INNOVATION CLUSTER ACCELERATING REMOTE SENSING

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Report on the analysis of the questionnaires received from knowledge and research institutions

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Content

"Developing a network of regulatory bodies, government, and RS sector associations regarding regulation and legislation"

ICAReS

Common challenges

Within the 2 Seas area the three major sectors (agriculture, nature and water) constantly face important challenges which require innovation to help tackle them. Greater use and development of remote sensing (RS) and data processing methods will help provide this innovation, and both will create and support new solutions to face these challenges. Moreover, it will greatly improve the efficiency of these sectors.

However, there are obstacles in the way when looking at remote sensing. For example, there is a lack of knowledge and awareness of the possibilities remote sensing can bring; there is a lack of suitable testing and demonstration locations for companies to further innovations; and the policy on legislation and the use of drones for remote sensing is unclear.

From this the following challenges need to be addressed: the aggregation of sector demands, communication with RS companies and knowledge institutions, creation and advertisement of sites for demonstrating new remote sensing applications, harmonisation of legislation and regulations and finally the formation of a durable cluster to work together on these issues.

Overall Objective

The overall object of the ICAReS project is:

To develop a cross-border innovation cluster and create the necessary conditions for innovation in the field of remote-sensing and advanced data-communication and -processing, based on the needs of the priority sectors: nature, agriculture and water & infrastructure.

A durable cluster will result in some key benefits. There will be cross-border collaboration within the sectors allowing the demands to be aggregated and jointly tackled. The innovation of remote sensing products and services will accelerate. This will allow business operations to improve through the increased use of remote sensing. Finally, the cluster will bring clarification of different national legislations and a joint lobby for better regulations to create business opportunities.

Summary Workpackage 1

In WP1, the stakeholders in the innovation chain, demanding sectors and end-users (water, nature, and agriculture), developers of technology (universities) and suppliers of products & services (SME), branch organisations and relevant governments within the 2 Seas area will be scouted and contacted by all project partners. Cross-border networks of end-users will be enlarged or established in order to aggregate and formulate their demand regarding the use of RS for a number of applications. This will be stimulated and promoted by masterclasses and demo days organised by the ICAReS project partners. Additionally, RS branch organisations and relevant governmental institutions in charge of regulation and legislation of UAVs will be brought together to identify and discuss the opportunities and obstacles of using RS applications in practice.

WP1 will also establish networks of knowledge (academia) and technology suppliers (SME) to formulate innovation and knowledge needs (e.g. data processing, lightweight materials, advanced sensors, systems reliability, energy efficiency) to be validated and delivered in future products and projects. From these networks, a cross-border RS innovation cluster will be developed, which will lead to aggregation of demand, increased technology transfer, cooperation with governmental organisations on legislation and regulation, and possibilities for SMEs to engage in international activities.

Activity A 1.2

One of the activities in ICAReS is to enlarge the cross-border networks of knowledge and research institutes. To achieve this, a report on the results of the questionnaire among RS knowledge and research institutes has been made. The short list of knowledge and research institutes willing to give demonstrations and to participate to the RS innovation cluster is part of this report but is presented in a separate document.

Research setup

In order to gain insight in the research and knowledge institutes working on remote sensing in the 2 Seas region, the ICAReS partners have chosen to develop a questionnaire.

Population

The project partners identified 69 knowledge and research institutes located in the 2 Seas area. These knowledge and research institutes were sent a questionnaire consisting of 20 questions about Remote Sensing. The questionnaire can be found in appendix A that will be attached to this report separately. A total of 25 institutes responded to the questionnaires, which makes a response rate of 36%.

Methodology

The questionnaire was created with the expertise of all the ICAReS project partners and reviewed thoroughly. An online survey development software (SurveyMonkey) was used to distribute the questionnaire and obtain the summary of results. In the next chapter, the results of the questionnaire are outlined.

