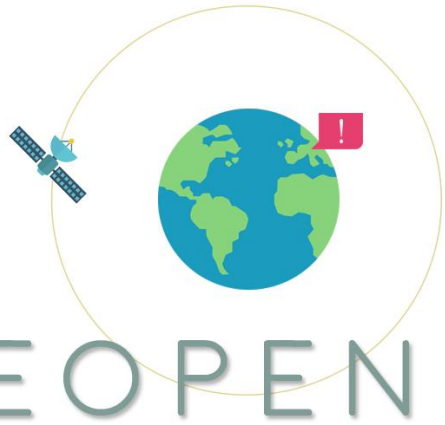

EOPEN

opEn interOperable Platform for unified access and analysis of Earth observatioN data

H2020-776019

D2.1
The Use Case Design Report

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Abstract

This deliverable D2.1 aims at providing a guidance document for the Use Cases: 1) Flooding, 2) Food Security and 3) Climate Change, which we denote: "Community Environment (data) Support" or CES of the EOPEN instantiation results. This report document will then be used as guidance for the preparation and realisation of the D2.2 User Requirements and the D2.3 “Joint Decision & Information Governance” Architecture of Work Package 2. Although the Use Case Design Report is developed as part of the project definition, it is a living document that evolves as the project progresses and is updated with the latest relevant information as required.

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History

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Executive Summary

This deliverable D2.1 aims at providing a guidance document for the Use Cases: 1) Flooding, 2) Climate Change, and 3) Food Security, which we denote: "Community Environment Support" or CES of the EOPEN distillation results. This report will then be used as guidance for the preparation and realisation of the D2.2 User Requirements and the D2.3 “Joint Decision & Information Governance (JDIG)” Architecture of Work Package 2. Although the Use Case Design Report is developed as part of the project definition, it is a living document that evolves as the project progresses and is updated with the latest relevant information as required.

This document provides guidance on the following areas:

- The three Use Cases in an Operational Model format which is a step-by-step report for the instantiation of the Target Operational Model (TOM) for a particular CES environment (Flooding, Climate Change, Food Security);
- The EOPEN Use Cases will inform the “Joint Decision and Information Governance (JDIG) Architecture”, backbone of the EOPEN platform, which in turn, informs the User Requirements. . Here we provide the step-by-step report for the instantiation and deployment of the EOPEN JDIG in a local context;
- A draft for a preliminary evaluation plan.

Because of the incremental approach being followed in EOPEN, with multiple activities running in parallel for the definition of the requirements, concepts, models and technology, this report will be kept as a living and dynamic document, along with the project activities, being enriched and refined as the project advances. This first version of the report will be enriched and enhanced in subsequent incremental versions as the activities progress. Updates for this report will be included in upcoming deliverables, in particular as sections in D2.2 (EOPEN User Requirements report; M4 and D2.3 “Joint Decision and Information Governance (JDIG) Architecture”; M6) in order to assure continuous update and refinement.

Abbreviations and Acronyms

COM	Current Operating Model
CES	Community Environmental Support
EO	Earth Observation
JDIG	Joint Decision & Information Governance
MoSCoW	Must have, Should have, Could have, Would like but Won't get
TBC	To be confirmed
TOM	Target Operating Model
WP	Work Package

Table of Contents

1 Introduction

1.1 Background and context

The activities under Work Package 2 (WP2) in EOPEN are devoted to the community needs of environmental data into the EOPEN "Joint Decision & Information Governance" (JDIG) Architecture, demonstrating the robustness and flexibility of the overarching EOPEN Platform. It therefore defines a framework for integration of EOPEN in its various dimensions: organizations, processes, technology, information and systems. The aim is to support the EOPEN system for real-life scenarios that include specific local policies, environments and communities. We approach our Use Cases with a 'Storyboard' scenario that describes through narrative: who and what is involved; the timings and sequences and how the story starts, plays out and ends. The three Use Cases described here allow us to move towards giving place to specific EOPEN instances, as overviewed in the figure below:

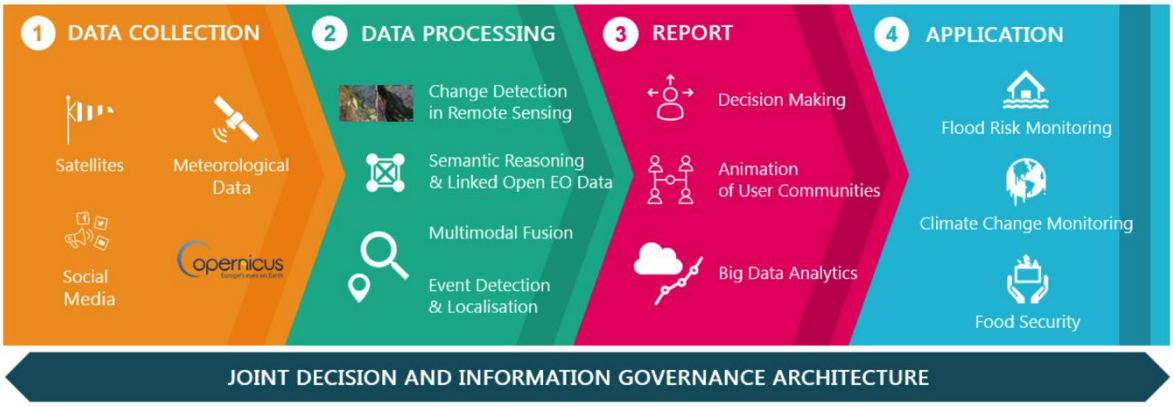


Figure 1: Background and context of WP2

In this context, deliverable D2.1 **Use case design report** aims at providing a guidance document for the instantiation of the EOPEN results. Instantiation meaning how we learn and extract the essentials from our Use Cases to provide information that is useful and applicable for broader contexts which have community environmental (data) support needs. This report document will then be used as guidance for Tasks (T2.2, T2.3) executed in WP2.

1.2 Definitions

This section provides a list of definitions of the most relevant terms defined in EOPEN and used in the course of this document:

- **Joint Decision & Information Governance (JDIG):** The EOPEN JDIG Architecture will support better informed decision making by end users involved in understanding how EO data, integrated into the wider data source mix, is more effectively and efficiently used in support of either their sole or multiple end user decision making needs. This objective will provide essential underpinning to support the innovation, technical and scientific objectives, and, ensure a shared and collective approach to achieving the benefits that EOPEN will bring for decision making that incorporates EO data into the wider data mix.

- **JDIG Journey:** Community Environmental Support (CES) Journey for the JDIG is an agreed and unified view of the core component parts that make up CES Use Cases.
- **JDIG Storyboard:** The script that describes through narrative what the Use Case is going to do; who and what is involved; the timings and sequences and how the story starts, plays out and ends. It's akin to a script in a play – all of the words and storyline are written down – the actors, props, stage (lighting, scenery, special effects etc.) which are found in the following headings, then need to be integrated together on stage and rehearsed.
- **Current Operating Model (COM):** The Current Operating Model (COM) for EOPEN is the defined and agreed model of the end users in each Use Case, and how they are currently undertaking the CES activities as described in their provided scenarios.
- **Target Operational Model (TOM)**: The Target Operating Model (TOM) for EOPEN is the defined, agreed end model of CES, that the operational end users Use Case, and which delivers to them improvements over their Current Operating Model (the COM) of CES. The EOPEN TOM has been achieved through several iterations: a process of iterative dialogue described within this deliverable, with the stakeholders that represent CES in each Use Case. Then adapted to their local context, validated through their Use Case Validation then tested and refined through their test bed.

1.3 Document structure

Chapter 2 focuses on the Operational Models in EOPEN, first providing an overview, and then developing a Storyboard of the Target Operational Model (TOM) for a particular CES environment, which leads to the EOPEN JDIG architecture. The chapter provides an overview of the tools provided by EOPEN, and then develops a step-by-step report for the instantiation and deployment of EOPEN in a local context. Next, Chapters 3, 4, and 5 describe the three Use Cases, respectively: Flooding, Food Security, Climate Change. Finally, Chapters 6 and 7 define an initial draft for a preliminary evaluation plan, findings, and conclusions, as well as some initial comments for the next steps are included as inputs for future activities in the coming tasks in WP2 and WP7.

2 Development of Community Environment Support (CES) Use Cases

2.1 EOPEN CES overview and release plan

The EOPEN Use Cases consider situations that end-users will face in the future, ensuring that EOPEN will go beyond current operations. The CES Use Cases have 4 component parts, which together, form a common baseline template from which the instantiations for Use Case and the CES adaptations to their local context are derived. These 4 component parts are:

- CES Journey
- COM
- TOM
- Delta map

In summary, the CES journey is an agreed and unified view of the core component parts that make up CES Use Cases. The COM and TOM are as described in section 1.2.2 above and a common

template for these, from which the Use Cases then provide their local adaptation. It is built from the individual partner research, dialogue with Stakeholders and an extensive literature review of existing available research findings and outputs that can be re-used and applied from EU wide research and innovation projects such as those of FP7 and H2020. The Delta map is achieved from the gap between the COM and the TOM and as with the COM and TOM, a generic and baseline template has been created from the research to enable local adaptation in the 3 Use Cases. The same principles and approach will be applied to adapt the 3 specific uses, to make them scalable and transferable into other related domains and geographic contexts.

