries Associations (*Bundesverband der Deutschen Luft-und Raumfahrtindustrie e.V.*, BdLI), a comprehensive UAS expert committee which comprised 28 members in 2008. Since its foundation in February 2006, the committee has been dominated by representatives of Rheinmetall Defence Electronics, EADS Deutschland, MTU Aero Engines Holding and Diehl BGT Defence. [55] By its own account, the committee engages in the external representation of the interests of the German UAV industry, determines national technology and industry policies, develops proposals for research and technology support and programmes and provides "political support for the proposal procedure for the admission of UAVs to unrestricted airspace" - in other words the enforcement of civil and commercial use of drones in national and international airspace. [56] The BdLI expert

Table 2: EU-funded research project on civil UAV deployment

Project (Programme) Grant sum, EUR [duration]	**Participants/Project coordination**
BSUAV (PASR) 5.0 million [2004/06]	Eurosense (BE), Sener (ES), **Dassault Aviation**, Flying Robots, Thales (F), Alenia (IT), NLR (NL), Saab (SE), SETCCE (SI), Rolls-Royce (UK)
CAPECON (FP 5) 5.1 million [2000-2005]	Deutsches Zentrum für Luft-und Raumfahrt, Eurocopter (D), Instituto Nacional de Tecnica Aeroespacial (ES), EADS Systems Services & Telecom, Eurocopter, ONERA (F), **Israel Aircraft Industries**, Tadiran Electronic Systems, Tadiran Spectralink Ltd., Technion – Israel Institute of Technology (IL), Agusta, Carlo Gavazzi Space, Centro Italiano Ricerche Aerospaziali, Politecnico di Torino, Universita degli Studi di Bologna, Universita degli Studi di Lecce, Università degli Studi di Napoli Federico II (IT), Stichting Nationaal Luchten Ruimtevaart Laboratorium (NL), Politechnika Warszawska (PL), Swedish Space Corp. (SE)
IFATS (FP 6) 5.5 million [2004-2007]	Deutsches Zentrum für Luft und Raumfahrt (D), Direction des Services de la Navigation Aérienne, EADS Defence and Security, Erdyn consultants, **ONERA**, Thales Communications (F), University of Patras (GR), Israel Aircraft Industries, Technion – Israel Institute of Technology (IL), Alenia Aeronautica, Centro Ricerche Aerospaziali (IT)
INOUI (FP 6) 4.3 Million [2007/09]	DFS, OFFIS, Rheinmetall Defence Electronics (D), Boeing Europe, INNAXIS, Isdefe (ES), ONERA (F)
TALOS (FP 7) 19.9 million [2008-2012]	Sonaca (BE), Smartdust Solutions (EE), TTI Norte (ES), ONERA (F), Valtion Teknillinen Tutkimuskeskus (FI), Hellenic Aerospace Industry (GR), Israel Aircraft Industries (IL), Instytut Technik Telekomunikacyjnych i Iinformaycznych, Politechnika Warzawska, Telekomunikacja, **Przemyslowy Instytut Automatyki i Pomiarow** (PL), European Business Innovation & Research Center (RO), Aselsan Elektronik Sanayi Ve Ticaret, STM Savunma Teknolojileri Muhendislik (TK)
UAVNET (FP 5) No information [2001-2005]	Sonaca (BE), Airobotics, DLR (D), EADS, ONERA, Snecma (F), Ae-Systems (GB), **Israel Aircraft Industries** (IL), Alenia, CIRA, Politecnico Torino (IT), NLR (NL), Politechnika Warsaw (PL), Space Corp. (SE)
USICO (FP 5) 4.6 million [2002-2004]	**Airobotics GmbH**, Deutsches Zentrum für Luft-und Raumfahrt (D), EADS Systems Services & Telecom, ONERA (F), Israel Aircraft Industries (IL), Marconi Mobile, Università Degli Studi di Napoli Federico II (IT), Stichting Nationaal Luchten Ruimtevaart Laboratorium (NL), Foersvarshoegskolan, Swedish Space Corp. (SE)
WIMAA (FP 7) 4.0 million [2008-2011]	Commission of the European Communities, DG Joint Research Centre, Eurosense Belfotop (BE), Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung (D), Satcom1 (DK), Aerovison Vehiculos Aereos, Sener Ingenieria y Sistemas (ES), Dassault Aviation, **Thales Systèmes Aeroportes**, Thales Communications (F), Galileo Avionica (IT), Universita Malta (MT), Instytut Techniczny Wojsk Lotniczych (PL), Totalforsvarets Forskningsinstitut (SE), Zavod za Varnostne Technologije Informacijske Druzbe (SL)
MDRONES (FP 6) 3.4 million [2007/09]	CEA-List, **Thales Security Systems** (F), AirRobot, University of Tübingen (D), Lisippos (GR)

Source: Author's compilation (figures rounded off)

committee cooperates with the German section of UVS International, the German Language Working Group UAV DACH, which was set up in January 2000 and comprises companies and institutions from Germany, Austria, Switzerland and the Netherlands. [57] UAV DACH is responsible for technical details, deals with the "drafting of air traffic relevant proposals", "evaluation of licensing-relevant technologies and specifications of the necessary research demand" as well as the "implementation of licensing-relevant experiments". [58]

