

DronEx - FESR1048

terracube
eurac research

Deliverables di progetto

Ed. n. 1
Rev. n. 0

Pag. 4

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Südtirol · Alto Adige
Europäischer Fonds für regionale Entwicklung
Fondo europeo di sviluppo regionale



AUTONOME
PROVINZ
BOZEN
SÜDTIROL



PROVINCIA
AUTONOMA
DI BOLZANO
ALTO ADIGE

Deliverable 5.2

WP5: Apertura del servizio

Ricerca di mercato

Edizione n. 1
Revisione n. 0

Preparato da
Dott. Andrea VILARDI
(Responsabile Tecnico)

Approvato da
Dott. Andrea VILARDI
(Responsabile Tecnico)

Data 12/02/2021

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Stato di aggiornamento

Edizione / Revisione	Data	Note
Ed. 1/ Rev. 0	12/02/2020	

Numero di pagine valide

Questo documento è costituito complessivamente da **4** pagine.

Sommario

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Premessa

Diversamente da quanto preventivato in sede di definizione della proposta progettuale, la ricerca di mercato relativi ai servizi oggetto di test è stata assegnata alla struttura del NOI TechPark, in virtù della rete di relazioni e delle consolidate esperienze nel settore degli UAV sviluppate negli anni all'interno della stessa.

Tale approccio ha generato due importanti benefici per il progetto:

1. La ricerca di mercato è stata svolta senza esborso di fondi da parte di Eurac, e quindi senza aggravio di spesa per il progetto;
2. I servizi oggetto della ricerca sono stati naturalmente integrati all'interno del più vasto pacchetto di offerta del NOI TechPark.

Nel seguito del presente documento si trasmette la versione ridotta e priva di informazioni sensibili di tale ricerca di mercato. Ulteriori dettagli sono in possesso di Eurac Research e sono stati utilizzati nello sviluppo del progetto.

Allegato

Ricerca di mercato

TESTING DRONES IN HARSH ENVIRONMENT

A SURVEY FOR TERRAXCUBE
PUBLIC EDITION

“Looking forward to a potential engagement.”
Jacques LeClair
CEO of BC Air Guards, British Columbia, Canada

Client: EURAC TerraXCube

NOI Techpark (2020): Needs analysis for TerraXcube.
Volume of methods and tables for an empirical survey.

Bozen: NOI Techpark

Project Management: Sebastian Mayrgündter

Bolzano - Bozen 2020.

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Executive Summary



Credits: TerraXcube, EURAC

This survey highlights a variety of challenges and opportunities that testing drones in harsh environment face and the service developed by the TerraXcube. Besides a changing nature of the technical challenges, the need for service within the industry is also different.

Participants which do use drones in their business were asked about what purposes they use their drones. The results revealed that for the future agriculture, monitoring / public safety and transportation with drones are interesting, while at the moment the predominant business cases are found in agriculture, aerial photography and mapping.

Whilst almost the drone operators want to explore the new opportunities created within the new European Regulation such a long distance-flying (BVLOS), science and manufacturers need to test propeller / UAV aerodynamics and electric components. Nonetheless the technological complexity of unmanned aerial vehicle (UAV, commonly known as a drone) the battery is still considered the most critical component. The ability of TerraXcube to vary temperature and wind are important for the drone sector and specially for the performance test of the battery also altitude is an important variable.

Testing UAV indoor, but also outdoor, appears to have a fundamental role in the product development of the industry. This reflects a technology ready to move from the conception phase to the next phase near the market introduction. Finally, when asked about the need of innovation services for the drone industry, respondents revealed that networking & cooperation and support in R&D projects will play a pivotal role in the industry in the coming years.

Contacts:

Andrea Vilardi

Hypatiastr./Via Ipazia 2, 39100 Bolzano/Bozen, South Tyrol –Italy

W: <https://terraxcube.eurac.edu>

M: terraxcube@eurac.edu

T: +39 0471 055 550

Background

The impact of extreme environmental conditions on drone flight has become a major topic in UAV science. Many of the existing applications designed for drones (e.g. precision agriculture, delivery of instruments or medical supplies) have not been fully exploited by the market so far. This is due to the lack of existing knowledge about drone flight under variable weather conditions. In the literature, there are no systematic studies that analyzed the success or failure of a drone flight, based on the variability of climatic conditions. Moreover, a bias in the existing tests has been the non-reproducibility of the same climatic conditions.

The outcomes of the project are mainly testing procedures for companies interested to better understand the performance of their drones under stressful environmental conditions. This kind of new competence developed in the project could be part of a larger strategy for the development of the UAV sector in South Tyrol. Some elements of the strategy are given in the last paragraph of the present report.

Objectives of the study

The aim of the study is to identify possible clients that can take advantage of the services that have been developed in the project “DronEx”. The basic assumption is that producers of drones face a lack of existing knowledge about UAV flight under extreme environmental conditions.

The determination of the topics can be done in different ways: by scientific approach studying relevant publications or by empiric methods predicting beneficiaries of the services of a testing facility for drone performance analysis in extreme environmental conditions.

This last approach, which is chosen here, has the disadvantage that it does not predict medium and long-term needs, but it has the advantage that it is able to determine the challenges that companies are dealing with in the short term. Thus, the objective of the study is outlining a short-term needs analysis for

- Applications, where drones can give a benefit
- Technology tests, especially components
- Requested services

To better understand the needs of possible clients terraXcube requested the following topics to be clarified

- Weather/environmental conditions for operation
- Difficulties related to environmental conditions, especially icing
- Mitigation measures to adverse environmental conditions
- Need of data about the UAV or its components in different environmental conditions
- Range of the temperature (in the range between -40°C and +60°C)
- Range of pressure (in the range between 0 and 9000 m SLM)

In addition to that, aim of the present report is to show how the added value produced by the project DronEx could be integrated into the larger and more industrial-oriented framework of the NOI Techpark.

