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Innovative Alpine technologies
Status quo – Case studies – Future prospects

Drones in the mountains of South Tyrol

Where are we today?

2018 version

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Preface by alpine.expert

Remote piloting is a market of the future, with many opportunities for companies in South Tyrol. Nonetheless, the opportunities offered by remote-controlled devices are not yet recognised by the larger public. This is particularly deplorable in fields such as the management of natural hazards or in agriculture where the drones of South Tyrol already offer direct benefits for the people living in the mountains and for the whole of society. This report shows how drones are making life in the mountains easier, better and safer.

Among the numerous technologies used for protection from natural hazards, we have chosen drones as the topic to be analysed in this report. Drone technology offers many deployment possibilities and can provide an innovative contribution during the entire risk management process, from prevention to regeneration. The creative combination of existing solutions and organizational talent in hard-to-access mountain areas also provides a significant contribution to the social, economic and ecologic development of South Tyrol.

Today, versatility in solutions is more in demand than ever before. The importance of Alpine technologies for the sustainable development of South Tyrol and of its enterprises is unquestionable. The support of technologies and applications of public interest aims at preventing possible market distortions and at reaching results that are useful to the entire community. For this reason, we have chosen to focus on technological innovations and to present concrete examples to illustrate the contribution of new technologies to the protection from natural dangers and to the sustainable development of South Tyrol and of its enterprises.

In collaboration with our community alpine.expert, we have selected several “pilot projects” in the Alpine sector. Said projects cover all the stages of the risk management process and represent examples of effective employment of innovative products. The following aspects give them further importance and prestige:
1) scientific evidence
2) the innovative force of local SMEs (small and medium-sized enterprises)
3) the organizational skills of civil protection technicians
4) the great commitment of numerous volunteer groups.

At the NOI Techpark, in Bolzano, we support a team of particularly active researchers and enterprises, working together in the alpine.expert/rpas working group, and we make available highly specialized infrastructural services for the research and development in the drone technology field. By fully exploiting the innovation potential of said technology and the strong propensity towards innovation already existing in South Tyrol, we intend to stimulate the experts in the Alpine skills area to implement new ideas for protection from natural risks.

Sebastian Mayrgündter
Ecosystem Sports & Alpine Safety Coordinator

Preface by ENAC

I am observing with great interest the expansion of the possibilities for employment of drones, especially in the rural and mountainous areas of our region. Today, in fact, remotely piloted devices, which were initially used (and are still being used) for film and photo shooting, are also being used in other sectors, such as geology, agriculture, crop protection, archaeology, safeguarding of the cultural heritage, and even civil protection (in the latter case, on an experimental basis). The aerial perspective, the “view from above” offered by drones, represents a precious and now indispensable aid, e.g for the securing of mountain rock walls, for the opening of new climbing and trekking paths, for measuring fields and land, for archaeological surveying, for the consolidation of roads and bridges in exposed areas, for assessing the conditions of old buildings, for the fight against pests, for evaluating the ripening of fruit and grapes and for the tracking of missing persons. And these are only some examples.

However, the more interventions there are, the greater the related risks become. The request for authorization to use drones in urban areas and small towns, on high traffic streets and roads in the vicinity of airports are increasing continuously, and proportionally there is an increase in the number of messages from helicopter pilots, especially helicopter rescue services, affirming to have sighted drones in the immediate vicinity of their aircraft with serious risk of collision. In this case, we must emphasise that this kind of situation is easy to prevent if the remote-controlled aircraft are used in compliance with the current legislation. We must add, however, that the technical opportunities of drones now on the market, which can be bought anywhere with no specific qualifications or certification, greatly exceed the restrictions levered by law. For example: although illegal, today it is possible to fly them from peak to peak, enjoy the panorama from above, and, just by pressing a button, send the drone back to its starting place. There has also been an increase in the number of claims for violation of privacy by those who want to enjoy the silence and tranquility of nature without being disturbed by the constant humming of electric motors and rotors.

One thing is certain: in the immediate and near future, drones will change all of our lives. In order for such change to be positive there must be a corresponding updating of the regulations as well as wisdom, respect and sense of responsibility on the part of the users.

Manfred Mussner
ENAC Bolzano Manager

Introduction

Over the past few years, drones - a term indicating unmanned remote-controlled aircraft - have increasingly gained acclaim in our skies. Multirotors have greatly evolved from being mere toys able to shoot spectacular aerial images. Indeed, when correctly programmed, these flying computers can perform endless tasks. Today they are already being employed in numerous professional fields, including filmmaking, land and housing surveying, use in agriculture and Alpine rescue and civil protection operations. Drones film, map, provide 3D images and data, carry food or apply pesticides. Where once it was necessary to use costly helicopters, we can now use compact and very sophisticated drones. These remote-controlled aircraft, among the most useful robots currently available, will have an increasingly important role as time goes on.

The enthusiasm for this new technology knows no limits in South Tyrol too. The alpine.expert/rpas working group, established within the Ecosystem Sport & Alpine Safety group, brings together brilliant inventors and gifted visionaries in the name of a sole objective: the manufacture of drones and the deployment of robotized aircraft in the Alpine territory. These professionals work together to develop the skills necessary for the efficient employment of unmanned aircraft for the management of natural risks in the Alpine areas and also to further develop these devices.

Ecosystem Sport & Alpine Safety of IDM Alto Adige organizes the Alpine platform with the aim of strengthening and giving visibility to Alpine proficiencies. This initiative intends to inspire and stimulate SMEs to promote innovation and apply the latest advanced technologies. This reportage provides a panoramic view of the current situation in South Tyrol and in the Alpine area but also looks toward the future: what is the potential of the “flying robots” and what fields can they be applied to in the next few years?

Drones in the Alpine areas

Geography and the economic situation are factors that decisively affect the type and employment areas of drones in our region. South Tyrol is a mountainous territory situated in the southern Alps. The landscape features mountains, hills and forests. Agriculture represents one of the traditional means of sustenance, while filmmaking is an emerging industry. Over the last few years, the use of civil drones in South Tyrol has increased enormously in these two sectors of activity. Other sectors, such as environmental monitoring, agriculture-related surveying and civil protection, will become ever more important in the future. This context requires specific knowledge and skills to handle the challenges of this particular mountainous territory, as well as knowledge of the regulations in force in Italy and specifically in the Province of Bolzano.