Results

Importance of RS for Knowledge and research institutes

Only 52% of the respondents are already working with Remote Sensing (RS). However, 71% of the institutions that are not currently using remote sensing, plan to do so in the near future. The respondents that are neither currently working with RS, nor have plans to do it in the future, indicated the following reasons: the technology or services are too expensive (33%), they don't know about the possibilities (33%), they lack the required knowledge or capabilities (67%). Of the respondents not yet working with RS, but with interest in remote sensing/UAV technology, 27% already have concrete plans to invest and start using RS. Figure 1 depicts the time span in which these institutions are planning to invest and start using RS. The respondents that checked the box 'other', indicated that their investment/use of RS will depend on future rules and legislation.

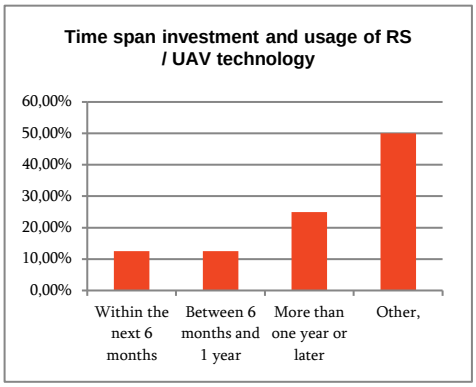


Figure 1 Time span investment and usage of RS

Products & Services in Remote Sensing

The most frequently used platform for remote sensing is a multicopter Unmanned Aerial Vehicle (UAV), illustrating the belief of the respondents in the potential of this relatively new technology. UAVs – both multicopters and fixed wing – are more popular than traditional remote sensing platforms such as manned aeroplanes and helicopters. Satellites are a popular platform as well. In our pool of respondents, there were no users of autonomous surface or underwater vehicles. These data are shown in table 1.

Remote Sensing platform	%
Multicopter UAV	81%
Satellite	56%
Fixed Wing UAV	50%
Aeroplane	19%
Ground based platform	19%
Helicopter	6%
Other	6%
Autonomous Underwater Vehicles	0%
Autonomous Surface Vehicles	0%

Table 1: Platform used for RS by respondents

Results

The use of UAVs as a platform for acquiring aerial images, height data and index maps is reflected in the choice of sensor technologies depicted in figure 2. The majority of the institutions (86%) use RGB (red, green and blue light, i.e. the visible spectrum of electromagnetic radiation) sensors for their applications, with Multispectral (60%), Near Infra Red (NIR) (47%) and Thermal (47%) sensors ranked second and shared third. The widespread use of RGB sensors is to be expected since most UAV platforms are equipped with such camera out of the box. It is interesting to note that multispectral/hyperspectral sensor technology is researched by 60% of the responding research and knowledge institutes.

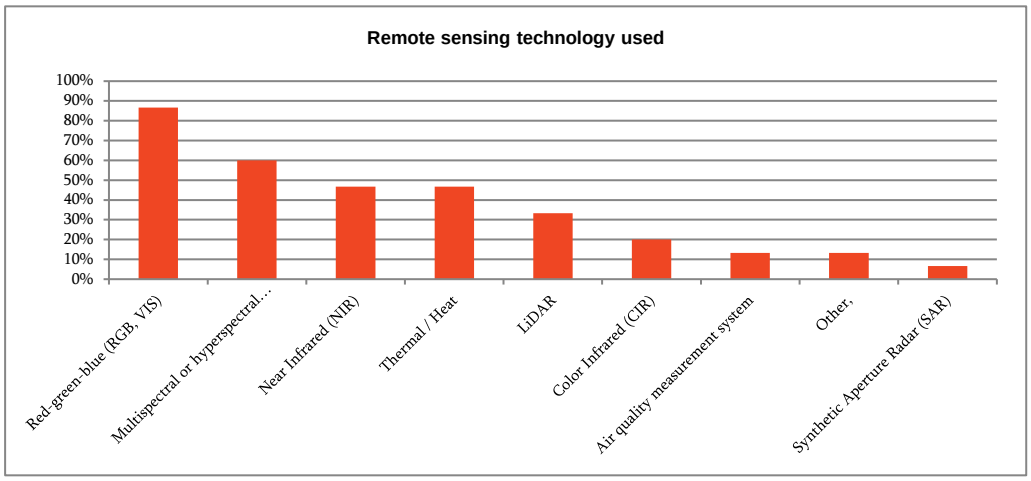


Figure 2: Technology used for RS by % of respondents

The focus on applications involving visual information is confirmed by the study of the sensors' data collected, shown in figure 3: in 75% of the cases, the data acquired consisted of visual images (e.g. aerial images, orthophoto mosaic, satellite image) followed by height information (Digital Elevation Model or Digital Terrain Model) and index maps (NDVI, yield, other