Methodology

For the study outlined above, a full empirical survey of three relevant groups is being conducted, based on a standardised questionnaire. The groups can be described as follows:

A) Experts of the company network of NOI Techpark

The use of civilian drones South Tyrol and the further development of this technology are the focus of the RPAS network in the NOI Techpark. Here, companies and start-ups work closely with the research institute EURAC Research, the free university Bolzano – Bozen, the Agency for Civil Protection, the Italian air traffic control authority (ENAC) and a European partner network.

Contacted persons: approx. 40

B) Members of UAV Dach

The UAV DACH e.v. exists since year 2000 and is the most experienced association for commercial unmanned aviation in Europe. It represents the interests of 175+ corporate members from research, manufacturing and application located in Germany, Austria, Switzerland, Italy, Spain and the Netherlands. UAV DACH stands for acceptance, safety, reliability, quality and promotion of unmanned aviation. With the expertise of its members, UAV DACH supports the development of regulations and laws at national and international level. UAVDACH has been founded from far ahead looking visionaries in industry and administration for gathering the interests and power of a developing industrial segment together. The proven reputation of UAV DACH e.v. is based on their strong and international members, with their expertise and their economic strength. UAV DACH exists of corporate members and therefore it represents the leaders of a major market share in Europe's UAS markets. Since three years the numbers of members are growing rapidly mostly because of the the rise of new European regulations and the uncertainties incurred by this change. the strong community and the mutual support help each member to develop its individual market and provides opportunities within this new, rising market of applications with commercial unmanned aviation. UAV DACH is a premium partner for developing new standards in regulations, regulations and developing new legislation on national and European level. Our members and working groups are taking advantage from this early stage of involvements in the future shaping of UAS business and UAS markets.

Info: <https://www.uavdach.org>

Contacted persons: 464

C) Members of UVS International

UVS International is a non-profit association founded in 1995, registered with the Chamber of Commerce & Industry in The Hague, The Netherlands and operating out of offices in Paris, France. The association's focus is on the promotion of the use of remotely piloted systems (air, ground, naval, space) of all types, sizes & classes, and their relevant sub-systems. Particular attention is paid to civil remotely piloted system operations-related policy, rules & regulations, and standards (industrial & product safety). UVS International represents manufacturers and operators, as well as service supplying companies (including ANSPs), state organisations, regulatory authorities, academic institutions, and partner organisations.

Info: <https://uvs-international.org>

Contacted persons: 119

The questionnaire was presented as an online questionnaire. The target persons were contacted by e-mail.

Realisation of the survey

Together with the experts from terraxcube we have developed a questionnaire with 23 questions regrouped in 5 sections. The sections are

- Section 1: General (question 1 – 3)
- Section 2: Technical challenges (question 4 – 7)
- Section 3: Testing facility (question 8 – 10)
- Section 4: Innovation services (question 11 – 17)
- Section 5: Personal information (question 18 – 23)

The population of the present survey was 616 experts nominated from the NOI Techpark network. For these experts, the name, the associated organisation and the email address were provided, so that they could be invited to participate in the survey directly on 27.02.2020 and on 04.03.2020 by email.

At the 1st mailing on 27.02.2020 616 persons were contacted. 601 target persons could be reached. 189 persons opened the mail and 50 of them opened the link to the questionnaire (click-through rate: 6.98%).

In the 2nd mailing on 04.03.2020, every 597 persons who had not yet completed the questionnaire were contacted again. A total of 578 target persons were reached. 184 persons opened the mail and 46 of them opened the link to the questionnaire (click-through rate: 6.92%).

On 08.03.2020 Dr. Achim Friedl from the UAV DACH office invited 470 members of UAV DACH to participate in the survey.

Finally, 35 of the identified target persons have answered completely sending out complete questionnaires and could be included in the analysis. The average response time was 16:39 minutes.

