# D 2.2.3.

***Tools for demand aggregation***


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# Content



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

# ICAReS

## Common challenges

The 2 Seas area has challenges regarding innovation and environment, like to strengthen innovation by more R&D and exploitation opportunities, climate adaptation, preservation biodiversity and natural resources. Agriculture, nature and water are 3 major sectors in the 2 Seas area. Just these sectors faces these challenges and need innovations to tackle. More use and development of Remote Sensing (RS) and data processing will create solutions to face these challenges and will also improve efficiency of these sectors. Obstacles to use RS are: lack of knowledge/awareness of the possibilities of RS, RS SMEs are not fully aware of the role they can play, a lack of suitable test/demo locations and unclear policy on legislation on the use of drones for RS. Challenges are: aggregation of sector demands, translation to RS SMEs and knowledge institutes, sites for demonstrating (new) RS applications, harmonisation of legislation/regulations and a structure (durable cluster) to work together on these issues.

## Overall Objective

To develop a cross border innovation cluster and create the necessary conditions for innovation in the field of remote sensing and advanced data communication & processing, based on needs of priority sectors nature, agriculture and water & infrastructure. A durable innovation cluster will lead to the following benefits: cross border cooperation in these sectors to come to aggregation of demand, acceleration of creation of innovative remote sensing products & services, substantial use of remote sensing and improved business operation in these sectors, clarification of different national legislations, and a joint lobby for better regulations to create business opportunities.

## Summery Work Package 2

A second important issue for innovation is the development of facilities and services so that partners in the cluster can find each other, get a good picture of the demands and have appropriate facilities to test innovative applications. The main services and facilities for the RS innovation cluster are: well-equipped test- and demonstration sites including a kind of central organisation that coordinates demo flights, an office or virtual desk for demands, aggregation of demands and transferring demands to research institutes and SMEs and a (virtual) desk or info point for questions about regulation and legislation in the different countries. In this work package nearly, all partners will participate in workshops to outline and describe the conditions for these 3 facilities/services. They will also make an inventory of existing and planned test sites in the 2 Seas region and describe the facilities of those sites, including what is missing. In this WP all Project Partners and Observer Partners are involved. Based on these descriptions the partners LP, and PP2 will (further) develop the test- and demo-sites in their area. The LP will develop a central organisation to coordinate demo flights. The branch organisation PP10 will develop (virtual) offices/desks together with the branch/sector organisations in the other countries. In this activity PP10 will get support from LP, PP5, PP7 and PP11.

## Activity A 2.2

There is a missing link between demanding sectors/end users on the one hand and developers of RS applications and data processors on the other hand. This is the reason why the RS sector does not achieve its expected growth and the end-users do not make use of the applications available. In this activity an Impulse Group Demand will be set up to overcome this challenge, but also to come to critical mass for R&D.

## Report D 2.2.3

In this report SWOT analyses will be presented for the sectors Agriculture, Nature and Water & Infrastructure. From these analyses tools for future demand collections have to be abstracted. Because in every sector the same method is applied on different examples of current or future innovations similarities should be highlighted in the conclusion. From these similarities conclusions may be drawn about the nature of such a Impulse Group Demand and in what form the cluster may contribute to closing the gap between the RS SME’s and end users in the RS sector.

# Research setup

The Impuls Group Demand Matching & Aggregation will investigate best practices of demand aggregation within regions of the 4 MS. These best practices will be analysed and described in a SWOT-analyses. From these analyses tools will be described for future demand collections by this Group. This method and these tools can be used in other MS and by other sectors.

## Methodology

Taking the results from D2.2.2 and subject them to a SWOT analysis. This to develop tools for further demands.

# Agriculture

## SWOT analysis aggregated demands for Agriculture sector

Arable land

- Automated disease and pest detection and quantification by remote sensing.
    - Strenghts:

      Objective overview of the condition of the crop.
    - Weaknesses:

      Failure to detect diseases or pests resulting in yield loss.
    - Opportunities:

      Reduced need of plant protection products in spot based treatments.

      More narrow treatment products.