A release plan for the CES will be determined and a draft released post the evaluation of the Use Cases that will take place in at the User Requirements meeting in Vicenza, Italy in April 11-12 2018. Because we are early in the EOPEN project, the integration as a working and useful whole process, able to support the enhancement of CES in the pilot partners, is only coming together in a meaningful way for the April User Requirements meeting, to be hosted by our project partner AAWA and the various multiple stakeholders identified within their Use Case storyboard. A reasonable working assumption is for the CES to be released to all remaining EOPEN partners in February 2018, where it will be more fully tested inside of Deliverables 7.1 Month 20 and 7.2 Month 28 (NOA leading).

Steps and accompanying actions/instructions required for the instantiation of the TOM.

Instantiation of the TOM is achieved through a clearly defined and formulaic process that each EOPEN Use Case developer has participated in to help formulate; the resulting TOM is then reviewed and enhanced, where appropriate, prior to its instantiation and validation at each pilot event and subsequent test bed. The process leading up to the TOM instantiation consists of the following 7 steps.

1. Scenario generation
2. CES journey & COM
3. COM process flow
4. ‘What works’ & TOM
5. MOSCOW analysis & Delta Map
6. TOM process flow
7. Pilot and Test bed (WP7)

From the development of the JDIG, in particular the Use Case descriptions, with iterations, a set of generic templates for the COM, TOM and Delta map are created. They, together provide a baseline from which each of the subsequent Use Cases can work, to produce their own adapted versions of the TOM, and then test and validate the outputs through their individual test beds.

The following sections provide an overview of the process and steps in creating the baseline TOM.

Scenario generation

A CES scenario, focused on the theme of a particular environmental hazard, has been produced by each of the three EOPEN Use Case partners. Each scenario provides hooks and triggers to support a framework for a Concept of Operations (CONOPS) for EOPEN outputs, and will be used as part of Joint Decision Making in the context of Earth Observations.

The scenarios will be used as the basis for the scoping of the rest of the steps that make up the TOM instantiation process, up to the test beds and beyond. In particular, the three scenarios have been aligned to reflect that of the CES journey as described below. For the purposes of this D2.1

deliverable, the following shows the Use Cases, from which each partner will develop a Storyboard Journey.

Table 1: Summary of the Use Cases

Use Case	Description
UC1: Flood risk assessment and prevention	This area within the Italian Eastern Alps river District, is regularly affected by critical flooding from the Bacchiglione River and its tributaries. Planned flood defences remain largely unfinished, and a high risk of flooding therefore persists. Flood in the cities led to high levels of water in the streets, causing many problems such as the drowning of people, building damage and traffic problems. As indicated in the Flood Directive (2007/60/CE) water authorities should plan measures in order to aim at reducing risks by minimizing the possible damages effects and losses that may result.
UC2: Food Security	The "Food Security" problem comprises several different components (food access, distribution, food supply stability, use of food). The Food Security, in South Korea, is a complex issue and is comprised by food self-sufficiency (rice as the main exported crop versus wheat, corn and bean crops as the main imported crops). Hence, the UC2 focus on crops monitoring (mainly rice) at national scale, providing tangible, accurate and timely information to decision makers.
UC3: Climate Change	In the present and future climate change environment, the average temperature in Finland is rising / will rise more (2°C by 2040), and precipitation will increase faster (5–10% by 2040) than the global average. The changes are affecting winters more than summers with the largest changes in the northern part of the country: Finnish Lapland. Since the early 2000s, Finland has taken a pro-active role in managing the Climate Change situation nationally, with mitigation and adaptation plans. The activities of the Transportation sector runs deeply through the sectors: sustainable industry, land use planning and construction, tourism and recreation as summers become warmer, wetter and longer and snow packed regions shift northward. Our use case begins with historical snow and temperature data, supplemented by EO data, which support Finnish Transportation Agency (FTA)'s current and future road maintenance for the Finnish drivers and riders. Our Use Case continues with temperature and snow data support for the Finnish Lapland communities, especially reindeer herders, who are, and will be, experiencing the greatest consequences due to climate change.

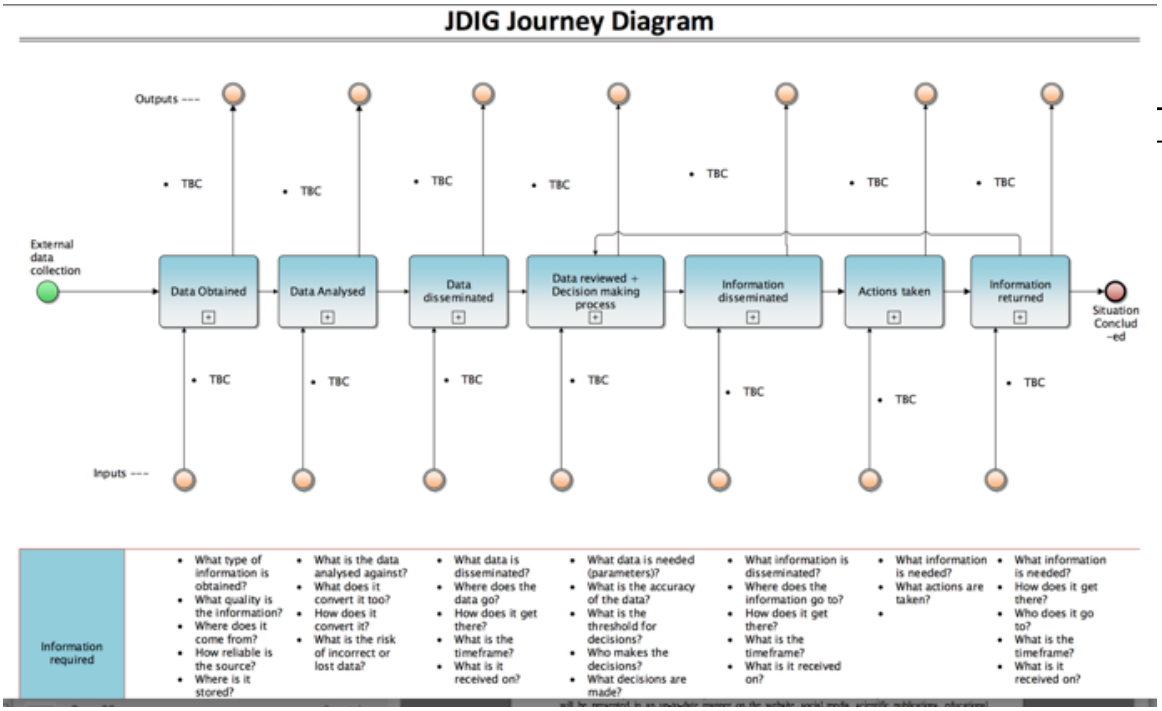


Figure 2. The CES JDIG Journey

CES journey & COM

The CES JDIG Journey, seen in **Error! Reference source not found.** above, and the CES Storyboard s een in Figure 3, gives the foundation for the full development of the Joint Decision & Information Governance Architecture, the JDIG (D2.3) The JDIG is the framework from which the TOM is created and in which it resides. The CES JDIG Journey has been based upon the research carried out by each of the EOPEN partners and a previous successful project (Unity). It provides a unified, common and transferable view of the key stages that make up the end-to-end activities of CES in each Use Case.