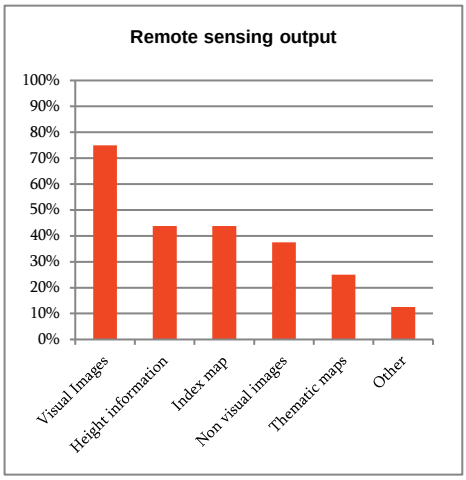


Figure 3: RS output used by % of respondents

indices) – both collected by 44% of the respondents. Non-visual images or mosaics (NIR, thermal) are collected by the 38% of respondents.

The post-processing software (used to translate the collected data into usable information) is, in the majority of cases, self-developed software (50%). This might reflect the fact that knowledge and research institutes are usually experimenting with new technologies and techniques. Therefore, the off-the-shelf solutions are not always suitable for their applications. Nevertheless, a number of software packets are popular for specific applications, such as Pix4D and Agisoft Photoscan for photo-stitching that are both used by 31% of the respondents. The most used software for Geographical Information Systems is QGIS, followed by ESRI (44% and 31%, respectively). The different software packets and the percentage of responded users are shown in table 2.

Data processing software	%
Self-developed software	50%
Pix4D	31%
Agisoft Photoscan	31%
ENVI	13
ERDAS Imagine	6%
GIS Software	**%**
QGIS	44%
ESRI	31%
SMS management Software	0%

Table 2: Software used for RS by % of respondents

The study of the indexes used for agricultural applications shows that the Normalized Difference Vegetation Index (NDVI) is the most used index by the respondents (60%) followed by the Leaf Area Index (20%) and the Weighted Difference Vegetation Index (10%). Other - unknown - vegetation indexes are also used by 50% of the respondents who use vegetation indexes. This is summarized in table 3.

Vegetation index	%
Normalized Difference Vegetation Index (NDVI)	60%
Weighted Difference Vegetation Index (WDVI)	10%
Leaf Area Index (LAI)	20%
Other(s)	50%

Table 3: Used type of vegetation index

Challenges in the development of RS using UAVs

Challenges for the development of remote sensing using UAVs are mainly in the area of regulation and law, according to the respondents, while pricing can also play a significant part.

Figure 4 shows the hurdles in the development of RS applications using UAVs according to the respondents by % of respondents. The values are calculated measuring the frequency each hurdle is mentioned divided by the total hurdles mentioned by the respondents.

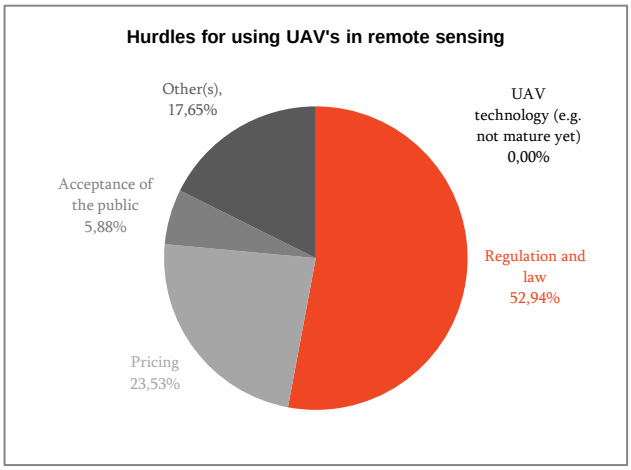


Figure 4: Hurdles for using UAV's by % of respondents

The restrictive regulations regarding the use of UAVs is the most mentioned hurdle for further use of UAVs for remote sensing, followed by pricing and acceptance of the public. Surprisingly, none of the participants indicated the level of maturity of the UAV technology as an obstacle to the technology adoption. However, the group that responded "others" indicated that multiple or all the above-mentioned hurdles are limiting factors towards use of UAVs for remote sensing. Other perceived obstacles included the sensors technology not being developed at the same pace as the UAV technology and the high cost related to the improvement of the current data quality.