      New jobs by pilots offering their services to collect the data.
    - Threats:

      Spray booms not able to perform spot based treadments.

      Needed sensors (like hyperspectral sensors) are expensive.
- Automated weed detection and quantification by remote sensing.
    - Strenghts:

      Objective overview of the condition of the crop and wheats between the crops.
    - Weaknesses:

      Failure to detect weeds resulting in yield loss.
    - Opportunities:

      Reduced need of plant protection products in spot-based treadments.

      New jobs by pilots offering their services to collect the data.

      Posibility to perform mechanical weeding even by sensors enabled robots.
    - Threats:

      Spray booms not able to perform spot based treadments.

      Wrong mechanical weeding weeding resulting in loss of crop.

- Yield determination as an input for future precision agriculture.
  - Strenghts:

    Yield optimalisation by variable plant density.

    Optimalisation in downstream processing because of yield indications.
  - Weaknesses:

    Regular farming techniques will be in place when data is missing, no weaknesses.
  - Opportunities:

    Better land management by using low yield locations for less intensive crops, subsedised crops or different purpouses like location for utilities.
  - Threats:

    High investments for harversters that can undertake yield determination.
- Prescription maps as an input for current precision agriculture.
  - Strenghts:

    Plant based treaments means a reduction in product use, fuel use, time consumtion.
  - Weaknesses:

    High investment for machinery that can perform the requested tasks.
  - Opportunities:

    Precision agriculture means righ treatment on a plant based level. This means no need of general wide treatments and linked to this an improvement in operating costs.
  - Threats:

    Machinerie not able to perform the location based actions coming from these maps.
- Variable plant density as an output from precision agriculture.
  - Strenghts:

    Beter seeds to harvest yields or less loss on lower performing patches compared to seed costs.
  - Weaknesses:

    High investment for machinery that can pefrom variable plant density.

  - Opportunities:
    In time the grounds potential will normalise allowing for an overall better yield prediction.
  - Threats:
    It's a novel agriculture technique, research is still in a preface.
- Variable foliage killing by potatoes.
  - Strenghts:
    Reduced need of foliage killing products.
  - Weaknesses:
    Wrong dosages with surviving foliage could introduce a soil desease.
  - Opportunities:
    Reduced needs of foiliage killing products is better for environment and for profits.
  - Threats:
    Spray booms not able to perform spot based treadments.

Livestock

- Using remote sensing for localisation and/or counting of livestock, localisation of missing or immobile animals and conducting regular surveys of fencing.
  - Strenghts:
    Animals are expensive, finding missing or immobile animals is preventing financial loss.
    Counting livestock provides an exact indication on the needed resources to nurture them.
    Automated surveys on fencing provides a convient way to verify quality and prevent the escape or mingling of animals
  - Weaknesses:
    Localisation of immobile or missing animals and conducting surveys have to be done on a regular basis. The land coverages might be big and rural making it inpractical to perform (regularly).

- Opportunities:
  Drone automation (automated take off and landing, automated charging, automated flying) is the direction to go to solve the weaknesses.
- Threats:
  Loss in faith in case of failed detection of missing animals resulting in the loss of the animal.

**Damage assessment**

- Using remote sensing for damage assessment for insurance claims..
  - Strenghts:
    Objective way to determine damage with a more correct payout related to the damage.
  - Weaknesses:
    More work to perform damage assement compared to the current techniques.
  - Opportunities:
    Drone pilots could perform the damage assement independent from farmers and insurance companies, providing jobs in the sector.
  - Threats:
    Insurance companies have to believe in this type of damage assement.

**Fruit growing**

- Deploy protective measures for fruit growing.
  - Strengts:
    Easy to deploy the cables, faster and less man power intense.
  - Weaknesses:
    Heavy use drone is needed to carry the cables over the orchard.
    Although a drone in a cable it typically not counted as a drone, special regulations might be needed.
  - Opportunities:
    The working principle can be used in other farming techniques benefiting from this technolgie

  - Threats:

    Still needs manpower and construction to drag the nets over the cables.
- Growth and height maps for fruit growing.
  - Strengts:

    Objective way for decision making on how to nurture the trees.