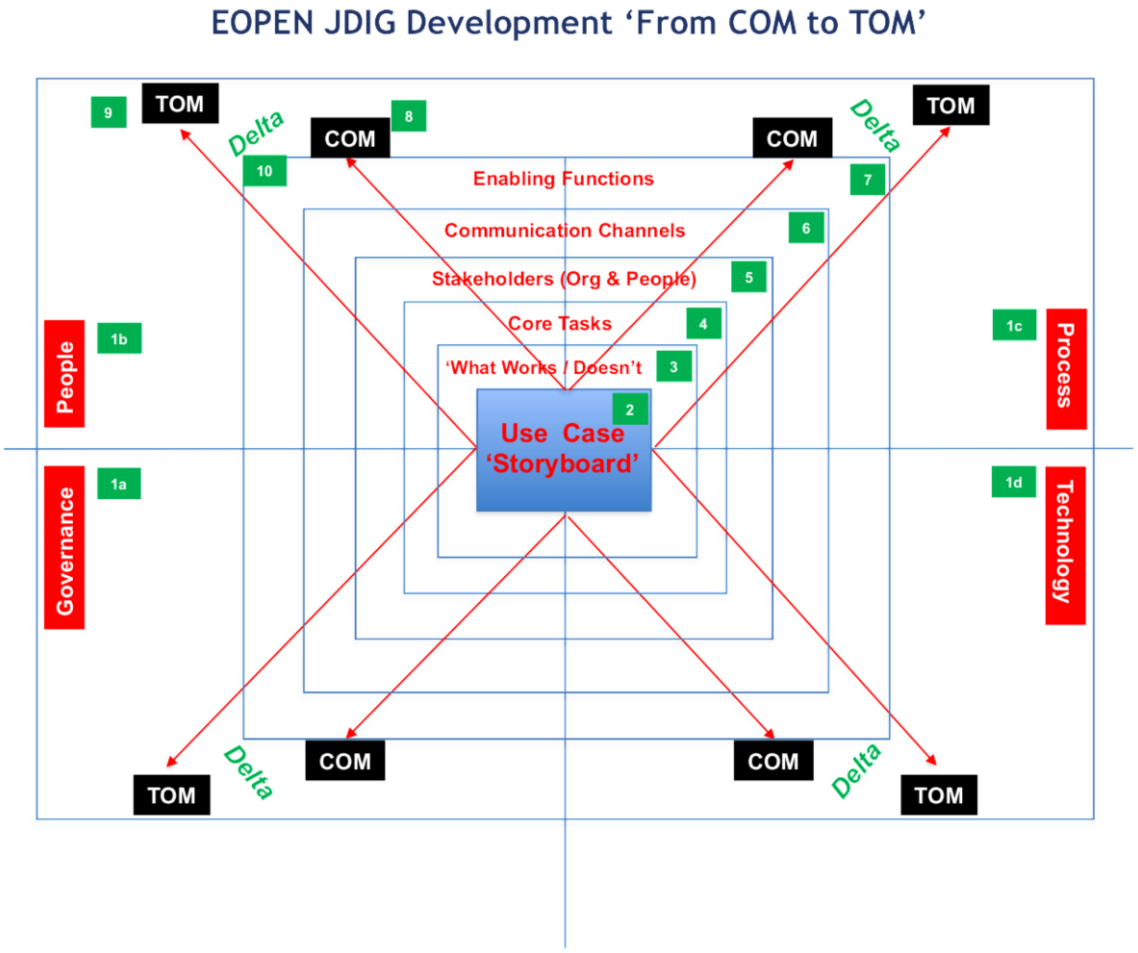


Figure 3: Use Case Storyboard

A description of each of the terms in the multi-dimensional Figure 3 follows.

In relating the CES JDIG Journey with the CES Storyboards, EOPEN will understand the context of the wider community policies using multi-mode EO data. Data, which the EOPEN TOM must eventually sit and in which it must function; and thereby, how the outputs from the EOPEN TOM can integrate downstream and form part of the 'Big Data' Use Case lifecycle.

This CES Journey provides the means for scalability and transferability both across the EOPEN partners and across the EU as a whole. Our plan to achieve this goal is to deconstruct the three Use Cases into a set of common key activities against the goals of the project.

For example, in each CES Journey and Storyboard would be a set of environment conditions that signal community actions by individuals, institutions and government bodies, which mitigate the environmental hazard. EOPEN, as a platform to integrate satellite and social media environment data, can better prepare a community with longer preparation time for such a hazard. Communication with the communities and stakeholders about our available EOPEN tools are included in our basic mandate.

No	Heading	Description
1. a-d	Capability Areas	These 4 capability areas – Governance (1a), People (1b), Process (1c) and Technology (1d) are the top level capabilities that represent all tasks, functions and activities needed by any one individual organisation or, multiple organisations, working collaboratively in undertaking their roles and responsibilities in relation to the planning, preparedness, response and recovery to flood resilience. For each of the following headings below, each of the capability areas needs to be considered as to how they support, are supported or interact with the subject heading.
2	Use Case 'Storyboard'	The Use Case ' Storyboard' or scenario, is the script that describes through narrative what the Use Case that supports the pilot is going to do; who and what is involved; the timings and sequences and how the story starts, plays out and ends. It's akin to a script in a play – all of the words and storyline are written down – the actors, props, stage (lighting, scenery, special effects etc) which are found in the following headings, then need to be integrated together on stage and rehearsed.
3	What Works / What Doesn't	With all stakeholders in the storyboard identified (along with their roles and tasks), a subjective and objective review and analysis of the storyboard is carried out jointly with the stakeholders to identify and validate what works and what doesn't work in the storyboard – where issues, challenges, risks and failures need to be overcome or addressed and where areas that do work can be improved upon.
4	Core Tasks	These are the core tasks, activities, functions and activities within the storyboard that are carried out detailing by whom they are carried out, with what, when and how.
5	Stakeholders (Orgs & People)	These are the stakeholder organisations and individuals within them or elsewhere as identified within the storyboard who are taking part and involved in heading 4. It documents their roles, responsibilities, hierarchies and interactions. What do they do and what roles do they play and how.
6	Communication Channels	To meet the headings detailed above, these are the communication channels (physical and/or virtual) that take place and are used to carry out the heading 4 core tasks as described by the storyboard. It details the exchange that takes place, the information that is used and communicated, the sources of such information and how that information (both source, transfer and communication) is governed and managed and the constraints attached.
7	Enabling Functions	The enabling functions is intended as a 'catch-all' for anything not picked up in the other headings - the enabling functions being: the governance & policies, processes & procedures, technology & systems, people & information involved to enable all of the above identified in the storyboard to happen.

Table 2: Explanation of Elements in the Storyboard

COM process flow

The COM process flows represent the activities and decision points within each Journey that make up the Current, or as is, Operating Model of CES within each partner as reflecting and aligned to the provided scenarios. The high-level process flow that represents the generic CES journey can be seen in Figure 2**Error! Reference source not found.**.

The decision points in the CES JDIG Journey can be seen in the figure**Error! Reference source not found.** where we have branches of action from particular triggers. For example:

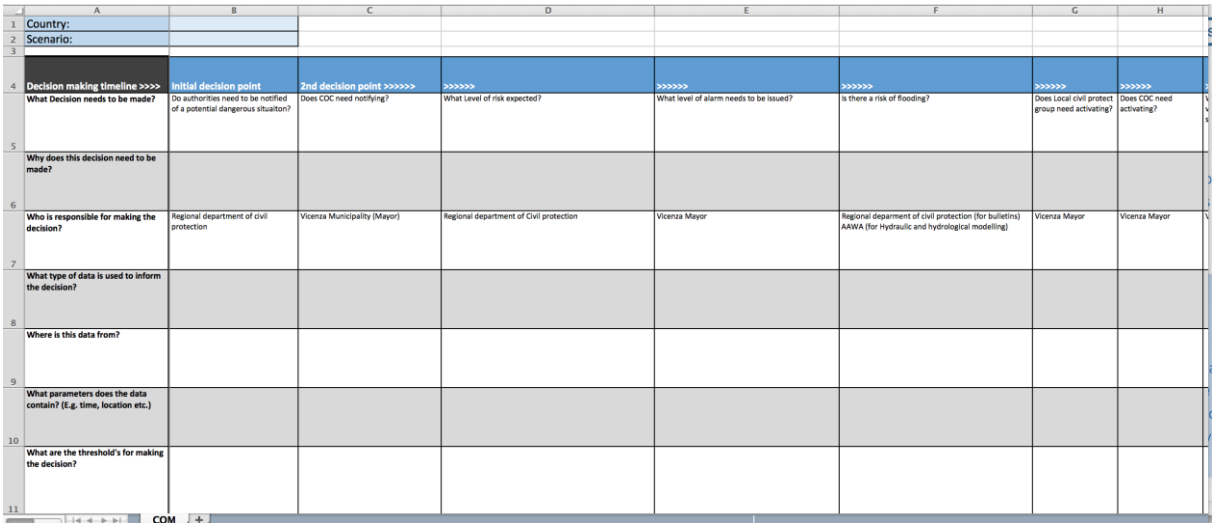
What is the threshold for decisions? How does it [threshold] get there? Who makes the decisions? What decisions are made?

The CES Storyboard (Figure 3) is iterative, with multiple journeys working in parallel at different stages within each scenario. Each iteration will provide a different COM process flow that consists of several layers, each increasing in granularity to provide a view of the processes that support the activities, decision points and information flows that make up the current way that CES is handled in each Use Case. This includes all of the functions, systems and technology that support and enable the CES journey to take place. They can be expanded or adapted as required, as CES processes change or developments take place, thereby providing the basis from which the TOM has been created.

The CES Journey**Error! Reference source not found.** is divided into two key parts; data collation, a nalysis and dissemination; and decision-making, actions and information exchange. Data collation, analysis and dissemination are captured using the CES Data template seen in a snapshot of the first

rows in Figure 4. The CES Journey data template provides the link between all the complex external data sources and how it is configured and presented in a usable format by the key decision makers.

The template is used to capture the key decisions points and complex relationships within each CES scenario, what information is used and how it is obtained to guide these decisions and the subsequent actions this information is responsible for. This CES Journey template performs the basis for the further more detailed COM process flows as detailed above, and highlight the key organisational and individual stakeholders that are involved across the CES scenario and CES journey at each Use Case.



	A	B	C	D	E	F	G	H
1	Country:							
2	Scenario:							
3								
4	Decision making timeline >>>>	Initial decision point	2nd decision point >>>>>>	>>>>>>	>>>>>>	>>>>>>	>>>>>>	>>>>>>
5	What Decision needs to be made?	Do authorities need to be notified of a potential dangerous situaiton?	Does COC need notifying?	What Level of risk expected?	What level of alarm needs to be issued?	Is there a risk of flooding?	Does Local civil protect group need activating?	Does COC need activating?
6	Why does this decision need to be made?							
7	Who is responsible for making the decision?	Regional department of civil protection	Vicenza Municipality (Mayor)	Regional department of Civil protection	Vicenza Mayor	Regional deparment of civil protection (for bulletins) AAWA (for Hydraulic and hydrological modelling)	Vicenza Mayor	Vicenza Mayor
8	What type of data is used to inform the decision?							
9	Where is this data from?							
10	What parameters does the data contain? (E.g. time, location etc.)							
11	What are the threshold's for making the decision?							