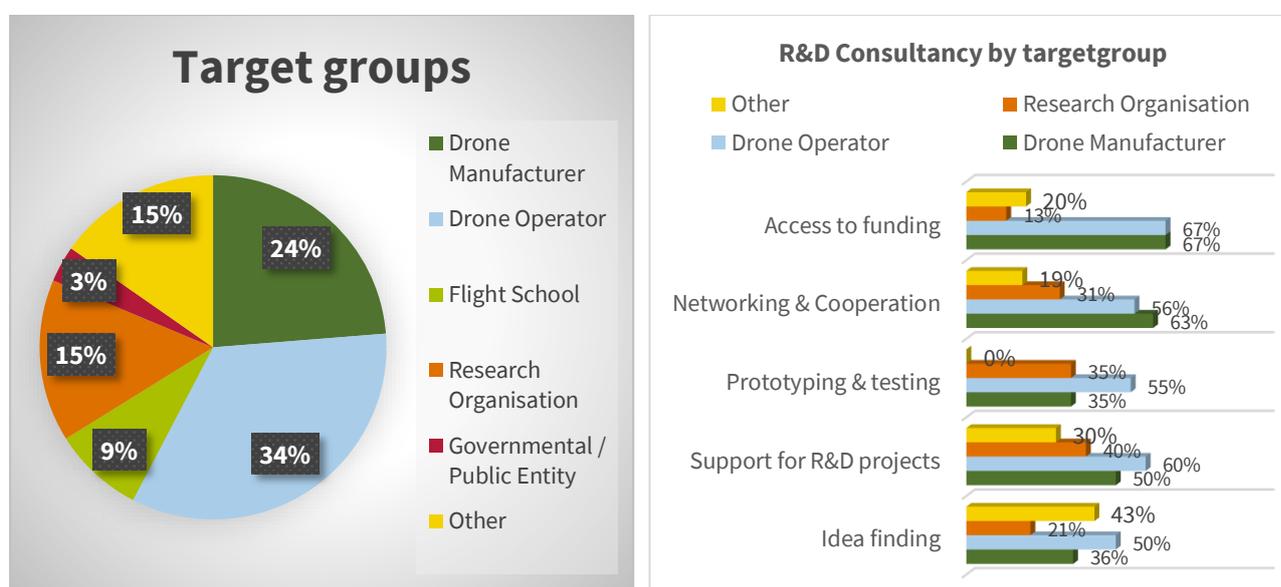
Results

In the Annex 2 you will find the results of the survey in the order of questions of the questionnaire. The diagram usually shows the percentage Overall distribution of responses. In some graphics several questions are displayed simultaneously. The following are not displayed all response categories are displayed as percentages, but a meaningful summary the answers, e.g. partial and full approval.

In order to focus the attention on the most meaningful results there have been selected some outputs to analyse detail. Aim is to favour the development of the industry reducing the time to market of the technology where the new capabilities developed thanks to the **DronEx project** are useful. Further support is needed to valorise new services and applications.

A. TARGET GROUP

In order to ensure the highest possible customer satisfaction in the long term, it is necessary to find out detailed information about the market with the help of a target group analysis. For this study we defined 5 groups along the hole value chain in order to identify the specific needs of possible user groups. Multiple answers were possible.



34% of respondents declared themselves as **drone operators** and they are responsible for most of the existing business cases. Technical challenges are low temperature, high altitudes and strong winds. A common problem they face is in flight loss of propulsion system. Drone operators have a stronger preference than the given population for testing BVLOS flight in an alpine outdoor-testrange. More than 85% of the drone manufacturers are also operators.

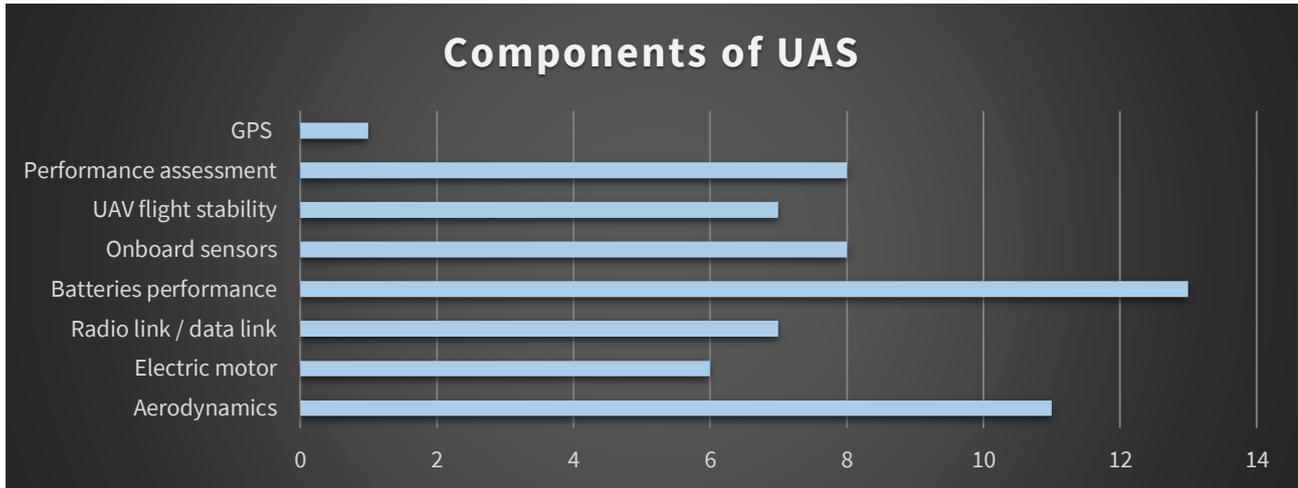
24% of respondents declared themselves as **manufacturers** representing 12 companies. Their existing business cases are agriculture or monitoring. Technical challenges for them are mainly low temperatures or high altitudes. For this target group “icing” is a problem and they need to test propeller / UAV aerodynamics and electric components. Attractive services are B2B meetings with local partners and information about European R&D funding.

8 **research institutes** participated in the survey. Applications that are planned to develop in the future are in agriculture, monitoring / public safety and transportation with drones. At the moment, they are interested to test BVLOS and automation in extreme environment. Also for this group B2B meetings with local partners and information about European R&D funding are an desired service along with prototyping as innovation service.