UVS International, founded in 1999, comprises 260 members from industry, academia and other institutions. They come from 36 countries and ten international organisations covering all five continents. [59] From its inception the organisation said it aimed for a "significant number of honorary members" made up of "representatives of national civil aviation authorities or serving military officers". The intention was to establish an (informal) international network "instead of having to go through official channels". [60] Honorary German members include, among others, representatives of the German Air Force Flight Test Centre (*Wehrtechnische Dienststelle für Luftfahrzeuge,* WTD 61), the state-owned Aeronautical Information Service Centre (*Deutsche Flugsicherung GmbH*), the Ministry of Defence, the Air Force and the Army Office, as well as international representatives from military and civil organisations such as the European Aviation Safety Agency (EASA), the European Defence Agency (EDA), the European Organisation for the Safety of Air Navigation (EUROCONTROL) and the USA Federal Aviation Administration (FAA). [61] The German involvement in (international) planning, implementation and deployment of UAVs is almost exclusively reserved for the military, (para)state airspace agencies, representatives of the relevant federal ministries and predominantly university electronic and engineering departments. The UAV industry therefore does not represent the "existence of a police-industrial complex, in which security industry and state as well as private security administration are closely interwoven", [62] but rather a military stepping stone for comprehensive future civil use. The police force remains focused on the relatively small-scale management of marginal groups.

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[42] Allgemeine Erlaubnis für den Betrieb eines ferngesteuerten Flugkörpers mit Eigenantrieb im Freistaat Sachsen [Licensing for the use of remotely-controlled

airborne vehicles in Saxony] (Regierungspräsidium Dresden, 7.4.08), cited in: German Language UAV Working Group: ILA 2008 – UAV DACH (Conference, 30.5.08), p. 5
[43] Institut für Zukunftsstudien und Technologiebewertung: Jahresbericht 2008 [Institute for Futures Studies and Technology Assessment (IZT): Annual Report 2008], Berlin 2009, p. 82
[44] ibid., p. 83. This is possible, interestingly, the IZT annual reports claim this since 2006 in exactly the same working - in relation to lighter-than-air technologies, see www.izt.de/suche/ (search term: Drohnen)
[45] UAV DACH (ed.): Eine Initiative zur Integration von UAVs in den zivilen Luftraum [An initiative for the integration of UAV into civil managed airspace] (Issue 6, March 2008), p. 2
[46] Giemulla, E.M.: An Approach of amending National Law (Presentation at ILA conference, 30.5.08), Berlin, p. 8ff
[47] Seif, A.: AIR4ALL Status of the EDA Study after 2nd Stakeholder Meeting (Presentation at ILA conference, 30.5.08), Berlin, p. 17
[48] "Contributions from social sciences and humanities are particularly welcome: on the necessity and acceptance of security solutions", Bundesministerium für Bildung und Forschung: Forschung für die zivile Sicherheit. Programm der Bundesregierung [Federal Ministry for Education and Research: Research for Civilian Security. Programme of the Federal Government], Berlin 2007, p. 13
[47] Rachel, T.: Zivile Sicherheitsforschung als Teil der Hightech-Strategie Deutschlands [Civil security research as part of Germany's high-tech strategy] (Speech during the Petersburg 'Dialog der Sicherheits- und wehrtechnischen Wirtschaft' [Dialogue of security and military economy'] NRW, 9.6.08), Bonn
[50] Government reply to parliamentary question, BT-Drs. 16/13609 v. 1.7.09, p. 3
[51] ibid.
[52] e.g. the Preparatory Action for Security Research (PASR, 2004-2006); see European Security Research Advisory Board (ed.): Meeting the Challenge: the European Security Research Agenda, Luxembourg 2006; Hayes, B.: Arming Big Brother: The EU's Security Research Programme, Amsterdam 2006; Statewatch (ed.): Neoconopticon. The EU-Security Complex, London 2009
[53] France, Israel and Italy hold the majority of shares; 45 per cent of all projects are coordinated by French companies.
[54] For the civil use of UAVs, the German Aerospace Industries Association (BdLI) assumes that this will still 25 years, the UAV Europe believes market domination is possible from 2013 onwards.
[55] see www.bdli.de/index.php?option=com_bdliboard&view=forums&Itemid=15
[56] Küke, R.: Bericht aus dem BDLI Fachausschuss UAS [Report from the BdLI expert committee] (Presentation at ILA conference, 30.5.08), Berlin, p. 4
[57] Schiebel GmbH (A), RUAG Aerospace Defence Technology, Swiss UAV (CH), ADSE Consultancy and Engineering Services, NLR (NL), AutoFlug, Diehl BTG Defence, DFS, DLR, EADS, EMT, ESG, IABG, OHB-System AG, Rheinmetall Defence Electronics, STEMME UMS (D)
[58] Küke ibid. (Fn. 56), p. 4; see Bothmer, B.: Deutschsprachige Arbeitsgruppe für Unbemannte Luftfahrtzeuge. Eine Initiative zur Integration von UAVs im zivilen Luftraum [German Language Working Group for Unmanned Aircraft Systems. An initiative for the integration of UAVs into civil managed airspace] (Information event at the ILA conference on 17.5.06), Berlin, p. 16
[59] van Blyenburgh, P.: UVS International. Promoting International Coordination & Cooperation, Paris 2008, p. 78
[60] ibid., p. 80
[61] ibid., p. 79

[62] However, see also the 'indect' research project (Intelligent Information System Supporting Observation, Searching and Detection for Security of Citizens in Urban Environment) within the 7th EU-framework programme, where the Polish police force represents other police forces:
www.indect-project.eu/files/deliverables/public/INDECT_Deliverable_D8.1_v20091223.pdf/at_download/file, p. 42 f.

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