COM

Figure 4. CES Journey Template

Actions in process:

After aligning the scenario(s) to the CES Flood journey, the Food Sustainability and Climate Change Use Case partners should then break down their scenarios into their key decision points, and the different types of data obtained to populate the templates provided. This detailed breakdown should then be used to identify the stakeholders involved across the entirety of the CES scenario process – these stakeholders should be kept engaged in the process of review and evaluation and invited as representatives of the CES journey and scenario for the pilot and resulting test bed.

'What works' identification

The 'What Works' aspect of the process and steps towards TOM instantiation also includes 'What Doesn't Work'. It's a review and analysis, both subjective and objective, from the stakeholders involved across the CES journey and COM process flow(s) at each pilot partner of what, relative to their chosen scenario(s), works and what doesn't work. It uses the five core capability areas that underpin the Information Management value stream of: Governance, People, Process, Technology and Data. These areas form the JDIG. From this, we have been able to carry out a more detailed analysis that maps to the successes, failures, risks, challenges and issues experienced by each pilot partner with the CES COM. It provides the basis from which the mapping and understanding of where the TOM can use or adapt existing CES processes and activities or where new developments need to take place.

From this 'What Works & Doesn't Work analysis, the stakeholders across the CES journey have then provided their subjective and objective input to support the development of the TOM on how they know or would like to overcome the issues and challenges identified; mitigate the risks; address and remedy the failures, and; improve upon the successes.

This input for the desired TOM along with the previous COM, have provided the vertical and horizontal axes for the Delta Map described in the following section. 0

Action required:

Against the CES journey, the COM and the detailed COM process flow of the activities and processes that take place in each pilot partner to reflect the scenario(s) provided, an objective and/or subjective review and analysis should be provided by each stakeholder involved across the entire CES journey of what is and what isn't working. This review and analysis should be provided in a free flow format and should include review and analysis set against the x5 core capability areas of Governance (polices etc.), People, Process, Technology and Data.

Using their 'what works / what doesn't work' review and analysis as a basis, each stakeholder should then give their view on what and how could enhance, improve and overcome any of the issues, challenges, risks, successes or failures of how their current model of CES, as set out by the scenario(s), could or might look in any future model. This should be a free flow review, based upon their real or perceived observations and not be restricted. It can include any element or activity whether organisational, cultural, behavioural, and technical or process related, etc.

MOSCOW analysis & Delta Map

The TOM described above, through the "What Works… Analysis" is used to identify the User, Data & System requirements, which provides a view of the entirety of the desired Target Operating Model as defined by the stakeholders within the CES journey. This view however, has to be set in context with the reality of what can actually be achieved within the parameters of the EOPEN project (e.g. cost and time) and by any constraints that exist within such areas as policy, economics etc., of the Use Case partner states. A Subsequent analysis: MoSCoW is used to shape the User, Data & System requirements into this more realistic Target Operating Model: TOM.

- ❑ The MOSCOW analysis is an acronym of **M**ust have, **S**hould have, **C**ould have and **Want**/**W**on't have and has been used in conjunction with the Delta mapping to provide the basis for our unified, common and amalgamated TOM which each Use Case partner will then adapt to enable their Use Case.

The Delta Map has two axis, the COM and the TOM as described above. Once populated, the grid has enabled the relationship, or Delta, between the CES COM and the Realistic TOM to be seen. This Delta, has provided the means to carry out a gap analysis for us to understand the similarities or differences between the two, and what actions need to be taken going forward. The components that populate this Delta are then subject to a further capability mapping analysis, which provides the understanding to realise the TOM operationally.

- **Capability Mapping:** The CES journey and the COM and TOM process flows, are the JDIG, which acts as a golden thread throughout all CES activity.

Underpinning the JDIG, and all other functions and activities that occur, whether CES or other, are five core capability areas. These together, provide the Enabling Functions for the EOPEN outputs, as described by the TOM, to become operational downstream. These 5 capability areas are: Governance (Procedures, Legislation & Policy); Business Operations; System & Infrastructure; Organisations & Personnel and Data & Information.

The capability mapping has looked at where the outputs from the Delta map and analysis sit, in relation to the Information Value chain and its five capability areas, to identify where the subsequent process flows that make up the TOM also sit.

Outputs also drive the high level functional requirements for the project's technology aspects. Together with the IT user requirements being undertaken in WP2, D2.2, this will refine what technology enables the TOM and how it is used.

TOM process flow(s)

From the combined capability mapping and MoSCoW analysis that has taken place in the Delta map as described above, a process flow(s) giving more granularity to describe an achievable TOM (based upon acceptable project and external factor constraints) that represents a generic, amalgamated view of CES has been produced for review and comment by the EOPEN Use Case partners in advance of their planned pilot events.

Action required:

Each stakeholder involved in the CES journey and across the detailed COM process at each pilot partner needs to review the relevance, applicability and achievability of this detailed process flow(s) for the TOM that has been constructed based upon the previous review and analysis by those stakeholders of 'what works/doesn't work'. Feedback needs to be provided where necessary until the resultant detailed TOM process flow is agreed by those stakeholders involved.

Adaptation and Pilot

In undertaking the review, as described above of the 'achievable', common and amalgamated TOM, each pilot partner is seeking to identify and understand how it would, could or should work in relation to their own specific scenario(s) of CES and their own existing (i.e. Current) and/or desired (i.e. Target) operational models, structures and procedures.

The final version of the TOM used for each Use Case Test Bed will be reviewed against the findings and output from the Test Bed, updated where required to provide the basis, alongside the technology elements of EOPEN, for the Test Beds post pilot.

The CES Journey Template has been filled in to provide the first draft of the Flooding Use Case, below in the following section

3 Flood Use Case 'Scenario' for Vicenza (Italy)

3.1 Use Case 'Storyboard' introduction

Vicenza is a city of 112.000 people city in the North East of Italy; the whole metropolitan area of Vicenza (that includes also the surrounding municipality) counts over 200.000 citizens. Vicenza was founded by Paleovenetians during the IV century A.C. near the confluence of the Retrone river and the Astico River, two important tributaries of the Bacchiglione river.

Flood events during history were frequent and catastrophic. In the last centuries, there were the flood of 1882 (failure of ponte Angeli bridge, a medioeval bridge modified during renaissance by Andrea Palladio), 1966 (most important event for damage and failures) and the most recent floods in 2010 and 2012.

Flood events cost millions of euros (direct and indirect damages) and people need years to rebuild what was lost. The flood risk management is also the scope of the 2007/60 EU Directive.

This particular scenario was built based on what happened in 2010 in Vicenza; the storyboard underlines the most important figures involved in the emergency management and their role in the "Command Chain".

The scope of this "play" is to remark the command chain, the important role of the Civil Protection structure (planning includes) that is the framework during the emergency.

In fact, AAWA is an administration that supports decision maker during emergencies and during ordinary time providing knowledge about flood risk management (as previous mentioned about the 2007/60 EU Directive)

The flood case scenario also underlines the most important aspects of the COM.

From the analysis of this storyboard it could be developed the TOM based on critical points inside the play.

Table 3: Flood case scenario

Date Time	
Day1	The National Weather forecasting service provides weather forecasts (2 times for day); they show a dangerous scenario for the Veneto Region with huge precipitation in the Pre-alpine zone with local peaks over 200 mm for the next 2 days (documents provided are only an example). Based on these forecasts the Regional Department of civil protection provides to all authorities at regional scale (municipalities, provinces, prefectures, ...): • a meteorological bulletin of adverse meteorological conditions at Regional scale (doc1_will be attached in the next version to complement the scenario) • a hydraulic bulletin which reports an "attention" level of warning for all the rivers in Veneto Region for the next 2 days (doc2_attached). In this bulletin the Bacchiglione River Basin which crosses the city of Vicenza is inside the codes VENE-B and VENE-E. • civil protection prescription (doc5_will be attached in the next version to

	complement the scenario) All bulletins come by email or fax or sms; they are also available on the website of the Veneto Region. The municipality of Vicenza informs the components of / (local control center during emergency): • AAWA • Municipal technicians • Fire fighters • Province of Vicenza • Municipal Police • Italian Red Cross • Vicenza Company for multi-utility services • Civil Protection Volunteers the communications are sent by mobile phones.
Day2	The Regional civil protection department provides an updated bulletin; the weather forecast shows a worsening; now they provide local amount of precipitation over 300 mm in the Bacchiglione River Basin in the 2 next days . AAWA decides to execute the Flood Forecasting Model AMICO to predict river water levels for the Bacchiglione River. AMICO was developed by AAWA and runs in AAWA office and in parallel in the Civil Protection Veneto Region Office. AMICO provides a forecast every 6 hours emitted by means of a specific bulletin (doc3_attached) by the Veneto Region ; It shows the overcomes of dikes in the section of “Ponte Angeli” in Vicenza at the day 3 Based on these information (AMICO (for Bacchiglione River Basin) + meteorological scenarios at regional scale) the Veneto civil protection authority emit a hydraulic bulletin which shows an “orange alert” for the basin of Bacchiglione. The bulletin comes by email or fax or sms; it is also available on the website of the Veneto Region. The mayor based on all the above information raised the alarm level to “Pre-Alarm”. The mayor of Vicenza decides to convene the COC; it call by telephone civil protection volunteers, municipal police, technical services (engineer and other technicians from the municipality office).
Day3	The night before the event, in the pre-alpine zone over 300 mm of precipitation has fallen with local max of over 500 mm. The event has been characterized by the presence of Scirocco wind; there has beena rapid snow melt due to the presence of Scirocco (hot wind coming from south). The Regional civil protection department provides a now-casting bulletin describing what has happened during the night (doc4_will be attached in the next version). The morning of the day3 the results of the last AMICO run (of 0 am) show lower river levels respect to the actual condition in the Ponte Degli Angeli River Section in Vicenza.