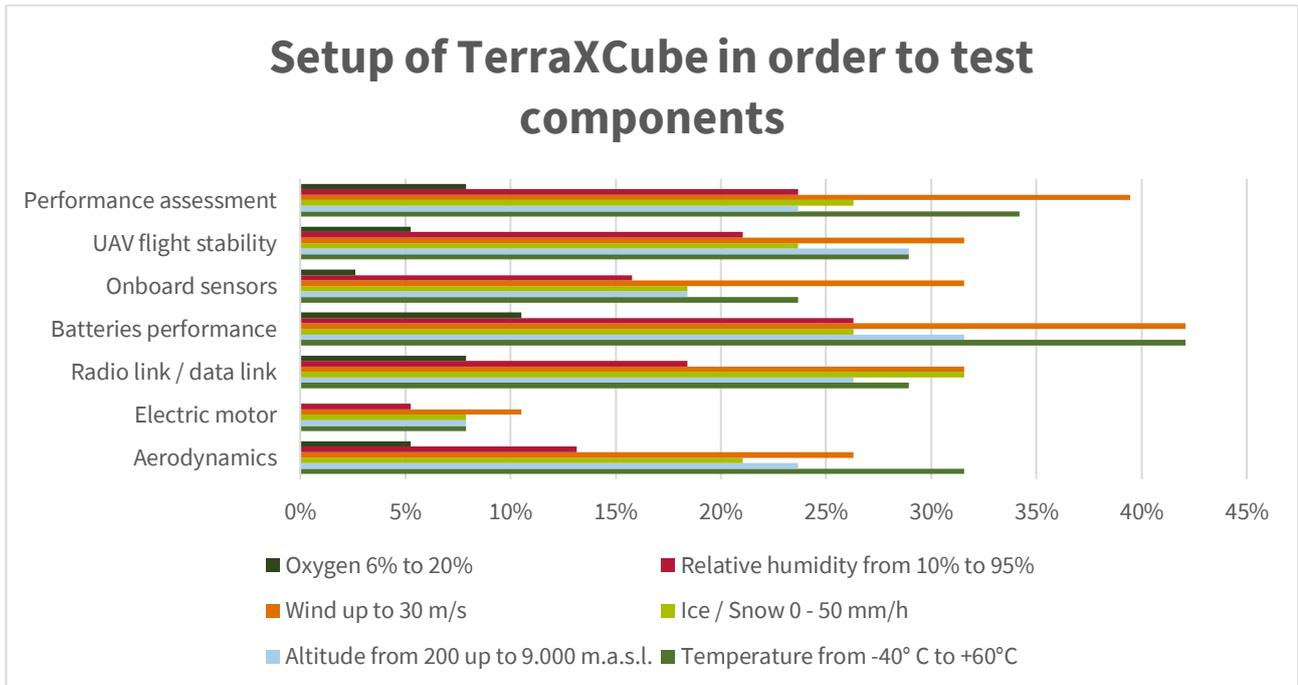
Others are organisations seem are players interested in technology development and implementation such as ACEN-TISS GmbH, Ottobrunn or Daimler AG, Stuttgart.

B. TECHNICAL CHALLENGES

A drone’s ability to contribute to the development of various economic sectors will increasingly depend on their ability to operate in difficult environments. Various critical components have to be tested for this. How does outdoor temperature affect wear and tear on the system’s electromechanical components? Is it possible to optimise battery use according to environmental parameters? In order to get information about the need for testing we ask what components of the drone need to be checked. From this insight we expect to unveil the competences that are needed in the testing facility in order to solve the problems of UAS.



The ability to test the technology under controlled conditions that simulate hostile environments is an important contribution to the industry’s progress. In fact, the technical characteristics of the TerraXCube offer the possibility to test UAS, including the payload, in different environmental conditions. It is important to understand which features are considered relevant for testing the specific components of the UAS. The following table shows the preferences of the participants of the survey for the changeable parameters of the test infrastructure.



Annex 1: Questionnaire

With this survey we would like to understand your needs for the development of drones, including the types of services you would benefit from. The outcomes of it are then summarised in a position or white paper. The survey, created together with NOI Techpark, explores the interests and behaviours of the drones' community regarding potential tests and examinations in an extreme climatic environment.

SECTION 1: GENERAL

1. Please select your core activity

- Drone Manufacturer
- Drone Operator
- Flight School
- Research Organisation
- Governmental / Public Entity
- Other

2. For which application do you use drones? *

	Existing Business case	Very frequently	In development	Sometimes	Planned for the future	Never
Aerial photography	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Construction & real estate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Agriculture - precision farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Search and rescue (SAR)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring of infrastructures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wildlife Conservation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transport of goods or persons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mapping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What type of UAS do you usually employ?

- Fixed wing aircraft
- Helicopters
- Multicopters
- All of them
-

SECTION 2: TECHNICAL CHALLENGES

4. What technical challenges have you ever faced while flying? *

	Always	Very often	Often	Sometimes	Rarely	Never
Low temperature	<input type="radio"/>					
High altitude	<input type="radio"/>					
Strong wind	<input type="radio"/>					
Other areal vehicles	<input type="radio"/>					
Missing data link	<input type="radio"/>					
Magnetic interferences	<input type="radio"/>					

5. Please select technical problems you have experienced while flying in un-conventional environmental conditions

- Ice accretion on propellers
- In flight loss of propulsion system (one or more motors stop running)
- Flight shutdown
- Loss of control (unstable autopilot behaviour)
- Loss of communication link between RC and onboard transmitter
- Sudden battery discharge
-

6. Testing which of the following topics would be most valuable to you? *

- Propeller / UAV aerodynamics
- Electric motor and electronic speed controller
- Radio communication link / data link
- Batteries performance
- Onboard sensors
- UAV flight stability & controllability
- Performance: assessments can include usability, functionality, durability, or endurance testing
-

7. What would you like to test in extreme environment? *

	Essen- tial	Im- portant	Desira- ble	Attrac- tive	Nice	No need
Scenarios of interest for the mountain rescue	<input type="radio"/>					
Flying in a variety of environmental factors (vertical rock walls, plants, water, gorges,)	<input type="radio"/>					
BVLOS	<input type="radio"/>					
Automation / instrumental flight (3-4 km)	<input type="radio"/>					
Transport flight	<input type="radio"/>					
Different types of sensors under different conditions	<input type="radio"/>					
Absence of GPS signal	<input type="radio"/>					

SECTION 3: TESTING FACILITY

With the new European regulation the operators of UAS must be able to fly under high safety and quality requirements, even over long distances and in fully automatic mode. Testing in alpine environment means facing low temperatures, strong wind, unforeseen rain or snow, insufficient data link, and great differences of the altitude of the terrain.