The mountain territory

The prevalently mountainous territory represents a significant challenge for the employment of drones in South Tyrol. One of the firm points of the current regulations states that there must be a continuous visual contact between the operator and the aircraft. This is a difficult requirement to meet, especially in mountainous and forest areas. According to Italian legislation, rotary wing drones with a 25 kg maximum operational take-off weight can fly to a maximum height of 150 m and move as far as 500 m away from the take-off point. For recreational use, the limits are lower: a max height of 70 m and a distance from take-off point not greater than 250 m. However, non-professional pilots are not required to complete a specific training course and no drone-related certification is required.

In compliance with current regulations, only **VLOS flight** (in short, VLOS: *visual line of sight*) is allowed, meaning that the operator must never lose visual sight of the drone.

To further complicate flight operations in mountainous areas, besides the above legislation, there is the fact that drones are piloted by means of radio waves; for this purpose pilots us the **free 2.4 GHz frequenc**, the same of WLAN users. The transmission of the radio signal can thus be compromised in areas having thick forest vegetation, at high altitudes or in Alpine gorges. It is also necessary to bear in mind the adverse weather conditions typical of the South Tyrolean climate: **thunderstorms, wind, hail, snowfall and low temperatures** at high altitudes.

Legal features and regulations in force

Current legislation in Italy and in the Province of Bolzano lays down strict restrictions on the use of drones, thus creating a juridical situation that is out of date with respect to today's reality.

The Italian Civil Aviation Authority *(Ente nazionale per l'aviazione civile* - ***ENAC***) authorizes licenses and certification to drone pilots. All pilots piloting unmanned aircraft heavier than 300 grams in Italy for **professional** purposes must complete a theoretical and practical training course. The prerogatives for the employment of drones and the different ways of air space access are defined by dividing the crewless remote-controlled aircraft into **two weight classes:** drones weighing up to 25 kg and drones weighing more than 25 kg.

a) Unmanned aircraft with operational take-off weight less than 25 kg

As regards lower-class aircraft used for **non-critical operations**, a self-certification solution has been adopted, meaning that the operator accepts all responsibility for flight operations.

The operator must be capable of assessing the critical aspects and the flightworthiness of the aircraft, excluding the possibility that the drone could harm people for example.
It is however necessary to obtain a **certification for the drone, which is issued by ENAC**. The certificate is issued only once and is valid for all non-critical flights. Since the issuing of said certificate is a long process, drone operators should contact the Civil Aviation Authority (ENAC) well in advance.
All **flight operations considered as critical** require a special authorization from the Civil Aviation Authority (ENAC). For example critical flights include **flights over urban areas, built up or congested areas, stations, airports, industrial infrastructures, gatherings of people, and streets.** For all drone uses in critical areas it is mandatory to request the relevant authorization from ENAC. The issue of said authorization normally takes several weeks.

b) Unmanned aircraft with operational take-off weight of 25 kg or more

For unmanned aircraft weighing over 25 kg it is **always** necessary to obtain, for critical as well as for non-critical flight operations, a **flight permit and the authorization for the operator issued by ENAC.** In this case, in fact, the regulations in force for traditional aircraft apply. For this reason, an airman certification and authorization to use the aircraft are requested.
Whenever the drone complete with video camera weighs more than 25 kg and the operation takes place in Italian territory, the exam and flight authorization by ENAC are always required. **Authorizations by non-Italian institutions are not accepted.** The aircraft operator must have a **pilot's license** for helicopters or airplanes.
Night flights are permitted since 2017 even without specific authorization by ENAC. However, the drone must be equipped with navigation lights: a white stern position lamp, a green lamp on the left side in the direction of flight and a red position lamp on the right side. Like day flights, VLOS flight mode is specified but the distance is limited to 100 meters from the take-off point.
The rapid spread of the use of drones for professional reasons implies constant updating of the current regulations. Said regulations can be consulted on the **ENAC** website.
By 2020, the approval of a **new European directive** is contemplated, aimed at harmonizing the legislation in the EU so that flight operations and the drones used for professional use will **not require specific authorizations and certifications in every country of the Union.**

The safe use of drones

The technical and juridical developments related to **safety in the use of drones** focus on guaranteeing **flight operations without accidents** and on **contrasting illegal uses.** To this end, the following are essential: **registration of the drone with the competent authorities** to ensure the reconstruction of the dynamics of any accidents; **an interference-proof real-time data transmission system** between the aircraft and the operator; a **system capable of guaranteeing data integrity,** i.e. the complete transmission of the encrypted data packs; **protection of the privacy** of the population by limiting the flight operations to the authorized areas only. All professional and non-professional drone operators must comply with the regulations concerning the protection of personal data.

Further information regarding the current regulations and the technical safety of drones is available **here.**

Research and development, manufacture and applications in South Tyrol

Drone technology is advancing steadily throughout the world. Market prospects are promising, also due to the many possibilities for use in the civil field. The great success of RPA began in 2010. After almost a decade, the market is now dominated by Chinese and French companies such as DJI and Parrot but there is still room for start-ups capable of offering individual solutions. There is great demand especially for multirotors tailored on the requirements of the customers.
In the research and development sector in South Tyrol, EuracResearch, the Free University of Bolzano and Ecosystem Sports & Alpine Safety of IDM Alto Adige play leading roles. The South Tyrol enterprises Soleon and MAVTech, both specializing in the manufacture of highly personalized drones, are equally on the uprise. Among the latest to arrive on the scene are the enterprises FlyingBasket and UP Caeli Via.

Use and fields of application

Over the last few years, the use of drones in the field of **marketing and in the filmmaking industry** has been growing rapidly. The standing of South Tyrol as a **filmmaking territory**, with the coordination of the **Film Fund & Commission of IDM**, has strongly contributed to the development of the technologies and enterprises of the field. The enterprises offering services to the filmmaking industry are now becoming numerous and include suppliers of services able to offer custom-designed multirotors and gimbals, such as Alpsvision, Dragonfly, VideoVolando and soleon.