	Probably AMICO's results were wrong due to the wrong boundary conditions on soil moisture and snowmelt. However the AMICO's bulletin report the passage of a flood wave during the morning in Vicenza with a probability of trespassing of embankments. At 7.30 of the water level rises over the alert point in sections upstream of some tributary of Bacchiglione (Legora and Timonchio). The mayor decides to activate the local civil protect group (civil protect volunteers) to ensure the city center from the passage of the flood wave. The mayor activates officially the COC (operative center) and sent volunteers to strategical posts to monitor the water level. Other teams of civil protection volunteers are sent to the municipality's warehouse to prepare some safeguards for the flood prevention called Aquadike. Many volunteers have not smartphone or internet. Sanitary provides also a PMA (medical post) to rescue the population in case of flood. All communications are sent by land mobile radio (PMR frequency) and a lot of information is lost during this phase. At 8.30 the Regional prevision center of Civil Protect gives another now-casting bulletin based on the results of AMICO that underlines the worsening of the weather condition and provides the maximum water level at the section of "Ponte Angeli" in Vicenza that may overcome the dikes of the Bacchiglione river at 12 pm. At 9.15 civil protect team starts to collect data to monitor the situation; most reports come to COC by radio or by phone call; a volunteer inside COC tries to gives to the mayor a global view of the actual situation with some post-it on a board (storyboard). At 9.15 Civil protect teams also place mobile barriers (Aquadike) along Bacchiglione dikes near "Ponte Angeli", they communicate with COC by radio. At 9.45 The level of water of Bacchiglione in "Ponte Angeli" section was near to overcome dikes, so the mayor decides to activate the sound system to warn people against flood. The mayor based on all the above information rose the alarm level to "Alarm". At 9.50 the mayor decides to close all streets near "Ponte Angeli"; he alerts local police for the closure; local police communicates with COC but COC isn't able to communicate the closure in real time to sanitary and prefecture. About 10 minutes after the closure the mayor sends to the prefecture and the sanitary a copy of the resolution about the closure via email. At 10.20 civil protection teams puts Aquadike and other safeguards in critical sections, they communicate via radio with COC and the volunteer inside updates the storyboard. At 10.30 the flood wave reaches Vicenza, the mayor and municipality technicians, based on the civil protection plan try to establish the magnitude of flood and consequently where citizen must be moved to. They also consult the Flood Risk Management Plan (PGRA) (Provided by AAWA and available from the AAWA website in pdf format).

	Unfortunately, there isn't any tool to superimpose the civil protection plan with risk maps in PGRA. Moreover, the PGRA maps are based on an old database[1] about landuse that cannot reflect the current status of the exposures element in the territory. At 10.40 a citizen calls the municipal emergency number to communicate that a person has felled inside Bacchiglione; At 10.50 the mayor orders to the coordinator of volunteers to rescue the citizen; the rescue team saves the person inside Bacchiglione; he communicates with the rescue team via radio and rescue team proceeds to the rescue. At 11.20 the flood occurs and the water level exceeds the embankments of 50 cm; Amico only in the last run (10.00) confirmed this exceeding and the bulletin was emitted at 11.00. The time was too short to act in advance. During the flood volunteers and citizens continue the monitoring of water level in the city; they also provide photos using social media from the emergency but nobody in the COC can print and store them or integrate those datain the scenario. From 12.00 to 15.00 there is a decrease of water level in the river, volunteers and citizen continue the monitoring of water level; they also provide photos from the emergency but nobody can print them or integrate those data in the scenario. At 15.00 the water level decreases under dikes crest and also upstream sections shown a decrease of water levels. At 15.20 the mayor order to remove the Aquadikes and safeguards against flood (following the decrease of water level), volunteers receive the order by mobile radios. They do the removal of flood barriers and communicate the end of operations. The storyboard inside COC is updated. From 15.20 am to 24.00 volunteers provide to municipality technicians a report of the flood damage observed and of their actions during emergency (report on paper (doc6)); many zones are flooded also due to the closure of sump pumps;
Day 4	The mayor form the COC continues to coordinate the rescue operations with volunteers all day (post-emergency phase). Volunteers provide to municipality technicians a report of the flood damage observed and of their actions during emergency (report on paper (doc6)) until midnight. At the end of the day the mayor declare the end of emergency and close the COC
Days after	The mayor convenes a press conference to inform about the emergency status. Regional govern request to the mayor of Vicenza all data about the flood (damage estimation, flood extension etc…(https://www.regione.veneto.it/web/protezione-civile/superamento-dell-emergenza)). The mayor orders to Volunteers and technicians to provide the requested maps but data

[1] Corine Land Cover 2006: https://land.copernicus.eu/pan-european/corine-land-cover/clc-2006/view) updated every 6 years

	inside this maps are not sufficiently precise; anyone activates satellite tools and it took about 8 days to collect and describe all aspect of the flood for the final document. As a consequence, insurance companies paid with large delay and the economic and social cost of the event rise up. PGRA and civil protection plan weren't updated correctly since the data from surveys were not stored in a database accessible to AAWA; for example PGRA can't show all information provided by the municipality technicians and volunteers since their paper reports were not stored in a database and a lot of information were lost during the emergency.

3.2 List of Stakeholders involved and role in emergency

Following previous description of the emergency, in this chapter we will describe stakeholders involved during a flood emergency with a brief description of their role during emergency.

Name	**Description**	**Actor Goal**
Civil Protection Agency: Regional	The civil protection actors that work on a regional scale, identifying risk, notifying stakeholders, supporting provinical emergencies and manging regional operations.	Monitoring of emergency
Civil protection forecasting Service (CFD)	Proving forecasting of meterological events. Provides the raw information used to determine the potential for and level of an expected emergency and emergency bulletin.	Monitoring of emergency
Prefect	Prefect of Vicenza	Monitoring of emergency
Mayor	Mayor of Vicenza	Decision maker, head of COC
Civil Protection Agency: Provincial	The civil protection actors that work on a provincial scale, identifying risk, notifying stakeholders, supporting local emergencies and manging provincial operations.	Monitoring of emergency
Civil protection Agency: Local	The civil protection actors that work on a local scale, identifying risk, notifying stakeholders, supporting volunteers, cohordinate emergencies and manging local operations.	Monitoring of emergency and management
Civil Protection Volunteers (Vicenza) and sanitary	Civil protection volunteers	Monitoring of emergency and action to rescue

		citizen
Fire Brigade (VVF)	Fire Brigade	Monitoring of emergency and management
Consorzio di Bonifica Brenta (Land reclamation authority)	Land reclamation authority of Bacchigione tributary basin, responsable for the minor hydrographic net	Flooded area and river status acquisition
Municipal Police	Municipal police of Vicenza	Monitoring of emergency and management
Veneto Region Soil Defence office	Office responsable for land use, water management and environmental issues	Monitoring of emergency and management
Alto Adriatico Water Authority (AAWA)	Alto Adriatico Water Authority	Monitoring of emergency and management
Municipal Technicians	Technicians of Vicenza responsible for thecnical services, emergencies and land use planning	Monitoring of emergency and management
Genio Civile di Vicenza	Veneto region office responsable for river maintance	Monitoring of emergency and management
Vicenza company for multi-utility services	Multiutility company responsable for water, energy and waste management	Monitoring of emergency
Citizen	Local citizens in the effected municipality	own Safety
Environmental agency (ARPAV)	Provide continuous precipitation, temperature, humidity and wind data, used for AMICO system.	Monitoring of emergency

3.3 Description of emergency structure

At municipal level: Municipal Operational Centres (COC). Within the COC the Mayor is the maximum authority and he uses all the municipal structures to realize the risk mitigation strategies. All the operations are coordinated by the Civil Protection Department that uses officials and volunteers. In case of the involvement of more than one municipality during the emergency, the Mayor may require to the Prefect the support of COM. Operational activities of COC are now coordinated by the Mayor with COM.

At provincial level: the Mixed Operational Centres (COM) and Rescue Coordination Centres (CCS). The Prefect is the maximum authority during a provincial level emergency, he activate COM in the prefecture when an emergency involves more than one Municipality. Under the COM's coordination the Fire Department, the police system (which includes Carabineers, state police...) and Civil Protection Department, manage the rescue operations and all the activities oriented towards resorting back to normal life conditions. Based on specific operative needs, the Prefect may activate more than one COM. In the prefecture is also activated an operative room in which are gathered every data and information related to the crisis. Actually, a COM is settled in Vicenza, with the presence of delegates of the Province, Public agency and of the 16 Municipalities under the prefecture authority. The Mayor of Vicenza has to join obligatory to COM. The CCS is activated by the prefect in case of a severe emergency that involves a large amount of provincial territory. CCS coordinates the activities of the COMs. The members of CCS are usually delegates of: Region, Province, Mayors of involved Municipalities, COMs, Fire Brigades, Carabineers, Police and other armies, U.L.SS, ARPAV, 118, CRI, public authorities an societies which provide essential services (such as furniture of gas, water, electricity, telecommunication networks..) and various volunteer associations).