8. Outdoor Testarea

How important are the following characteristics to test drones outdoor in an alpine environment?

	Essen- tial	Im- portant	Desira- ble	Satisfac- tory	Insuffi- cient	No need
Above 1.500 m.a.s.l.	<input type="radio"/>					
Dimension of 3.000m x 200m x 120m	<input type="radio"/>					
Absence of flying obstacles and artifacts (roads, houses, ...)	<input type="radio"/>					
Presence of a part with vertical rock	<input type="radio"/>					
Presence of a part with a river / lake	<input type="radio"/>					
Presence of a wooded area	<input type="radio"/>					
Above 2.500 m.a.s.l.	<input type="radio"/>					

9. If you had the opportunity to test your vehicles setting environmental conditions, which of the following parameters would be most interesting for you? *

terraXcube is a research infrastructure in Bolzano/Bozen that simulates the Earth’s most extreme climatic conditions. From storms atop the Himalayas to extreme arctic cold to the scorching heat of the North African deserts, all of the Earth’s climates—pushed to their extremes—can be found at Eurac Research’s terraXcube.

	Essential	Important	Desirable	Satisfactory	Insufficient	no need
Temperature from -40° C to +60°C	<input type="radio"/>					
Altitude from 200 up to 9.000 m.a.s.l.	<input type="radio"/>					
Ice / Snow 0 - 50 mm/h	<input type="radio"/>					
Wind up to 30 m/s	<input type="radio"/>					
Relative humidity from 10% to 95%	<input type="radio"/>					
Rain 0 - 60 mm/h	<input type="radio"/>					
Oxygen 6% to 20%	<input type="radio"/>					

10. To test technology in an alpine environment it is essential that the ideal outdoor test area would have the following requisites:

- Information system to announce flights
- GPS reference points
- BVLOS testing
- Take-off / landing runway
- Weather station with webcam
- Digital fences
- Procedures for risk management
- Accurate terrain model of the area
- Mission database (with private and public logs)
-

SECTION 4: INNOVATION SERVICES

11. Do you need support with aviation authorities?

What certification are you interested in acquiring?

- standard CE mark will be accompanied by the identification of the class of the drone (from C0 to C4)
- support with aviation authorities: FAA, EASA, AESA, ENAC, DGAC...
- No
-

12. TerraXcube

A typical test in a controlled environment is done at different simulated altitudes (for example in the range between 200 m and 4.000 m) and different temperatures (from -20°C to + 20°C). How much are you willing to pay for a test service on your vehicles?

€ 10.000 + VAT	€ 6.000 + VAT	€ 2.000 + VAT	€ 12.000 + VAT	€ 8.000 + VAT	€ 4.000 + VAT
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13. Outdoor testarea

If your threats have successfully passed a test in the terraXcube, how much are you willing to pay for a outdoor test in a nearby outdoor testarea in the alpine environment (supplementary testing)

€ 8.000 + VAT	€ 2.000 + VAT	€ 0	€ 1.000 + VAT	€ 4.000 + VAT	€ 500 + VAT
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14. Which additional services for testing would you be interested in?

- Get raw data without post-elaboration
- In depth analysis off you test
- B2B meetings with local partners
- Information about European R&D funding
- Information about hosting & travel
-

15. Have you ever heard about the NOI Techpark in South Tyrol, Italy?

NOI Techpark in South Tyrol, Italy is a meeting place for entrepreneurs, researchers and technical experts, and we use it to support networking and the creation of opportunities for cooperation.

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16. Networking & Cooperation

Are you interest in working cooperatively for R&D of drones with the scientific or business partners in South Tyrol?

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17. R&D Consultancy

Consultation and support in research and development projects for drones in the Alps is one of our core competences. A broad local and international network of experts who can be involved as research partners or project partners or as service providers is available to companies here.

- Idea finding
- Support for design and project planning
- Prototyping & testing
- Interested to become a cooperation partner
- Support to access to funding
-

SECTION 5: PERSONAL INFORMATION

**18. How much have you spent in terms of cash and personal hours for R&D in the last 2 years?
Are you satisfied?**

19. ORGANISATION

Please enter name of organisation, Address, State, Webpage

20. CONTACT PERSON

Please enter Name, Surname, Position, Telephone and Mail

21. Please enter a valid mail-Address, where our scientific Partner EURAC terraXcube can send you information about the testing facility, of different than the mail above.

22. Privacy

NOI Spa, headquartered at Via Volta 13/A, Bolzano/Bozen (BZ), I-39100, has created a privacy policy in accordance with Articles 4 et seq. of the Regulation (EU) 2016/679 (General Data Protection Regulation) and all other laws and regulations applicable to privacy. See <https://noi.bz.it/en/>

My personal data need to be disclosed in order to provide any services to me and/or for the processing of my personal data. By accepting I give my consent to the processing of my personal data by NOI Spa. I hereby acknowledge that NOI spa has the right to provide third parties with my personal information if: I give my express consent to the disclosure of my personal data to third parties.

23. Thank you for completing the survey. As a thank you will receive a free access to the first research paper of our scientific partner EURAC TerraXcube. Do you have any further suggestions and recommendations?