Agriculture and forest management are particularly interesting sectors for the suppliers of custom-made services. So-called **precision agriculture** allows farmers to reduce the costs of seed sowing and pesticide application. Said operation consists in the use of drones able to provide precise data about ground characteristics, plant development, degree of fruit ripening and pest infestation. The projects that have already been completed (among which the **SMILE** project by the technological company MAVTech) have made it possible to decrease the amount of **fertilizers and pesticides** used, with very positive repercussions on the harvest.
The **forest management** sector uses drones mainly to obtain information about terrain and vegetation characteristics. In agriculture, the use of drones has made it possible, for example, to greatly reduce the number of fawns accidentally killed during mowing operations. During the last few years, there has also been a sudden increase in the use of **multirotors** in the field of **surveying and measuring techniques.** Aerial photogrammetry makes it possible to carry out extremely precise measurements of ski areas, road corridors, high-altitude bridges and reservoirs. The South Tyrolean enterprises **Cartorender**, **Pixair** and **Dragonfly** are specialising in this sector. **Alto Drones** is one of the first European companies also capable of offering Lidar-based measurement operations.

Research, development, manufacture and implementation

The most evident advantage for customers turning to the drone manufacturers from South Tyrol is represented by the immediate availability of repair and maintenance services. ”It is our strong point”, confirms Michael Überbacher of soleon and continues, “we purchase the electronic components for our multirotors prevalently in Europe. Our suppliers must offer

availability and rapid delivery times". The Chinese market leader **DJI** offers commercial items, whereas **soleon**, **MAVTech** and the enterprises **FlyingBasket** and **UP Caeli Via** have chosen to focus on highly personalised products, finding market niches mainly in the agriculture and surveying sectors.
South Tyrolean drone manufacturers such as **soleon** or **MAVTech** offer solutions mainly in the agriculture and surveying field, such as, for example, assistance for setting up hail protection netting, gathering information about the condition of plants and soils, aerial surveillance of agricultural works and building sites, assistance in the application of pesticides and fire extinguishing agents, quantification of damages caused by hail and pests, early diagnosis of plant diseases, measuring of vegetation density and general surveys. The startup **FlyingBasket** was one of the first enterprises in Europe to specialise in the transportation of loads greater than 100 kg using drones. The projects by UPCaeliVia, an enterprise that employs the most avant-garde technologies (e.g. hybrid drones) and that is making a name for itself in the future field of passenger transportation, are also innovative and visionary.
For several years now, **automatic pilots** have been able to pilot the multirotors **automatically**. Automation has proved to be especially useful in the measuring of agricultural terrain and in the fight against pests. The pilot receives high resolution real-time images and can supervise the flight during the entire operation. Of particular public interest is the possibility to use drones in **civil protection** and **rescue operations**. The initiative **Drones4Safety**, started by Ecosystem Sports & Alpine Safety of IDM as part of the **ArgeAlpEVADAR project**, has seen professional drone pilots assisting the local rescue organisations during interventions and training exercises. Operations with specialized drones (such as those equipped with **thermal video cameras**) are also feasible for **tracking missing persons, for example after an avalanche.**
Within the context of the ArgeAlp EVADAR project, it has also been possible to test the performance of drones and operators in **extreme weather conditions** and on **hard-to-access terrain** featuring rocks, Alpine gorges and cliffs, etc..

Climate simulation tests on drones

From snowstorms to desert heat: drones must be able to fly even in extreme weather conditions. At present, this is one of the most interesting topics in the field of drone technology research. In fact, at the moment the data about the operation of drones in extreme weather conditions is scarce.

The EuracResearch institute of Bolzano runs the **terraXcube** climate simulator in the NOI Techpark. Here, as part of the Eurac **dronEx** research project, numerous tests are performed on aircraft. The simulations include flights in an artificial environment able to reproduce different climatic factors such as wind, extreme heat, rain, snow, high altitude weather conditions etc**.** The results obtained contribute to the development of increasingly safer and more resistant drones.
Tests on drones have been carried out for some time now as part of the **dronEx project by R&S**. DronEx stems from the collaboration between the groups alpine.expert/rpas, EuracResearch and Ecosystem Sports & Alpine Safety of IDM. The use of drones in artificially simulated and repeatable flight conditions makes it possible to assess the resistance of materials and components and carry out modifications if necessary.

Further interesting data will be provided by the **cold climatic chambers** of **terraXcube**, whose climate simulation space is able to reproduce the most extreme weather conditions on Earth. In these chambers it will be possible to test the impact of environmental conditions on the performance of products and materials.

Drones save lives

One use of this new technology that is especially significant and of public interest is represented by rescue and civil protection interventions in the event of natural calamities.

To this purpose, within the ArgeAlp EVADAR poject **IDM's Ecosystem Sports & Alpine Safety** has introduced the initiative called **Drones4Safety**. In 2017 firefighting, Alpine rescue and other civil protection organisations in South Tyrol were given the opportunity to test professional drone units during drills and operations. The goal of the initiative was to create the foundations for decisional processes based on evidence regarding the use of RPAS in emergency situations.

From mid April until the beginning of September 2017, three operations with drones were carried out successfully. On May 16th, the pilots Michael Überbacher and Michael Schmalzl participated in an **Alpine rescue research operation**. With the aid of drones it was possible to painstakingly search a steep, rough slope with serious risk of rockfall. The rescue team did not have to expose itself to danger and the research operations took less time than the customary operations carried out on foot. Even though the missing person was found somewhere else, the representatives of the Alpine rescue said they were very satisfied with the information acquired during the drone operations.

On June 5th, pilot Giovanni Cretti worked alongside a collective **training drill of firefighter volunteers and the Croce Bianca (*White Cross)* of Clusio.** His drone filmed the drill from the sky. The shootings were used afterwards to discuss the operation. The aerial perspective provided precise images of the dynamics of the drill, enabling the participants to analyse the operations in detail and objectively.

The positive experience of the **Drones4Safety project** and the **contemplated modifications of the European regulations** have motivated the working group alpine.expert/rpas of IDM to prepare, in collaboration with the local and Alpine area rescue organizations, a proposal for a future standard scenario. The proposal will include a base model for interventions and drills carried out with the aid of drones. Following the approval of the standard scenario by the competent authorities, it will be much easier to complete the bureaucratic procedures for the use of drones in action operations and drills.