At regional level: the Regional Operations Centres at the regional level (COREM): the maximum authority of COREM is the President of Region (or his delegate), who settled COREM during a severe emergency which involves several Provinces. COR coordinates the activities of CCSs, provides to continuously elaborate data and update risk scenario. The members of the CCS are delegates of CCS, Regions and every other authority which at regional level is part of the Civil Protection System.

At national leverl: the Direction of Command and Control (DICOMAC) at the national level. Even though the DICOMAC represents the national level, it is physically set up on the disaster site or close thereby. The National and Regional civil protection authorities, the delegates of Italian institutions and the Regions are involved when the event assumes a high gravity level. In these cases often the army is involved in addition to the National Civil Protection System.

AAWA and other national offices can support administrations locally by sending officers into emergency scenario (i.e. inside COC or COM or COREM, depending on the magnitude of the event).

3.4 What Works / What Doesn't

The analysis of what works and what doesn't will be draft in several times; first of all, by the analysis of the storyboard many critical aspects emerged (availability of internet connection, communication methods and infrastructures etc.), so a first draft of what and what doesn't works was prepared. After that, based on questionnaires sent to stakeholders (involved during emergencies) a second document will be produced.

During the User Requirements meeting in Vicenza (11-12th April 2018) these documents will be discussed with stakeholders to improve that aspects and receive other contributes from who really act during flood emergencies.

Finally, What works and What doesn't, will be a fundamental part of D2.2 (User Requirements).

WP7 will also test EOPEN platform with a field demonstration with the objective to overcome what doesn't work.

Basically, during emergency all forces work together with a common target that is the emergency support and safety for citizen; the main problem is the fragmentation of information due to the

number of actors involved. During emergency is very difficult to share information in traditional ways (papers, emails, fax and so on) and it required much time, so the decision maker couldn't have a precise view of the emergency.

Another problem is that at the end of emergency the lack of a unique database causes lack of information acquired.

The lack of powerful computer infrastructure is mainly a limit for the use of satellite imagine that required a specific formation on satellite science and an appropriate ICT infrastructure.

What works is mostly the command chain that is known by all, during emergency every actor work separately with its team, information and decision are shared at manager/director level that are physically inside each structure (from COC to DICOMAC).

3.5 Benefits from EOPEN platform

EOPEN platform should be able to overcome problems described in the previous paragraph; EOPEN should be a unique platform for all actors involved and this aspect could overcome the problem related to information sharing.

EOPEN will provide also a powerful HPC infrastructure that can treat satellite datasets properly so also offices with a low ITC infrastructure can visualize data from COPERNICUS.

Lastly the unique datasets that merge EO and non-EO data will reproduce the status of emergency correctly and can store data for future study or damage estimation.

4 Food Security Use Case

4.1 Use Case 'Storyboard' Introduction

South Korea has experienced rapid population growth due to urbanisation, commercialisation of the food chain and changes in diet. Korea has low food self-sufficiency that is decreasing in the long term, due to the market opening and due to being dependent on the import of most major grains. For instance South Korea is maintaining 50% of food self-sufficiency under the influence of high self-sufficiency of rice, but grain self-sufficiency rate decreased to 20% because of the increasing import of feed grain. Therefore, it can be stated that South Korea is exposed to a food security crisis due to its high dependence on international grain supply in major crops and limited number of exporting countries.

Statistics Korea is the assigned partner to announce the results of Korea's annual rice production forecasts in October each year. According to the Ministry of Agriculture, Food and Rural Affairs (MAFRA)'s key statistics on agriculture, forestry and food, in 2014, Korea's food self-sufficiency rate was 49.8% and grain self-sufficiency rate was 24%. Major grains, except for rice, depend more than 90% on imports. Since 2000, rice supply has been constantly oversupplied and it is estimated that the annual supply of rice is over 280,000 tons. Therefore, the government's market intervention is inevitable. One of the main reasons for the overproduction of rice is the government's agricultural policy and active market intervention. The government would isolate the market if the price falls below the target price and compensate 85% of the price decreased. Apart from the central government, local governments also have a lot of support policies for rice farmers. Producers prefer

rice farming because of the relatively lower labour input due to high mechanisation and stable income compared to other crops. Relevant stakeholders and actors are the Prime minister, the Ministry of Agriculture Food and Rural Affairs (MAFRA), the Korea Rural Economic Institute (KREI), the National Institute of Agricultural Science, Local Governments, Producers (farmers), SMEs, Food Importers and Consumers.

To sum up, the primary Food Security issue in South Korea is the over production of rice and the heavy reliance on the import of other crops. The monitoring of food security in South Korea is focused almost exclusively on rice production. However, monitoring the production of wheat and corn in the South Korean trade partners, such as USA and China, is also of great interest and of high impact in decision-making. Nevertheless, the import sources are largely diversified and vary from one year to another. For this reason, the pilot case will focus on monitoring rice production within South Korea.

4.2 Main actors

Korea Rural Economic Institute KREI

Role: KREI is an exclusive agency for providing an agricultural outlook service for the government and tries to stabilize food supply and achieve food security by monitoring the impact of climate change and farm product trade on the domestic agriculture industry. KREI conducts policy research on 'agriculture/rural area and food industry development plan' which is 5-year period official plan for building a mid/long-term food policy and suggests the direction for national food policy and specific goals for food self-sufficiency.

Current Status: Using statistics data provided by Statistics Korea. Their application is limited to displaying the statistics by combining shapefiles with the current statistical data in a province level. In addition, the data is not spatial which means it is hard to calculate distribution costs. If the spatial information is not applied, analyzing economic feasibility is relatively hard.

Also, the current statistics data in a site unit relied heavily on samples. For the calculation, after carrying out the field study, you should multiply the sample parcel with the cultivating area in an administrative unit.

Services:

1) KREI conducts a monitoring on domestic farm products, international grain, and raw material prices in a process of agriculture monitoring service and operates warning system using early warning index. The warning system is operated at all times, but they provide the warning index through monthly report called "Global Grain Monitoring" (Domestic/imported agricultural product monitoring).

2) Conducting farm sample survey, crop yield model/supply-demand model development, expert interview for domestic farm product monitoring.

3) Constructing early warning system using econometrics, and suggesting countermeasure depending on crisis management phase for government to respond quickly and accurately. Many economic indices are used including consumer price index, material cost index, farm sales price index etc., and such data are provided through quarterly report, "Agriculture and Rural Economic Trends".

4) Making a diagnosis on overall food security along with self-sufficiency rate and suggesting basis for policy decision by developing index that expects status of future food security through the change of agriculture environment (Assessment on food security).

EOPEN targeted input: Currently the crop yield data is in province level; however, we can downscale and provide it in a city, borough, county level or town, township, community level. Through this service, accuracy and objectivity can be improved.

The current government is planning to increase its budget for the whole process from production to consumption. As KREI is in public sector, our data can contribute to their goals of achieving the government's policy related to the evaluation of the whole process. Beyond providing them a crop yield, if we can draw out a trend line from the past, they can then use it as a forecaster of the market, crop consumption, exports, stock and supply and demand for crops; as KREI is not familiar with handling GIS/remote sensing data.

KREI monitors the cultivation area and predicts the crop yield for 35 main farm products in an attempt to provide high-level and actionable information in regard to national food security. EOPEN can directly assist KREI via introducing Earth Observation in their in house crop yield estimate models, shifting from a sampling-based approach to a nationwide monitoring approach. The Food Security Use Case of EOPEN can offer EO-based products, such as nationwide, high resolution rice extent mapping and crop growth monitoring (using both Sentinel-1 and Sentinel-2) to be fused with their statistical, in-situ and field survey based data for a more accurate and timely large-scale monitoring. This pertinent EO-based information can be used both for their early warning system, but also their annual crop yield statistics.

NAS (National Institute of Agricultural Science)

Role: RDA (Rural Development Administration) has focused its effort on the improvement and advancement of Korean agriculture, thus NAS institute was established with a mandate to conduct research on the agriculture domain. Some of NAS's activities focus on the monitoring of domestic crops, development of statistical model, perform in-situ observations and provide all the data and information to RDA, which disseminates the appropriate info to the public (e.g. rough production estimates). The results from NAS are not open access and only some are planned to be used and shared. Since NAS is a public institution, the purpose is to serve the public and has constraints in providing information for private entities.

Current Status: monitoring domestic crops using MODIS, combining their EO based data with statistical information from Korea Statistics. As in the questionnaire, they don't use a platform such as Asia Rice Geoglam due to low-resolution of their products.

Services:

1) NAS has been monitoring domestic crop using 250m MODIS image since 2002. The derived data is related to the Korea Statistics and there is ongoing network between the two organizations.