Annex 2: Summary

35
Responses

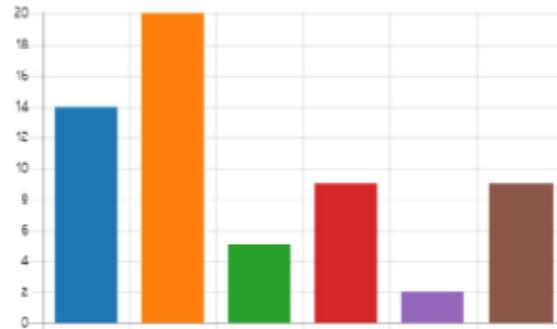
16:39
Average time to complete

Active
Status


Ideas

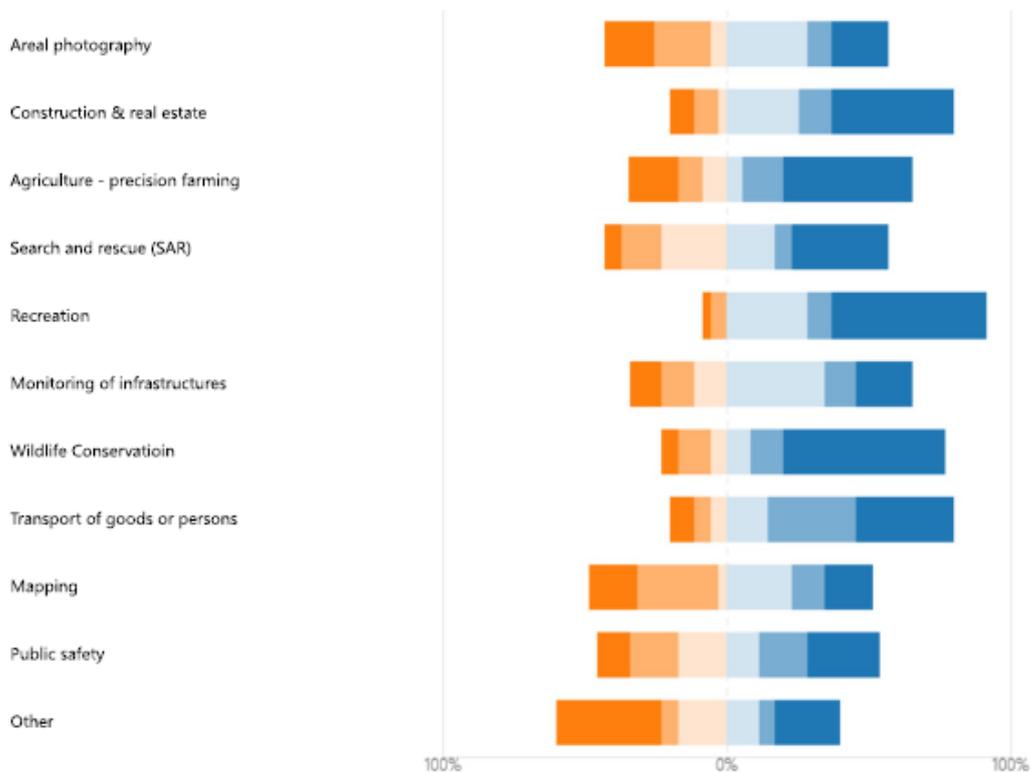
1. Please select your core activity

● Drone Manufacturer	14
● Drone Operator	20
● Flight School	5
● Research Organisation	9
● Governmental / Public Entity	2
● Other	9



2. For which application do you use drones?

■ Existing Business case
 ■ Very frequently
 ■ In development
 ■ Sometimes
 ■ Planned for the future
 ■ Never



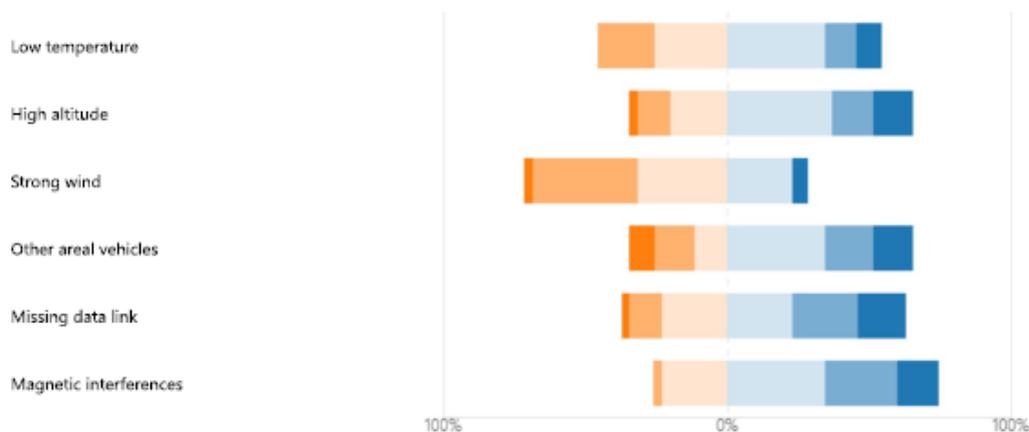
3. What type of UAS do you usually employ?

● Fixed wing aircraft	12
● Helicopters	5
● Multicopters	28
● All of them	4
● Other	4



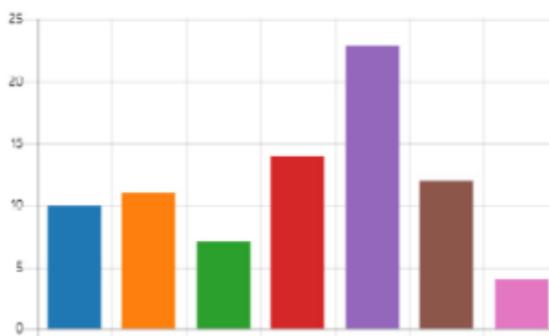
4. What technical challenges have you ever faced while flying?