Drones piloted in a negligent way and without authorization still represent a danger, though, even for the operators. The remote-controlled devices are on the average smaller and lighter than a helicopter but can cause a helicopter to crash by accidentally entangling in its rotors or hindering the pilot.

alpine.expert in action

The development of Alpine skills must come about in a sustainable way in order to positively affect the life, economy and work in South Tyrol.
The alpine.expert platform brings together enterprises, research institutes and local experts with the objective of incentivising the economy, research and society of South Tyrol. Drones represent one of many areas of activity of this platform.
The progress made in this particular sector is especially significant with regard to natural hazard management. A methodical, scientific approach is an essential prerogative to sustainable development in Alpine skills, making itself available for the technological management, i.e. for the organization and control of development and application of these new technologies.

Methodical approach: the alpine.expert activity

The “Alpine Experts” community analyses the starting point and gathers examples of good practice within the Alpine skills and natural hazard management sectors. The latter sector goes from the monitoring of sediments of Rio Solda to the plan concerning the dangerous areas of Chiusa, from the rockfall barriers above Termeno to the cord barrier for the containment of the Rienza river. These innovative solutions, of proven efficiency, are veritable “pilot projects” and are excellent examples of how an avant-garde product can be used successfully. Moreover, the experts of the community were asked to develop further and more interesting applications.

Product: support of development

The new technologies for the management of natural hazards often arise from the creative combination of scientific knowledge and existing technologies. The resulting products are generally public-interest oriented and, as such, subject to strict regulations. In order to obtain the whole picture of the main features of the new products, alpine.expert has made a form available to developers that allows them to classify their own project in terms of technology, purposes and cost effectiveness.

Community: strength through unity

Experience shows that technological progress needs an efficient organisation to fully express its potential. The alpine.expert platform unites in a single collaboration network the technical collaboration public administration technicians, scientists, freelance professionals, entrepreneurs and Alpine rescuers and firefighters - all categories interested in exploiting the Alpine skills to manage future challenges in the most efficient way.

Technological management: working for innovation

The “alpine.expert days” represent an opportunity to present technological innovations to a specialised public; here, entrepreneurs and developers invited to the event can introduce their innovative products, technologies and solutions. The alpine.expert days consist in a convention, several round tables and the practical testing of selected products, that takes place directly outdoors, during an excursion. In the context of a participatory process the enterprises receive useful advice for the further development of their technologies and they also have the opportunity to establish contacts with researchers, other entrepreneurs and

authority representatives, as well as the chance to develop ideas for new products and innovative approaches to the solution of any problems.

Case studies: the flying robots of South Tyrol

Ranging from the war against parasites to the creation of spectacular mountain-based films, from the measurement of complex urban settlements to the control of photovoltaic systems, in recent years a growing number of South Tyrolean firms and research centers have used drones or conducted experiments on them. Many of these belong to the working group alpine.expert/rpas with headquarters at **Ecosystem Sports & Alpine Safety** of **IDM**.
Following is an overview of the companies that operate in this field and a few research & development projects under way (info updated to August 2018).

1

Alto Drones: flying detectors

The most recent project of the South Tyrolean companies **Alto Drones**, **HydroloGIS** and **soleon** is dedicated to the services provided by drones **with built-in laser**.
Within the context of the project "Laser scanner per droni" (Laser scanner for drones), engineer **Thomas Fontana** of **Alto Drones** and RPA manufacturer **Michael Überbacher** of **soleon** make 3-dimensional visual representations of reality.
Both professionals are pioneers in the drones sector in South Tyrol. When, in 2009, drone manufacturer Michael Überbacher founded soleon, civil use drones were still very rare, but the market for drones started expanding shortly after that. Today, Überbacher is considered an absolute expert in South Tyrol in the field of RPAS. Thomas Fontana, a civil engineer specialised in detection techniques, entered the RPA market in 2014. Since then, Fontana has been offering detection services using UAV for ski areas, quarries, rock walls, waterways, roads, power lines, artificial lakes and historical buildings.
The **cooperation project "Laser scanner per droni"** by **Alto Drones**, **soleon** and **hydroloGIS** was launched in 2017. The use of laser scanners mounted on multicopters that can fly over mountain areas has made it possible for the first time ever to obtain fast and detailed topographic measurements of the Alpine territory, regardless of how dense the vegetation is. Public entities, such as the Geology Department, the Forest Administration Department and the Civil Protection Agency receive precise data regarding the conformation of a specific area, enabling them to create more accurate simulations of natural hazards. A concrete example of this is the quantification of the snow mass on avalanche-prone slopes.
This in turn benefits the planning and construction of protection barriers. The technology applied in this context consists in a multicopter capable of flying over mountain areas and equipped with a full-waveform Lidar sensor capable of measuring the entire laser signal wave

2

Alpsvision: “From hobby to profession”

Michael Schmalzl is a committed drone pilot. Together with Alexander Fontana, a cameraman with many years of experience, he offers **professional film recordings shot using drones** in South Tyrol. In 2013, with the appearance on the market of the first multirotors, this sector witnessed the rise of a new era. Michael Schmalzl, quick to realise the importance of this novelty, in the following year founded **Alpsvision** that, since then, offers films for cinema, television and advertising shot with multirotors weighing less than 25 kg.

In 2015, Schmalzl obtained his drone piloting licence, the first in Italy, and then went on to specialise as a pilot for professional services. He now plans to acquire drone piloting licences in Austria and Germany too.

Nowadays, drones are an unrenounceable device for filmmaking. These aircraft are no longer used only for traditional aerial filming but increasingly more often for short tracking shots too, thereby replacing the dolly, namely the camera mounted on rails or cranes. Aerial filming performed with drones is not only of much better quality, but it is also **economically more convenient and environmentally friendly when compared to that performed from a helicopter**. **Alpsvision** has very high quality equipment that can also shoot in mountain environments, such as the drones of the market leading brand DJI and those of the local dealer **soleon**.

Alpsvision has participated in several international movie productions such as “Hexe Lilli rettet Weihnachten” and the fiction produced by ARD “Meine Oma spinnt” (temporary title).

“The market has much larger potential, however”, firmly comments Michael Schmalzl, the Alpsvision drone pilot, who goes on to explain: “The international producers that decide to shoot in South Tyrol usually assign shooting to their own drone pilots who, for the most part, do not have a piloting licence for Italy but prefer to take the risk. At the same time, I too would be interested in shooting abroad, but each country has its own legislation. In short, I should get a piloting licence in every member State. We all hope that in the near future there will be harmonisation at European level”.