    Data collection and applying can happen on different times
  - Weaknesses:

    Might not be automated, meaning the person that applies the root cutting will need to basic knowledge on how to interpret the data.
  - Opportunities:

    By collecting the data in time the progress and change in time can be followed.
  - Threats:

    Wrong interpretation and application resulting in degradation of the orchard.
- Regulation of production of fruit trees by mapping the intensity of the flowering in the spring by remote sensing.
  - Strenghts:

    Application maps can be used for precision agriculture, meaning data collection and application can happen on different periods of the year, when relations are less visible.

    More stable uniform production results between trees and between years.
  - Weaknesses:

    None so far.
  - Opportunities:

    By collecting the data in time the progress and change in time can be followed.
  - Threats:

    Wrong interpretation and application resulting in yield loss.

**Nurseries ornamental plants**

- To measure plant diameter in nurseries of ornamental plants.
  - Strengts:

    Better stock management that can be used for making better decisions for the ornamental plants.

- Weaknesses:

  High resolution data is needed or even lidar data could be needed. High resolution data might be inaccurate while lidar data is more challenging to work with.
- Opportunities:

  Location based stock management in these types of farming is novel. A first application will be a learning process to the possibilities of precision farming.
- Threats:

  None so far, regular farming techniques can be used as a fallback.

# Nature and Heritage

## SWOT analysis aggregated demands for Nature and Heritage sector

- Recording of archaeological sites and heritage buildings.
    - Strengths: Rapid, detailed record, repeatable, allows access in difficult locations, provides and interactive and easy to explore model. Use of digital terrain models has developed as a vital and invaluable tool for revealing, identifying and assessing landscape archaeology over large areas.
    - Weaknesses: Equipment and commissioned surveys are expensive and are either impossible or require extensive training if to be done 'in-house'. No single RS technique provides all the information required. Processing of data for use requires considerable processing power. Specialist contractors may be needed for larger scale projects to achieve cost-effectiveness.
    - Opportunities: Fast-growing area of remote sensing. Speed, resolution, mobility and portability of the laser-scanning technology is advancing at a rapid rate. In the UK, the technique is being embraced by Historic England to maximise the use of these tools for heritage conservation and to inform cultural heritage professionals unfamiliar with the approach to make best possible use of it. Data can be presented through web portals to enable crowd-sourcing investigations and interrogation.
    - Threats: The speed with which the technology is advancing, along with its technical nature means that only those that dedicate time and effort to the area of remote sensing can remain up to date with the techniques. There is a growing reliance on specialist contractors to provide the specialist knowledge.
- Habitat and vegetation management and monitoring.
    - Strengths: LiDAR and photogrammetry techniques using manned flights provide a high resolution and detailed assessment of habitat and vegetation extent and condition over large areas. This is enhanced if the techniques are combined along with the use of data collected by UAV. UAV's allow quick data collection on smaller sites and rapid advances in technology allow high resolution imagery that can be used to determine vegetation communities. UAV collected data can

  be repeated and duplicated quickly at different times of the year and at the same time of year on an annual basis to determine trends and inform subsequent management of sites.
  - Weaknesses: LiDAR and photogrammetry remain expensive techniques when undertaken over a large area i.e. landscape-scale monitoring. Both require extensive processing post-capture. For accurate vegetation community assessment, these techniques need to be supplemented with on-the ground surveys for confirmation and the technology is unlikely to be able to provide accurate species identification for some time (except for tree species).
  - Opportunities: With the rapid improvement in the technology it is likely that the accuracy of vegetation community identification will improve. Potentially this will also ultimately enable ground flora species identification – but remains some way off now.
  - Threats: Equipment cost and ability to process data remains a barrier to this application. However, specialist contractors are constantly adopting and testing new applications of these techniques and is likely to remain the way forward. Ecological and habitat management organisations are required to better communicate their needs.
- Monitoring change in landscape character.
  - Strengths: RS techniques such as photogrammetry and aerial photography from using technology such as Near-Earth Observation (satellite imagery), manned flights and from UAV are well suited to monitoring landscape character change. The techniques are repeatable and allow direct comparison over the long periods of time that character changes.
  - Weaknesses: This is an embryonic area for RS. Existing tools such as those provided by Google Earth allow investigation of aerial imagery taken over the last 70 years but are limited by a lack of consistency in approach, timing, quality and interpretation. They also do not consider aspect, geomorphology and ground form – all important aspects that contribute to landscape character.
  - Opportunities: As an embryonic use, this provides a growth opportunity for the use of RS techniques. Protected landscapes struggle with an objective way of measuring landscape character change over the significant time periods that