Legend: Always (dark orange), Very often (light orange), Often (pale orange), Sometimes (light blue), Rarely (medium blue), Never (dark blue)



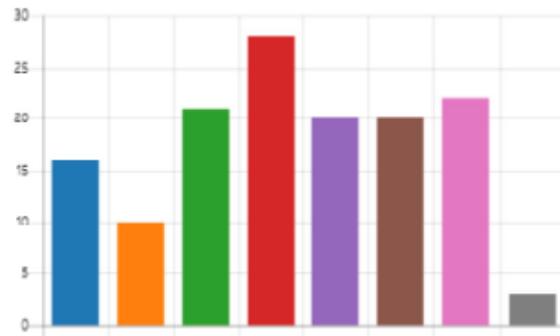
5. Please select technical problems you have experienced while flying in un-conventional environmental conditions

● Ice accretion on propellers	10
● In flight loss of propulsion sys...	11
● Flight shutdown	7
● Loss of control (unstable auto...	14
● Loss of communication link be...	23
● Sudden battery discharge	12
● Other	4



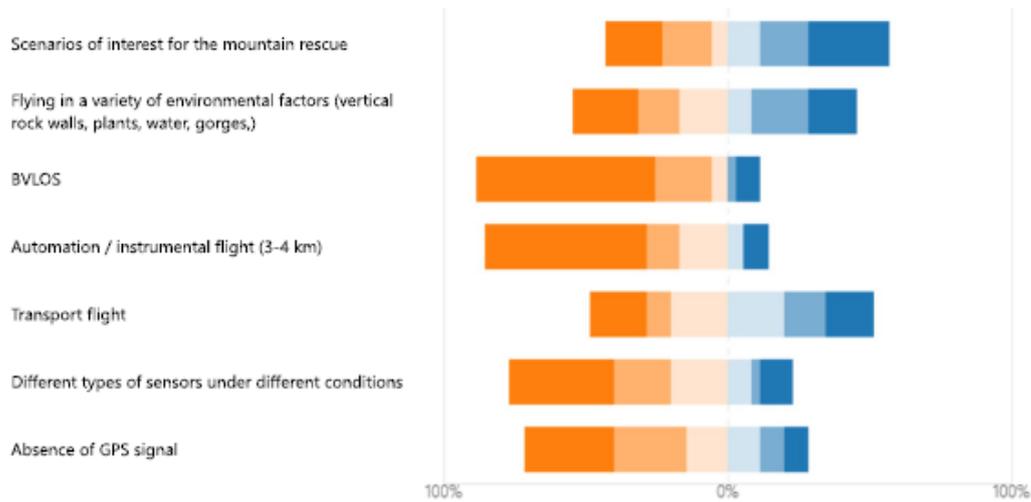
6. Testing which of the following topics would be most valuable to you?

Propeller / UAV aerodynamics	16
Electric motor and electronic s...	10
Radio communication link / d...	21
Batteries performance	28
Onboard sensors	20
UAV flight stability & controlla...	20
Performance: assessments can...	22
Other	3