In addition to filmmaking-related activities, **Alpsvision** also offers, in cooperation with partner companies, services in the **agricultural and land surveying** sectors. **soleon** multicopters, for instance, allow to distribute efficiently and precisely the eggs of *Trichogramma brassicae* for the biological fight against the European corn borer, a corn crop parasite.

3

FlyingBasket: direct deliveries to mountain huts using drones

FlyingBasket, with headquarters in Ortisei in Val Gardena, is a start-up specialised in drone technology or, to be precise, and as the name suggests, in 'flying baskets'.

Matthias Vinatzer and the two brothers **Matthias** and **Moritz Moroder** work at developing drones and electronic and IT components for aircraft systems. With their latest project, the three professionals intend to conquer the mountain pastures. In 2018, **FlyingBasket** won first place at the 'Euregio for young innovators' award.

The idea of delivering food at high altitudes came during a mountain excursion, on which the Moroder brothers watched a helicopter delivering a load of foodstuffs. "We thought that the same operation could have been done with a large-sized drone, that would actually offer greater flexibility in terms of quantity and frequency of deliveries and a considerably more cost-convenient service", Moritz Moroder explains. Drones do what up until now only helicopters could do. "For a long time, only helicopters were able to lift off and land in the vertical and hover above ground for long periods of time. The advantages offered by our multicopters are considerable: **lower purchase price and maintenance costs**, **very high maneuverability**, **compact size** and consequently easy to transport. Our devices, moreover, **do not burn fossil fuels**, do not emit greenhouse gases and contribute **considerably to the reduction of sound pollution**", Moroder concludes.

The two brothers' interest in drones began back in the period of their computer engineering studies at the Free University of Bolzano. Since 2015, the Moroder brothers **have been designing and testing various types of multicopters to verify their flight maneuverability and stability**. The first tests were conducted without added loads and a weight at take-off of 50 kg. In their subsequent tests, the young entrepreneurs progressively increased the weight, until they reached 100 kg in payload, and an **operational weight at take-off of 160 kg**. The drone used by FlyingBasket measures 2.4x2.4 meters and has been developed **specifically for the transport of goods** by the Moroder brothers together with Matthias Vinatzer, who joined the company in 2016.

In autumn 2018, the specialised multicopter performed some test flights **to Alpine mountain huts** based on a special authorisation issued by the European Aviation Safety Agency **EASA** (mandatory for devices with take-off weight greater than 150 kg). The drones that fall within this category are subject to the same regulations applied to passenger aircraft. "Ours was the **first enterprise in Europe** to apply for authorisation for the aerial transport of cargo using multirotor drones with take-off weight greater than 150 kg", Moritz Moroder tells us. The young entrepreneurs have completed special drone piloting courses and now plan to obtain the so-called '**EASA** Type Certificate' that would enable them to widen their range of muticopter use throughout Europe.

"In Europe, the rules regarding the training necessary for piloting drones of this weight category are not clear", says Moritz Moroder. The brothers hope that the new European directive expected to come into force in 2020 will clarify this aspect.

FlyingBasket aims at **starting regular service in 2019**, provisioning Alpine mountain huts not only with foodstuffs but also with heavy equipment. Their goal is to offer complete service packages that start with the purchase of the goods and ends with its delivery via remotely piloted aircraft. This would allow the mountain hut manager to save time and money and also increase the frequency of food orders.

The entrepreneurs also forecast the use of **FlyingBasket drones for transporting loads** in the **civil protection** sector. Indeed, the multicopters could be used to provision remote areas that have been cut off from supplies due to landslides, avalanches, debris flows or other natural calamities, for example. Another service multicopters could accomplish is backing Alpine rescue operations, which often require considerable quantities of material to be transported over impervious terrain. With their capacity to transport loads of up to 100 kg, the multicopters could significantly help rescuers by quickly transporting material from the valley floor to the high altitude location of the rescue operation. One may also imagine using them for conducting various kinds of geological surveys, since their maximum load capacity is enough to transport the measurement equipment used by surveyors.

4

MAVTech: research, development and consulting

MAVTech (micro aerial vehicles technologies) is a pioneer in the drone technology sector in Italy. The company was founded in 2005 as a spin-off company of **Politecnico di Torino**. MAVTech currently operates as a technology company of the **NOI Techpark** of **Bolzano**.

“The first objective of the company was to develop fixed-wing aircraft. The drones fitted with so-called fixed wings were standard fare at the time. Rotary wing drones, as we see them today, emerged only at a later stage”, Gianluca Ristorto of MAVTech explains.

MAVTech aircraft were initially used for monitoring rice crop fields in the Po Valley. The transfer of the company from Piedmont to Bolzano (South Tyrol) took place within the context of the SMILE project, focusing on monitoring the **health status of crops**. Consequently, MAVTech intensified the **development of drones with built-in camera and sensors**, such as the **Q4E drone** and the **Agri 1900 drone**, **destined for use in the agricultural sector.**

“Our interest and commitment are aimed at further developing the sensors”, says Gianluca Ristorto, and then continues, “we have collected a series of photographic and multi-spectral data of the vineyards around Merano, which we will now match with the soil sample data given us by the Laimburg research centre. We hope to be able to provide vine farmers with greater and more useful information regarding the health status of their vineyards. The primary objective of the project is to reduce the use of pesticides and therefore improve the quality of wines”.

In recent years, MAVTech has also gained further experience within the context of the **WEQUAL** and **SASNET** projects and in the development of **drones designed for civil protection and Alpine rescue operations**.

The company currently creates, develops, manufactures and sells high-tech aircraft with built-in equipment and ground stations. MAVTech is also an acclaimed **consulting company**. It has been an **ENAC certified company** since 2014 and as such it is authorised to provide support for the certification of operators of Remotely Piloted Aircraft Systems (RPAS). Within this context, via the SAPR and SAPR2 projects, the company has also succeeded in defining the criteria for assessing the amount of hazard these aircraft pose to humans, that are then used for operational risk assessment.

5
soleon: “We make your project fly”

“In 2009, our passion for flying and for the new multicopter technology led us to design our one line of aircraft. In the beginning, we designed custom multicopters for specific needs. A few years later, the requests coming in from our clients convinced us that we should design, manufacture and sell the devices outright. We intuited their high potential, especially when used for agricultural and surveying purposes”, explains Michael Überbacher who is renowned in the sector for his ingenious resourcefulness.