2) NAS is developing, at national scale, a system for monitoring domestic crops using the statistical model (regression), biomass model (CASA MPP) and deep learning model. Until 2012, NAS used the statistical regression model but when it reached a certain degree of accuracy, other models were adopted since 2013. The different models are being integrated for crop monitoring. For this service and for NAS, it is important to contribute in lower the percentage of error in monitoring the crops.

3) NAS monitors Central US Corn Belt region, and parts of China and South America

4) NAS is also utilizing drones. The high land Korean cabbage supply is a sensitive issue in Korea and NAS is currently collaborating with KREI for the cabbage monitoring.

EOPEN targeted input: NAS focuses more on the R&D of crop monitoring rather than providing actionable data for decision making, as KREI. NAS has done excellent work in monitoring domestic crops using MODIS imagery of 250 m spatial resolution, combining their EO based data with statistical information from Korea Statistics. EOPEN could contribute to the NAS research by bringing in the expertise in using Sentinels, involving the fusion of SAR and optical data, the handling of big and high resolution data and the downscaling their existing MODIS-based implementations. EOPEN and NAS could also exchange know-how in machine learning techniques and yield estimation models, establishing potential synergies.

CJ Corporation

Role: The status of food security in Korea is mostly shared between private businesses. The company that exhibits the greatest interest in collecting and acting upon food security related information in South Korea is CJ. They are disseminating internally produced information such as vegetation index, meteorological related estimates to other players in the business both weekly and monthly. Some data are from USDA and some internal data of the company are also used in the reports made by CJ. The information is disseminated through e-mail. Since the self-sufficiency rate of grain for Korea is less than 24%, South Korea relies heavily on imports. CJ, as the biggest food and grain importer in the country, has great interest in the available scientific observation data.

Current Status: CJ currently relies heavily on open-source global data which has a low spatial resolution. They use NDVI maps with minimum mapping unit of 2.5 km * 2.5 km that is sufficient for the monitoring in Brazil and USA (large exporters for South Korea), where crops are planted in large homogeneous areas. However, as for South Korea and other Asia regions, higher resolution EO images and indices are required for accurate monitoring.

Services:

1) Global Sea Temperature Information + El Nino and La Nina Outlook

2) Forecasting weather conditions (temperature/precipitation etc.) in cultivation area (corn, soybean, jugular, sugar, olives, etc.)

3) Long term weather forecasts by region, Normalized Difference Vegetation Index (NDVI), and soil water (topsoil, subsoil)

4) Grain production outlook (Annal and institutional forecast information) / information on severe weather conditions (floods, droughts, typhoons, heat waves, etc.)

EOPEN targeted input:

EOPEN could assist CJ in the extraction of large regional data (high level information), as now they are highly dependent in the interpretation of EO images and indices. This can translate in regional yield estimates and high level crop growth monitoring information. CJ currently uses NDVI maps with minimum mapping unit of 2.5 km * 2.5 km that is sufficient for the monitoring in Brazil and USA (large exporters for South Korea), where crops are planted in large homogeneous areas. However, this is not true for South Korea, where higher resolution EO images and indices are required for accurate monitoring. The large scale application of Sentinel-1 and Sentinel-2 imagery envisaged for this Use Case would directly assist CJ in their current operations.

4.3 Core Tasks/ Communication Channels

The following image indicates the main involved organizations (chain of command) that are being involved in Food Security in South Korea's.

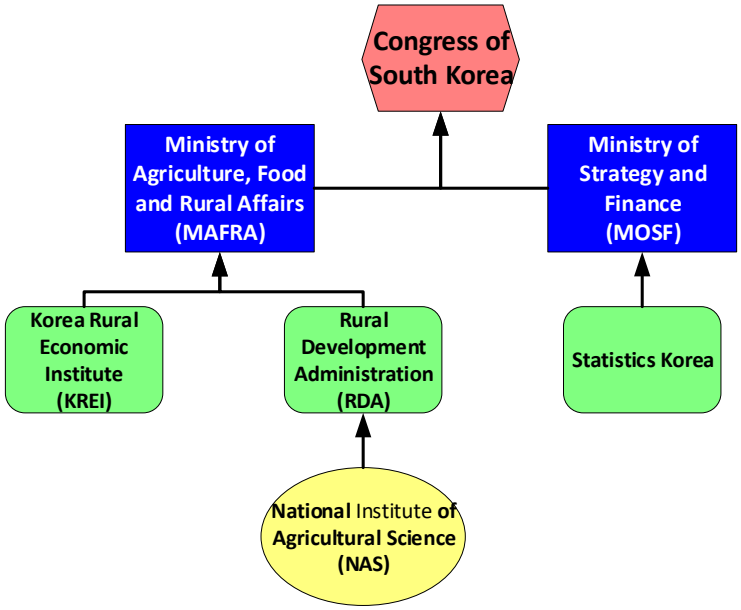


Figure 5: Chain of Command in South Korea

Korea Rural Economic Institute (KREI), Rural Development Administration (RDA) and National Institute of Agricultural Science (NAS) are all national research institute which receive various governmental funding sources, and mainly include the Ministry of Agriculture Food and Rural Affairs (MAFRA) and the Ministry of Strategy and Finance (MOSF) (Statistics Korea is part of MOSF). The research and development conducted include the national institutes, SMEs (e.g. CJ Corporation) and universities and the results are open access to the public.

Research findings and needs of producers and consumers will be shared to the government institutes which then will be delivered to the Congress and the distribution of national finance and related decisions will be made by the Congress and MOSF.

More precisely, **KREI** is an exclusive agency for the provision of an overall agricultural outlook service for the government.

NAS's is operating, under RDA, and its' data and analysis are used for statistics and policy materials for MAFRA.

Statistics Korea performs statistical analysis and in food security perspectives is sharing the annual food crop production (in metric tons) and growth rate.

RDA gathers all the data and opens it to public but only the rough estimates, intermediate products/findings and other variables are confidential.

4.4 What Works / What Doesn't

Due to such oversupply, through the prime minister-led examination and adjustment of national agendas, the government decides and announces the harvest rice supply and demand stabilisation

measures. These include market isolation, private rice purchase capital, improvement of public stockpiling system, reinforcement of logistics management. The government purchases rice for use in public stockpiling and overseas isolation, support private rice purchase capital, induce the production of quality rice and expand the supply of rice for welfare, forage and processed food, overseas food aid and stop imported rice sales. The government plans to reduce the rice cultivation area by introducing the rice production adjustment plan and promote the cultivation of other crops.

The estimation of crop yield using satellite imagery is important for mapping the cultivation area and estimating the production of major grains in order to control food supply and demand, forecast prices and establish policies for farm income conservation. The estimation technique of rice paddy in Korea using satellite images has been developed but requires additional adjustments. Domestic rice yield estimation models have also been developed but face difficulties in local application. Also they do not account for the direct impact of agricultural disasters such as wind and flood, which limits its application in the event of an extreme weather condition.

Below follows a brief description of the stakeholders and their current operations and how EOPEN could specifically address their individual needs based on the 4 EO products it plans to implement (see section 4.4.). It should be noted that level of the EO-based thematic information and the level of integration and alignment of the offered services to their current practices is strongly dependent on the engagement of stakeholders and the provision of the necessitated in-situ and ancillary data.

4.5 EOPEN's contribution

Asia-Rice is the work of an ad hoc team of stakeholders with an interest in the development of an Asian Rice Crop Estimation & Monitoring (Asia-RiCE) component for the GEO Global Agricultural Monitoring (GEOGLAM) initiative. In the context of Asia-RiCE, important work has been done in the EO-based monitoring of food security in Asia, in terms of collecting user requirements, deploying pertinent services and performing excellent research in the field. This work has led to the definition of relevant EO products and services to address the large scale monitoring of food security. For the purposes of this EOPEN Use Case we have evaluated these products with respect to the scope of the project and the requirements of our target stakeholders in South Korea. It is our goal to link and contribute to the GEOGALM initiative and Asia-RiCE, offering added value to their implementations and avoiding overlaps and replications. Therefore, the envisaged contribution of EOPEN in South Korea will be based on the following EO products.

1. Crop-Land mask at national scale
2. Rice paddy area extent at national scale
3. Crop growth status at national scale (focusing on rice)
4. Crop yield estimation at national and regional scale (focusing on rice

The use of in-situ observations (e.g. crop yields values at regional level, in-situ measurements and field inspections) are of fundamental importance, for the training of the algorithms and the calibration & validation of the results. Therefore, the local partners of South Korea (SUN & KU-eGISRS) will come in contact and constantly engage with the relevant stakeholders, such as KREI, NAS and CJ informing them about the Use Case developments and requesting constant feedback on the relevance of these developments to their original requirements. But most importantly the stakeholders will have to be actively engaged to accommodate the in-situ and other ancillary information needs of the Use Case.

All the above information and analysis has been contacted by EOPEN's local partners, KU-eGISRS and SUN, with the support of NOA. Given the extended analysis, it is foreseen that Food Security EOPEN's

pilot could support and complement the work that is taking place by the key players KREI, NAS and CJ, while at the same time establish strong links to the GEOGLAM initiative. SF.