Finally, the weather-dependence of the operations is the most mentioned challenge to address for RS end-users (or, in other words, how to collect and process the data on a non-perfect weather day). The second and third most mentioned challenges are the required knowledge and hardware, necessary to translate the collected sensor data to usable information and to translate this information into an action plan for the final application.

Interest in the ICAReS innovation cluster

All the respondents that indicated their interest in the ICAReS project would like to know about new technologies. 40% of them hope to be informed about RS companies and their activities and/or hope to encounter new contacts and extend their network (20%). Figure 5 depicts the full distribution of reasons of interest.

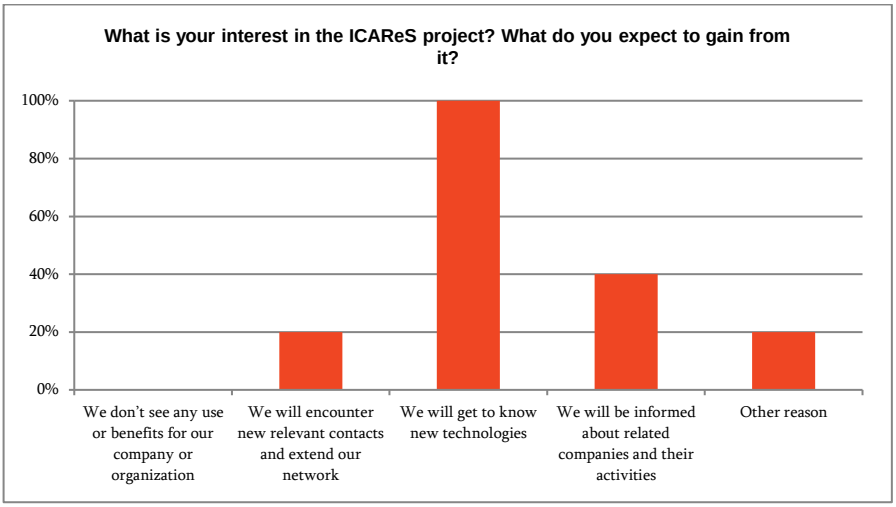


Figure 5: Reason for interest in ICAReS

Of the knowledge and research institutes already active in RS, 83% is interested and available to give demonstrations and lectures about RS, which is a total of 15 knowledge and research institutes. 78% is interested in joining a future remote sensing innovation cluster and would like to cooperate with the (inter)national research institutes. Finally, 15 respondents provided us with additional contacts for the ICAReS cluster to contact.

Appendix B (provided separately due confidentiality) shows the shortlist of respondents, which indicated they are interested and available to give demonstrations and lectures.

Appendix A: ICAReS – Questionnaire Remote Sensing/UAV technology for Knowledge & Research organizations

1. General / contact information

Person Name

Company Name

Tick the best answer(s), multiple answers possible

2. Does your organization have expertise regarding remote sensing/UAV technology?

- ○ Yes (Go to question 8)
- ○ No

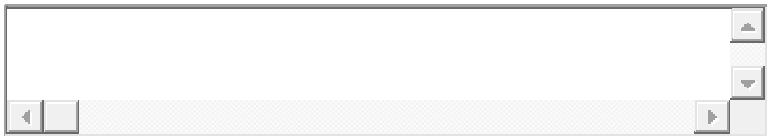
3. Does your organization have any interest or plans to start using/researching remote sensing/UAV technology in the near future?

- ○ Yes (Go to question 6)
- ○ No

4. If you don't have any interest or plans to build up expertise regarding the use of remote sensing/UAV technology. What is the reason?