In 2009, Michael Überbacher founded **soleon**, with headquarters in Varna. Since then, the entrepreneur has been **developing** professional-use drones up to 25 kg in weight, **custom designed** to the clients’ needs, and creates innovative projects together with his partners.

His projects include drones to be used for a wide range of applications, including agriculture, surveying, civil protection, filmmaking and photography. **soleon** offers tailored solutions for **organic parasite control** against, for example, *Cydia pomonella* (an apple tree pest) and the European corn borer. The **soleon DisCo** distribution system used for this purpose is patent pending and has already been requested by countries around the world: Europe, Uzbekistan and recently Brazil. The company also designs drones for surveying using photogrammetry, laser scanning, aircraft for thermographic detection, for use in agriculture and for scientific projects conducted by universities and research centers. The users of **soleon** drones include universities, surveyors, farmers as well as archeologists and artists.

6
UP Caeli Via: vertical take-off

In recent years, the aviation sector has witnessed some substantial changes. Some companies are firmly convinced the mobility in the future will be airborne. One of these is **UP Caeli Via** owned by Gianni Baggio, with headquarters in the NOI Techpark. At UP Caeli Via, the key word is **VTOL**.

This acronym stands for *vertical take-off and landing*, a technology that enables aircraft to take off and land in the vertical, without taxiing, and is applicable to both airplanes and drones. Next to the great airplane producers, many start-ups today are building electricity-driven, vertical take-off and remotely controlled aircraft, which means that the "flying taxi" is literally just round the corner.

UP Caeli Via is designing a new **technological platform** that will allow the future development of small and medium-sized VTOL aircraft as well as ultra-lights. The aircraft made by UP Caeli Via are designed and manufactured **in the R&S department inside the company** according to the specific requirements of its clientele that comprises civil protection, police and emergency response departments such as Alpine rescue centers and firefighting brigades.

UP Caeli Via applies an innovative kind of technology that enables its drones to fly for significantly longer periods of time compared to conventional rotary wing drones. Thanks to their advanced maneuverability, quadcopters are the most popular drones today, but these devices are only battery-powered and therefore have a short flight range. The drones designed by UP Caeli Via instead are **hybrid vehicles** equipped with combustion engines or hydrogen chamber engines matched with electric cell motors and are the new generation of VTOL drones, capable of merging the vertical take-off capability of drones with the flight range of an airplane.

UP Caeli Via aims to fulfil one of mankind's greatest dreams: autonomous flight with PAV (personal air vehicle). This dream could become reality thanks to a lightweight and flexible vertical takeoff aircraft, the "Ferrari of the skies", as Gianni Baggio rather proudly defines his prototype that would allow to shorten travel time by 75% compared to an automobile. "This would have extremely positive repercussions on the quality of life of every human being. It seems utopian, but instead it's a concrete project we are currently working on! I plan to present my first model, that will be about the size of an ultra-compact car, in 2021 at the Dubai Air Show", explains Gianni Baggio, who aims at making UP Caeli Via one of the market leaders in the production of VTOL aircraft.

7

Wörndle & Partner: what is hovering over the nature reserve?

The preservation of natural assets and the sustainable development of tourism in South Tyrol envisage the need to limit the use of drones within the protected areas. The issue is currently the main topic within the alpine.expert/rpas working group of IDM Alto Adige. The task of defining exhaustive rules for this has been assigned to Michael Schmalzl of Alpsvision, Ortisei, and to Thomas Wörndle, of the legal firm Wörndle & Partner, Bolzano. The provincial legislation currently in force could be complemented with the proposals they will come up with.

To date, South Tyrol **does not have any laws** regulating the use of drones in protected areas, but only rules applicable to motor aviation. In South Tyrol the law establishes that in protected areas (all of the province's territories above the altitude of 1,600 m are considered protected area) motorised aircraft must fly at least 500 metres from the ground. At national level, current provisions established by the national civil aviation authority (ENAC) regarding drones envisage a maximum height of 150 m off the ground for professional use and 70 m off the ground for recreational use.

In line with environmental protection and tourism development requirements, Schmalzl and Wörgle think it would be more useful to make a distinction between recreational flying and professional use, thereby forbidding the use of recreational drones in specific protected areas, extended at least to nature reserves and to UNESCO heritage sites.

- The following regulations could be envisaged: aircraft weighing up to 250 grams: no distinction between model airplanes and drones, no flight restrictions within the context of the ENAC regulation, no obligation to notify or ask for authorization for flying in protected areas.
- Aircraft weighing between 250 grams and 25 kg: restriction of flight to drones that are registered and authorised for professional use, as well as to operators holding piloting licences, at least within the nature reserves and UNESCO heritage sites; obligation to complete an environmental protection awareness course and obligation to notify the planned flight duration to the Nature Reserves Office and to the Forest Administration Office.
- Aircraft weighing 25 kg and more: in all protected areas, restriction of flight only to registered drones for professional use and to operators that have completed an environmental protection awareness course. Authorization issued by the Nature Reserves Office, obligation to notify the South Tyrol Mobility Division and the Forest Administration office.

8

PIXAIR Drone Solution: geology from the air

“When we started, in 2014, we experimented with many types of drones, cameras and software packages. Today, I work mainly for South Tyrolean drone developers. In this way I can develop special drones for our geological surveys”, Alessandro Bozzani of Pixair explains. Drones, measurement equipment and software today make it possible to conduct land surveys that were unthinkable just a few years ago.

In an age of climate changes and, consequently, of increasingly frequent rainfall and landslides, the monitoring of rock walls and soils, of waterways and lakes is becoming increasingly important. In 2014, geologist Alessandro Bozzani founded Pixair as the new branch of the company Geoprobe SAS, a company that since 2005 has been operating in the field of land surveys and monitoring in support of environmental and geological studies.

“We are interested in aerial photogrammetry and in 3D data processing. Thanks to the new drone technology and to the continuous development of software, much has been done for us geologists” Alessandro Bozzani reports. The surveying required for monitoring rock masses, for example, once required that geologists get into their harnesses and climb the rock wall. Now a part of this work can be done with the help of drones, that allow to check larger surfaces in a shorter time and at lower cost. “Drones, however, cannot replace people entirely”, Bozzani stresses, “but we can work on the wall in a much more targeted manner”. By using 3-D models and storing the data and documentation of the conditions of a critical site it is now possible to make reliable forecasts.