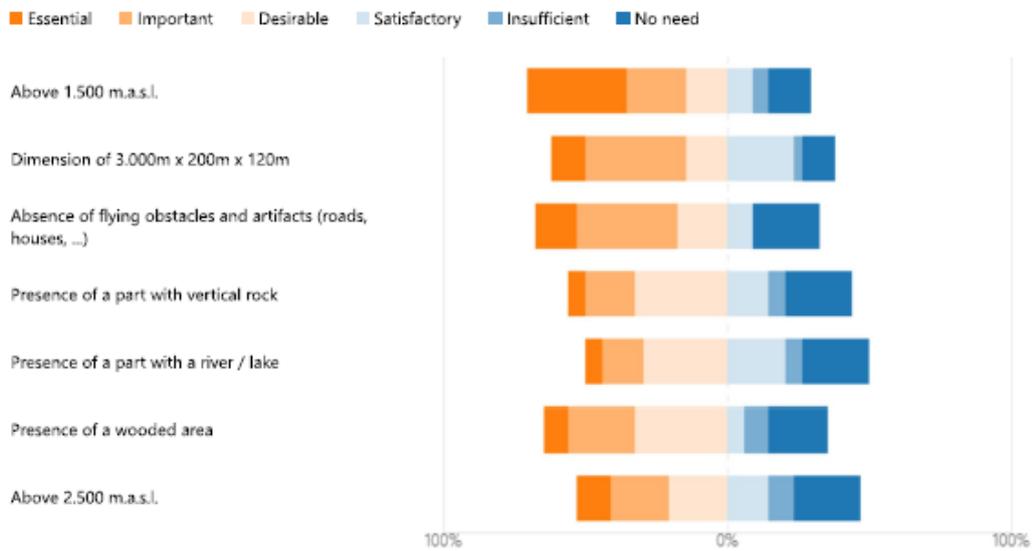


7. What would you like to test in extreme environment

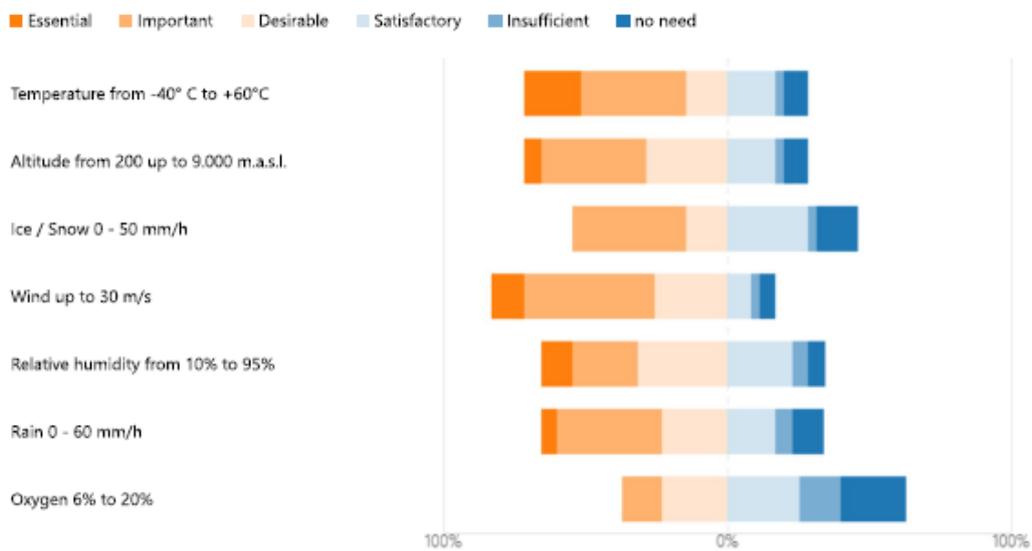
Essential Important Desirable Attractive Nice No need



8. Outdoor testarea

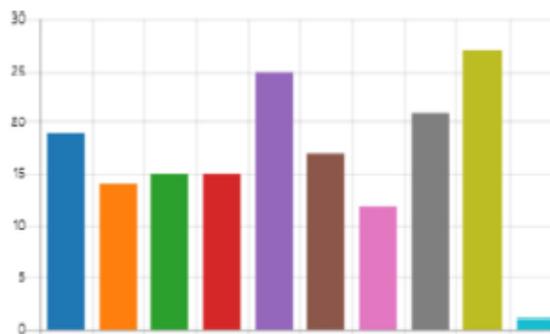


9. If you had the opportunity to test your vehicles setting environmental conditions, which of the following parameters would be most interesting for you?



10. To test technology in an alpine environment it is essential that the ideal outdoor testarea would have the following requisites:

● Accurate terrain model of the ...	19
● Take-off / landing runway	14
● Information system to announ...	15
● Weather station with webcam	15
● GPS reference points	25
● Mission database (with private...	17
● Digital fences	12
● Procedures for risk managem...	21
● BVLOS testing	27
● Other	1



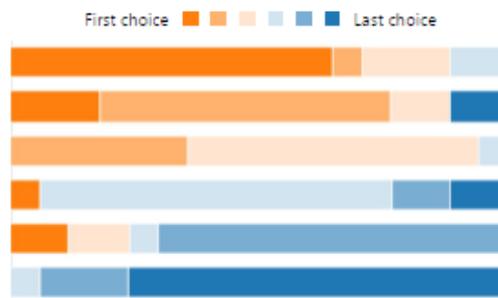
11. Do you need support with aviation authorities?

● standard CE mark will be acco...	17
● support with aviation authoriti...	23
● No	7
● Other	1



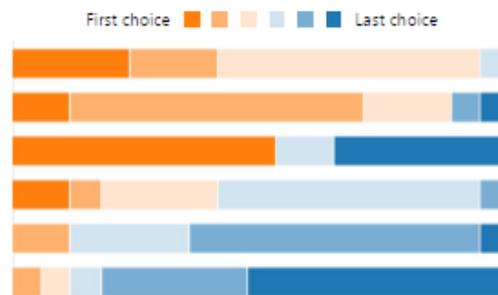
12. TerraXcube

Rank	Options
1	€ 2.000 + VAT
2	€ 4.000 + VAT
3	€ 6.000 + VAT
4	€ 8.000 + VAT
5	€ 10.000 + VAT
6	€ 12.000 + VAT

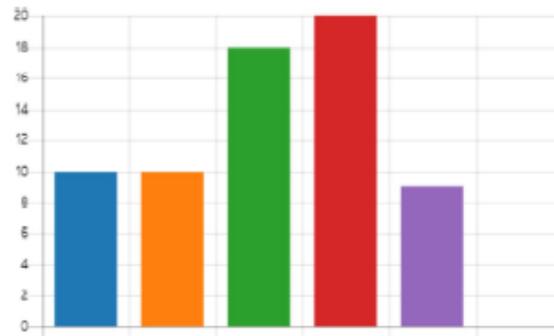


13. Outdoor testarea

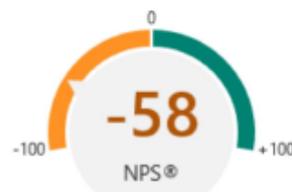
Rank	Options
1	€ 1.000 + VAT
2	€ 500 + VAT
3	€ 0
4	€ 2.000 + VAT
5	€ 4.000 + VAT
6	€ 8.000 + VAT



14. Which additional services for testing would you be interested in?



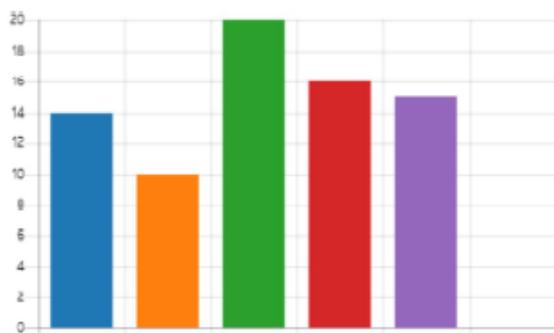
15. Have you ever heard about the NOI Techpark in South Tyrol, Italy?



16. Networking & Cooperation



17. R&D Consultancy



18. How much have you spent in terms of cash and personal hours for R&D in the last 2 years? Are you satisfied?

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Responses

Latest Responses
"1,2 Mio."
"600.000 Euro"