they occur along with ensuring that there is a consistent approach. Using 3D models created through (for example) photogrammetry techniques and combining with DTM and DSM LiDAR models there is an opportunity to develop a universal tool to deliver on this need.
    - Threats: Cost continues to be the main barrier. In the UK, several protected landscapes can exceed 2,000 $km^2$. National Parks in the Netherlands exceed 1,000 $km^2$, whilst in Belgium most are somewhat smaller and in France can be extremely large. Currently UAV use is not capable of providing the detail required over such large areas and therefore manned aircraft or NEO techniques are the only feasible way of achieving this.
- Delivery of targeted chemical treatment.
    - Strengths: UAVs designed for agricultural applications are already well advanced and adaptation for dealing with invasive pest species that threaten sites of biodiversity importance would appear to be a simple evolution. UAVs are well suited to this application due to the need for precision application to avoid collateral damage to high value conservation assets and where problem species are often found in inaccessible locations or at height. Consequently, they represent a reduced cost solution that is capable of fast deployment. In addition, it also removes the need for specialist tree-climbers which brings with it safety risks.
    - Weaknesses: This is a largely untested application. In 2012, The Federal Government Department in Germany tested UAV delivered pesticide in Brandenburg to control Oak Processionary Moth, but precision delivery was difficult to achieve. UAV applied chemical treatment is difficult in heavily leafed tree environments and may represent limitations.
    - Opportunities: New UAV technologies allow for more agile and smaller, more mobile machinery. Specialist bespoke UAVs that are small but capable of carrying a payload may be required.
    - Threats: This is a specialist area of UAV use and the market may not be big enough to for UAV providers to see as a profitable area for innovation. The balance of agility, small size but capable of carrying pesticide may not be achievable.

- Monitoring of water flow paths during flood events.
    - Strengths: Use of UAVs allows capture of real-life flood events. Flood paths are notoriously variable and rapid deployment of UAVs to capture imagery in order to inform interventions is not something that can be achieved through any other means. Robust UAV design means that they can be deployed in heavy rain conditions.
    - Weaknesses: Data captured in this way requires combining with data-modelling to provide a true picture of the issue. The number of UAVs capable of flying in poor conditions is currently limited, and long-term robustness has yet to be determined.
    - Opportunities: Applications in other sectors, particularly in water and infrastructure, means that there may be a critical mass for innovations to be achieved for this use. A demand exists for progressing design robustness to be continually improved.
    - Threats: Cost remains a threat to widespread use of UAVs in this area.
- Tackling environmental crime with UAVs.
    - Strengths: UAV use is rapidly being adopted by enforcement agencies for a variety of uses. Rapid deployment, a 'stealth' application and an ability to use in remote locations that are difficult to access mean that they are a valuable additional tool. This makes them particularly applicable to environmental crime scenarios. Cost effectiveness is extremely favourable compared to deployment of manned aircraft.
    - Weaknesses: Initial outlay and cost of training for use by staff can be prohibitive with squeezed public sector funding. Legislative controls and privacy concerns are also considerable and restrict some applications.
    - Opportunities: Increasing adoption by enforcement agencies in all partner countries demonstrate that this is a rapidly growing sector of the market. Bespoke surveillance drones that meet the needs of these users and widespread training to generate a larger pool of users would further support this sector.
    - Threats: Privacy concerns and regulation present the biggest threat to widespread adoption.