According to Bozzani, as a geologist, photogrammetry is the work tool par excellence. It not only allows to monitor rock walls and soils, but it also can be used to conduct studies for the construction of tunnels or for archeological site research. Once completed, a georeferenced 3D model can be used as a basis for the processing of the geological context under many different points of view - something that is immensely important in the design phase.

Alessandro Bozzani is one of the drone pilots certified by ENAC. In non-critical contexts, Pixair works with drones that weigh from 2 to 25 kg. These drones, however, are also equipped with all that is necessary to operate in critical settings. In the latter cases, though, Pixair must apply each time to ENAC for the necessary authorization.

Since its establishment, Pixair has participated in various international research projects, such as the one conducted on the shores of Lake Bolsena in Lazio. There, Pixair conducted a large number of flights for archeological survey purposes. In this case, aerial photogrammetry helped the researchers document their project, and the drones were of great help in fly-overs and in the 3D representation of submerged portions of ancient Etruscan settlements. These renderings were made possible thanks to specific algorithms developed and tested by Pixair. The software designed by the company can be of great help also to power companies, since it is capable of detecting sediment deposits at the bottom of a water basin. This way, it is possible, for example, to assess the natural silting up of artificial lakes and dams.

In the meantime, however, drones have become indispensable also in the field of digital mapping of arduous land areas. The data collected by the drones provide a much more detailed landscape and altimetric variation model than ever before. To this end, Pixair has developed an application that depicts the ground correctly, regardless of its vegetation cover (unless it is excessively thick).

9

WEQUAL project: monitoring the green infrastructures

Water is one of mankind's most precious assets, as it is the source of life for all living beings and for ecosystems. The WEQUAL project (derived from the abbreviation of WEb service center for a QUALity multi-dimensional design and remote-sensing monitoring of Green Infrastructures) is focused on **monitoring river ecosystems** and envisages the creation of an online platform with a built-in geo-information system (GIS), capable of helping technicians and administrators in assessing the ecological health of the green infrastructure. The **environmental monitoring is performed using drones**.

The data used in these assessments are collected either via traditional surveys or with the help of high-tech sensors mounted on the drones. The drones are used to shoot from the air, to make optical distance measurements using LiDAR sensor technology and to film the energy reflected off the earth's surface at the various wavelengths of the electromagnetic spectrum. The web platform of the project is currently being constructed. Its launch online is planned for the summer of 2019. To date, the surveys are being conducted in the Lagundo area of the Adige River, on the Rio Passirio near Scena and on the Rio di Tel near Parcines.

The data collected during the WEQUAL project will be also used for planning future actions in river areas. The online database will be placed at the disposal of the engineers, ecologists, geologists and public administrators in charge of monitoring the riverways and of securing the territory. The WEQUAL project is being conducted together with the **Free University of Bolzano**, **Maccaferri Innovation Center**, **MAVTech** and **Naturstudio**. In 2018, thanks to her work in WEQUAL, Nadia Zorzi of the Maccaferri Innovation Center ranked third at the "Euregio young innovators award".

10
SASNET: a swarm of drones for rescue operations

Excellent results in the shortest time possible: this is the declared objective of the R&S project **SASNET**, launched by the companies **Digital Lightning** and **MAVTech** together with the rescue organizations Croce Bianca and Aiut Alpin Dolomites and with the support of the Carabinieri and civil protection forces.
SASNET stands for SAprSwarmNETwork and defines a swarm of four or five drones with own fixed or mobile charging station. The drones are connected via a Wi-Fi mesh network that allows the exchange of data among several devices. The communication network of the drones remains active even in weak signal areas because the drones connect to the network hub that emits the strongest signal. The intelligent swarm of drones for Alpine operations will allow the unmanned aircraft to recognise potential risks more efficiently and faster, remain in flight longer and over longer distances.
The drone swarm is useful, for instance, along mountain trails where the concentration of tourists is high, during bicycle races, near lakes and in the surveillance of industrial areas. The use of an intelligent swarm of drones can be very useful during rescue operations, in which they can help in the search of people dispersed or lost in unreachable areas and by providing an overall picture of the situation in the event of emergencies at high altitude. Another goal is to reduce operation times.
With SASNET, the technology companies **Digital Lightning** and **MAVTech**, both of which hosted at the **NOI Techpark of Bolzano**, plan to develop a system capable of piloting a swarm of drones in sync and of working semi-autonomously, under human supervision. “We would like to organise the first flight demonstration together with Croce Bianca in early 2019. During the development phase, the power consumption and weight of the drones turned out to be critical points. Luckily, we have already optimised the power consumption and weight of the five drones of the swarm we are working on”, confirms Riccardo Tallon of **Digital Lightning**.
The entire product development by **Digital Lightning**, with headquarters in Padua and Bolzano, is focused on the Smart City strategy and, in particular, on the intelligent connection of lighting and traffic control at public level and of charging stations and hot spots at private level. Digital Lightning develops applications concerning power saving, security and traffic flow improvement. Within the context of the **SASNET** project, Digital Lightning designs the **Wi-Fi mesh application** for the drone swarms and creates the **charging station prototypes**. The stations are mobile platforms (placed on a car’s rooftop, for example) or fixed platforms (for the long-term monitoring of hazard areas such as sensitive landscapes or industrial areas, for example). Drone battery changing is performed automatically and takes just a few minutes. **The Wi-Fi mesh and the charging stations make it possible to use swarms of unmanned drones for longer operations covering larger areas.**
Within the SASNET project, **MAVTech** is in charge of designing and prototyping the drones. MAVTech was founded as a spin-off company of **Politecnico di Torino** and today has its headquarters at the **NOI Techpark**. The company operates in the fields of development, production and sale of high-tech aircraft with built-in instruments and ground stations.

Future prospects

The drone market is growing quickly in all directions: sports, recreation and professional uses. If the producers and suppliers could have their way, there would not be any restrictions on autonomous flight. This does not exclude the fact that there are some issues, however, concerning the technological challenges to be overcome, the questions about their economic potential and the questions regarding new applications, such as the field of civil mobility for example.

Amendment of the current legislation

The most important challenge today concerns the **integration of drones in national and international air traffic**. Every EU member state is now applying its own regulations. The harmonisation of these different regulations that today are quite divergent is one of the future challenges to be met.