- ☐ We don't see any use or benefits for our company or organization
- ☐ It is too expensive for our company or organization
- ☐ We don't know about the possibilities
- ☐ We don't have the required knowledge/capabilities

Other reason (please specify)



5. What is your interest in the ICAReS project? What do you expect to gain from it?

- [ ] We don't see any use or benefits for our company or organization
- [ ] We will encounter new relevant contacts and extend our network
- [ ] We will get to know new technologies
- [ ] We will be informed about related companies and their activities
- [ ] Other reason (please specify)

6. Your organization has interest or plans to start using/researching remote sensing. How concrete are your plans?

- ○ We are interested, but have no concrete plans. And we like to be informed by ICAReS and be invited for your activities. (Go to the end of the questionnaire)
- ○ We have concrete plans to invest and start with using remote sensing.

7. Your company or organization plans to invest and start using remote sensing/UAV technology:

- ○ within the next 6 months
- ○ between 6 months and 1 year
- ○ next year (2018) or later

Other, ……..

Please, fill in the following questions as if your company or organization already started using remote sensing

8. What are the main goals to use/research remote sensing for your organization?

9. What carrier do you use for remote sensing?

- Multicopter Unmanned Aircraft System (UAV) or drone
- Fixed Wing Unmanned Aircraft System (UAV) or drone
- Aeroplane (manned Aircraft)
- Helicopter (manned)
- Satellite
- Ground based platform
- Autonomous Underwater Vehicles (AUV)
- Autonomous Surface Vehicles (ASV, i.e. boats)
- Other ……

10. Which technology do you use for remote sensing?

- Red-green-blue (RGB, VIS)

- ☐ Near Infrared (NIR)
- ☐ Color Infrared (CIR)
- ☐ Multispectral of hyperspectral sensor
- ☐ Thermal / Heat
- ☐ LiDAR
- ☐ Synthetic Aperture Radar (SAR)
- ☐ Air quality measurement system
- ☐ Other, ……

11. What software do you use to translate the data to information?

- ☐ We write our own software (python, .NET, java, …)
- ☐ SMS Management software (Ag Leader)
- ☐ Erdas Imagine
- ☐ Agisoft Photoscan
- ☐ Pix4D
- ☐ ENVI
- ☐ ESRI (Arcmap, ArcGIS)

- [ ] QGis
- [ ] Other(s), please specify

12. What is the output of the data?

- [ ] Visual Images (e.g. aerial images, orthophoto mosaic, satellite image,)
- [ ] Height information (Digital Elevation Model or Digital Surface Model or Digital Terrain Model)
- [ ] Non visual images or mosaics (NIR, thermal, …)
- [ ] Thematic maps (habitat, vegetation or water, classifications, …)
- [ ] Index map (NDVI, yield, other indices)
- [ ] Other(s), ……

13. If used in the sectors 'Agriculture' or 'Nature', which vegetation indexes are presented?

- [ ] Normalized Difference Vegetation Index (NDVI)
- [ ] Weighed Difference Vegetation Index (WDVI)
- [ ] Leaf Area Index (LAI)
- [ ] Other(s), please specify

Appendix A: ICAReS – Questionnaire Remote Sensing/UAV technology for Knowledge & Research

14. What are the main problems or challenges when using remote sensing/UAV technology?

15. What are the restrictions and hurdles that need to be tackled to facilitate more use of UAV's for remote sensing?

- [ ] Regulation and law
- [ ] UAV technology (e.g. not mature yet)
- [ ] Pricing
- [ ] Acceptance of the public
- [ ] Other(s), please specify

16. Is your company interested and available to give demonstrations and lectures?

- ○ No
- ○ Yes, Please specify

17. Are you interested in joining a future remote sensing innovation cluster

- ○ No

Yes, why

18. Are you interested to cooperate with the (inter)national research institutes?

No

Yes, why

19. Do you know about other relevant organizations for us to contact? Please provide us with their contact details

20. Do you have any additional remarks or suggestions?

Thank you very much for your time! You efforts are appreciated by the Icares team! Please feel free to contact us if you require more information!
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