- Using UAVs to communicate environmental stories.
    - Strengths: Imagery captured using UAVs provides an entirely different perspective to engage the public and communicate a story or message about nature or heritage. This has been used particularly effectively by specialist nature broadcasters in the past, but with reducing costs, is increasingly more available to users outside the media sector.
    - Weaknesses: Cost and the need for creative expertise does still prevent the potential from being entirely fulfilled.
    - Opportunities: The sector is continually demanding new media for communicating its key messages. This demand is both overt and latent and ripe for innovation.
    - Threats: Regulation remains a threat and cost is also an inhibitor to adoption.

# Water & Infrastructure

## SWOT analysis aggregated demands for Water & Infrastructure sector

The following input for possible future innovations has come from a workshop with the Dutch Waterauthority, a local township and from report ‘D3.3.1. List of potential interested sectors’. Whether or not the examples given are realistic or expected to be put into practice in the coming years they provide solid input for the SWOT analysis and will give insight in the general problems and opportunites that are seen in the RS sector.

### Strength – Weaknesses – Opportunities – Threats

#### Water Authority

*Short term*

- Fighting Muskrat

| | |
|---|---|
| S | Does not scare away muskrats, can reach lots of area’s |
| W | Battery life, flying above nature reserve |
| O | Nightvision, localize nests & profitable trap locations |
| T | Night & wildlife disturbance |

- Responding to calamities (also during nighttime and bad weather)

| | |
|---|---|
| S | First impression in very short time, can reach flooded areas |
| W | Legislation; flying over waterways, BLVOS |
| O | First responders (police, firedepartment, etc.) inform water authority drone pilot |
| T | |

- Responding to illegal chemical/drug dumping in cooperation with police

| | |
|---|---|
| S | Non intrusive, no health risks for personell, toxic gas concentration detection |
| W | Has to fly in forestry, unhabitable areas. Only available when airspace is available. |
| O | |
| T | |

- Progress report on environment (e.g. ecological zones)

| | |
|---|---|
| S | Non disturbing, exact imaging of growth |
| W | No physical sense of environmental condition |
| O | Apply different sensors and other (agricultural) techniques to improve assessment |
| T | Privacy of surrounding habitats |

- Map and detect flora and fauna before maintenance of grasslands i.a.

| | |
|---|---|
| S | Non disturbing, exact count of animals, nests etc. |
| W | |
| O | |
| T | |

- Quantity measurement, inspection & frequency determination for dredging

| | |
|---|---|
| S | Less inspection necessary |
| W | Not possible for underwater measurements & inspection |
| O | |
| T | |

- Blue algae detection

| | |
|---|---|
| S | Quick detection of algae |
| W | |
| O | |
| T | |

- Inspection of waterbodies (ponds, trenches, canals etc.)

| | |
|---|---|
| S | Less material & machinery needed |
| W | |
| O | |
| T | |

*Long term*

- Inspection waste water pressure pipes

| | |
|---|---|
| S | Detailed 3D images in combination with technical drawings and real time data enable in-time maintenance |
| W | |
| O | |
| T | |

- Traffic congestion control & monitoring

| | |
|---|---|
| S | Roadworks, accidents and traffic congestion can be detected and mapped out instantly. This way more congestions/accidents can be avoided. |
| W | |
| O | |
| T | |

Township

- Building inspection

| | |
|---|---|
| S | No scaffolding needed |
| W | Privacy sensitive |
| O | Other civil engineering works & public buildings can be inspected |
| T | |

- Security of industrial and logistic areas and business parks

| | |
|---|---|
| S | Evidence is instantly gathered, personell is safe. |
| W | Drones can be taken out of the air, sensitive to privacy |
| O | |
| T | |

- Fire department inspections

| | |
|---|---|
| S | No lives in danger, infrared cameras & heat detection can search for persons in fires & sources of the fire |
| W | Drones (electronics) can light on fire / melt |
| O | |
| T | |

- Security and monitoring of police enforcement

| | |
|---|---|
| S | Evidence is gathered, personell is safe, monitoring can happen quietly |
| W | Drones can be taken out of the air, sensitive to privacy |
| O | |
| T | |

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