In the early drafts of a homogeneous European regulation, the focus is on defining the **regulation for the use of drones for practical purposes**, especially **civil protection** ones. When the flight is performed in the course of rescue or civil protection operations, the pilots are always performing so-called **"critical operations"**. This often implies flying over densely populated areas and, furthermore, the pilot may be forced to fly in absence of visual contact with the aircraft and to make the aircraft and the material it carries fly over arduous and difficult-to-reach areas. A concrete example of this are the **operations conducted on steep mountain slopes or in fog and bad weather conditions**.

The proposal for the new EU regulation envisages the possibility of defining civil protection operations based on a standard scenario and of concluding *a priori* the long process concerning the approval of critical operations, so as to guarantee the legal coverage of said operations.

Within the context of the **Arge Alp EVADAR project**, the **alpine.expert/rpas working group of IDM Alto Adige** is especially active in this sense and prepares concrete proposals in cooperation with various local and transnational rescue organisations. The **regulations currently in force and the current standard scenarios defined by ENAC** are available at the following **link**.

Technical challenges

Following the progressive upgrading of the basic structure of the drones that has occurred in these past few years, current development is focusing on the definition of **uniform industrial safety and production standards relating to the outfitting of the aircraft.**

The all-round introduction of **4G and 5G mobile networks** has speeded up pilot-to-drone data transmission. The **basically perfect synchronisation of the data** results in greater aircraft piloting precision and opens new prospects for flights **partially conducted without visual contact with the aircraft**.

The new mobile technology also allows for progress in **fully automated flight**. Existing safety technology such as the **obstacle recognition system**, the **geofencing (i.e. localisation with respect to virtual barriers), the detection of weather conditions and the autopilot for safe landings,** are allowing us to achieve increasingly better results thanks to the progress made in the transmission of data and in the communication within 4G and 5G networks. The risk of losing the data is practically annulled.

Therefore, the **future focus of innovation** is on the development of new sensors, on the size reduction of components, on the further development of information and communication technologies, on the network and automation technologies and on the designing of ultra-light aircraft for long-term missions.

Economic potential

In order to be able to develop further, drone technology must also prove to be beneficial in terms of costs. **Precision agriculture** is a sector in which companies have a chance of quantifying the economic impact the use of drones has on their clients. The targeted analysis of the data collected during flights over crops, for example, can help **reduce the costs** incurred for seeds and pesticides. The lower concentration of toxic substances and the greater precision in plant treatments in turn brings an **increase in the quality** of the crops and favours the **preservation and protection of the soil** and of the crops themselves.
Mobility is certainly one of the most interesting sectors. In this case, drone technology could play a crucial role in the very near future. Drones, that currently still require the presence of a pilot, in the future could become capable of flying without human assistance. In just a few years, the delivery of our mail and packages could be done by a drone (and no more by the postman). Tests are also currently being performed on the so-called '**travel drones**', i.e. devices capable of autonomously reaching their destination, of flying in formation, of planning routes and of avoiding obstacles. Aircraft of this kind must be capable of acting in an intelligent manner and of taking decisions autonomously.
An essential role in research and development is that played by the **drone test centers** such as decommissioned airports or other large complexes. Research and development, technical demonstrations of flight projects, test flights with methods still subject to legal limitations and piloting without visual contact: all this can be performed at the test centers.
A preliminary assumption for the creation and the safe and economically convenient management of these centers is the existence of a network of potential users coming from various sectors and willing to work together. A test area could bring together, for example, various figures such as service providers, developers and producers, flight instructors and maintenance technicians. Public interest organisations such as rescue and civil protection entities are important partners that should be involved, too.

Glossary

Precision agriculture: the targeted actions performed on single areas or plants within a cultivated surface, such as specific actions on soil conditions or on parasite-infested plants, for example.

alpine.expert: a platform that brings together South Tyrolean enterprises, research institutes and experts working in the Alpine skills sector. The platform is coordinated by Ecosystem Sports & Alpine Safety of IDM Alto Adige.

alpine.expert/rpas (work group): this group is composed by South Tyrolean researchers, enterprises and other stakeholders operating in the drones sector. The group, hosted by Ecosystem Sports & Alpine Safety of IDM Alto Adige, interconnects enterprises, scientists and experts in order to stimulate drone technology and the economic activities linked to it.

Drone: a remotely piloted aircraft. The term, that initially referred especially to military drones, today is used to generically indicate unmanned aircraft.

ENAC: *Ente Nazionale per l'Aviazione Civile*, the Italian Civil Aviation authority that issues authorisations and certificates to drone pilots.

EVADAR: *Emergencies handled using remotely piloted aircraft in difficult-to-reach and hazardous areas.* An Arge Alp project that from 2015 to 2017 analysed the potential of the data collected using drones in support of civil protection and soil defence operations, of environmental protection and of land and landscape mapping operations.

Lidar: *Laser Imaging Detection And Ranging*. A surveying method similar to radar, used for measuring the distance and speed of an object; unlike radar, that uses radio waves, Lidar is based on pulsed laser light.

Environmental monitoring: the observation and documentation of the environment from scientifically significant viewpoints; monitoring is important for agriculture and for forest management, for the development of town-planning programs and for the protection of the environment.

Multirotors: aircraft equipped with two or more propulsion rotors; the term here indicates unmanned aircraft, namely drones.

Critical flight operations: according to Italian law, any flight operation that envisages flying over urban built-up areas, overcrowded areas, train stations, airports, industrial infrastructures and gatherings of people is defined as critical.

RPAS: *Remotely Piloted Aircraft Systems*. The term is used especially by ENAC to indicate unmanned aircraft, namely drones.

Flying taxis: in 2017, a taxi capable of automated flight made its first test flight in Dubai – but without passengers on board, for the moment. The aircraft, that looks like a helicopter,

has a flight range of half an hour. Large automotive and aviation industry players such as Boeing, Toyota and Porsche are investing in the development of flying taxis.

UAV: *Unmanned Aerial Vehicle*. Currently the most commonly used term to indicate a drone.

Hybrid vehicle: a hybrid electric vehicle combines a combustion engine with an electric engine. Hybrid drones can overcome the problem of limited flight range typical of aircraft with combustion engines.

VLOS: *Visual Line Of Sight*. Based on current legislation, flight is allowed only if the pilot stays in constant visual contact with the aircraft.

VTOL: *Vertical Take-Off and Landing*. Technology that enables the aircraft to take off and land without a runway.