5 Climate Change Use Case for Finland

5.1 Use Case 'Storyboard' introduction

Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer[2]. In the present and future climate change environment[3], the average temperature in Finland is rising / will rise more[4] (2°C by 2040), and precipitation will increase faster (5–10 % by 2040) than the global average[5]. The changes are affecting winters more than summers[6,7], with the largest changes in the northern part of the country: Finnish Lapland. Finland has taken a pro-active role in managing the Climate Change situation nationally[8], and in international climate change policies[9,10].

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[2] "IPCC Fourth Assessment Report: Climate Change 2007"
https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html

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[5] Ruosteenoja, K., Räisänen, J., Venäläinen, A., Kämäräinen, M. & Pirinen, P. 2016. Terminen kasvukausi lämpenevässä ilmastossa. Terra, 128:1: 3–15.
http://en.ilmatieteenlaitos.fi/documents/31422/83635880/Ruosteenoja+Terminen+kasvukausi+l%C3%A4mpenev%C3%A4ss%C3%A4%20ilmastossa+2016/5cd98a30cab8421d970b432ceb67fefd

[6] Ruosteenoja, K. 2013. Maailmanlaajuisiin ilmastomalleihin perustuvia lämpötila ja sademääräskenaarioita. Sektoritutkimusohjelman ilmastoskenaariot (SETUKLIM) 1. osahanke. Ilmatieteen laitos. 15 s.
http://ilmatieteenlaitos.fi/c/document_library/get_file?uuid=c4c5bf12655e467a9ee0f06d8145aaa6&groupId=30106

[7] Jylhä, K., Ruosteenoja, K., Räisänen, J. & Fronzek, S. 2012. Ilmasto. Julkaisussa: Ruuhela, R. (toim.) 2012. Miten väistämättömään ilmastonmuutokseen voidaan varautua? – yhteenveto suomalaisesta sopeutumistutkimuksesta eri toimialoilla. Maa ja metsätalousministeriö, Helsinki. MMM:n julkaisuja 6/2011: 16–23.
http://www.mmm.fi/attachments/mmm/julkaisut/julkaisusarja/2012/67Wke725j/MMM_julkaisu_2012_6.pdf

[8] Ministry of the Environment, Ministry of Agriculture and Forestry and Ministry of Employment and the Economy 2015.
https://ilmasto-opas.fi/ilocms-portlet/article/8a54c390-fed4-42da-a2c2-4bab74993ebd/r/b844a8fb-f69d-4c20-a506-cf17ac9f5a9e/suomen_ilmastopolitiikka_rgb_en.pdf

A Use Case in the Context of Climate Change requires identifying the hooks and triggers that will be used as part of Joint Decision Making which operates over decades. In our Climate Change scenario, the triggers will be climate conditions from EOPEN time-series data + satellite Earth Observations data that trigger actors in a linked societal and community context to respond. The response of the actors depends on international and national and local policies.

The EOPEN project for the PUC3 has engaged Reindeer Herders, Reindeer Researchers, and the Finnish Transportation Agency (FTA) as our Stakeholders.

5.2 Stakeholder Overview

Reindeer Herders

In Northern Finland, reindeer herding is a traditional small-scale livelihood with around 5000 reindeer owners[11]. It is practised by both Finns and Sámi people. Even though reindeer herding is characterized by a low productivity and profitability, its value as an important part of Sámi culture, its emblematic livelihood of Northern Finland, and its value in tourism marketing is considerable[12].

In particular, at the National (Finland) Level are the:

a) National climate and energy strategies (2001, 2005, 2008, 2013) Government Foresight Report on Long-term Climate, and b) Energy Policy (2009), c) Energy and Climate Roadmap 2050 (2014), d) Climate Change Adaptation Plan 2022 (2014), e) Climate Change Act (2015), f) National legislation and other policy instruments, programmes.

At the Local Level are the a) municipalities and b) civil society

[9] At the EU level are the: a) Ratification of the Kyoto Protocol and the EU's internal distribution of responsibility (effort sharing), b) The EU's shared and coordinated policies, c) Monitoring system for greenhouse gas emissions, d) EU climate and energy package until 2020 EU climate and energy targets until 2030 Energy roadmap 2050.

[10] At the international level are the: a) United Nations' Framework Convention on Climate Change, 1992 Kyoto Protocol, 1997. b) United Nations new climate change agreement 2015.

[11] Simo Sarkki and Hannu I. The resilience of communities and nature-based livelihoods in northern Finland. Heikkinen Nordia Geographical Publications 41: 5, 95–106 https://nordia.journal.fi/article/download/66057/26710/

[12] Sarkki, S., T. Komu, H. I. Heikkinen, N. Acosta García, É. Lépy, and V.-P. Herva. 2016. Applying a synthetic approach to the resilience of Finnish reindeer herding as a changing livelihood. Ecology and Society 21(4):14. http://dx.doi.org/10.5751/ ES-08819-210414

https://www.ecologyandsociety.org/vol21/iss4/art14/ES-2016-8819.pdf

To understand the herder's ties to the land, the districts for the reindeer herders in Northern Finland, are distributed over the following land areas. Of the country's 123 000 km^2, approximately 33% of the surface of the country, is designated for reindeer herding (Fig. 7)[13]. Reindeer husbandry is practiced through a system of reindeer herding districts (*paliskunta*). There are 54 districts. The number of breeding stock (post-slaughter herd – *eloporot*) is about 200,000 head[14]. The area is divided into the *Special* Reindeer Herding Area and the Reindeer Herding Area. In the middle and southern part of Finland the reindeer management areas are small and usually fenced. Decisions are fast because the herds are small. Compared to the herders in Southern Finland, the herds in the North are more nomadic with the herders following and occasionally guiding the herds.

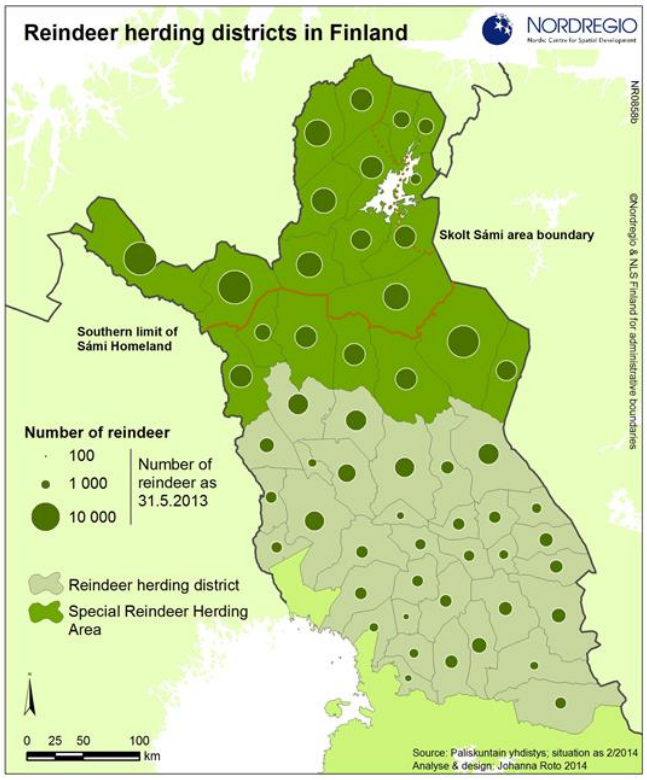

Figure 6. Reindeer Herding Districts[15]

Reindeer herding is an essential part of the local traditions and economy[16]. Annually some two million kilos of reindeer meat come to the markets. The gross economic value of the reindeer economy (e.g. inclusive of tourism, refining, indirect value) has been estimated to be many times that of the value of unrefined meat markets[17]. Reindeer herding serves as a fruitful example of livelihood resilience in a complex social-ecological context because it is directly exposed to land use

[13]Reindeer herding districts in Finland http://www.nordregio.org/maps/reindeer-herding-districts-in-finland/

[14] Hannu Heikkinen, Neo-Entrepreneurship as an Adaptation Model of Reindeer Herding in Finland, Nomadic Peoples Vol. 10, No. 2, Special Issue: Humans and Reindeer on the Move (2006), pp. 187-208 https://www.jstor.org/stable/43123784

[15] Reindeer herding districts in Finland. http://www.nordregio.org/maps/reindeer-herding-districts-in-finland/

[16] Stammler, F., and H. Beach, editors. 2006. Humans and reindeer on the move. Nomadic Peoples 10(2). Berghahn, Oxford.

[17]Reindeer Herders' Association (2006).

changes as well as to climatic variations[18]. Thus, reindeer herding cannot be viewed as disconnected from wider social, ecological, economic, technological, and political influences[19].

Reindeer Herding Research

Due to the herders' socio-economic importance, multiple research institutes exist to study the herders and related topics. EOPEN considers these reindeer research institutes as stakeholders, as well. The reindeer researchers are more experienced at data usage than reindeer herders. The researchers utilize long-term climate data and models. Their research topics: 1) economic development and sustainability, 2) adaptation to climate change, 3) effects on land-use and environment. They are keen users of data that provide temperature and snow conditions, in particular, of herding pastures over time. They would especially like data that they can use to correlate with the herder's deep climate experience. For example, they have (and continue to) correlated herders' language of snow conditions with historical climate data and snow modelling. E.g. from the reindeer herders' experiences of problematic snow: deep snow, late snowmelt, icy snow, and ground ice.

Finnish Transportation Infrastructure Agency

Here we consider the Finnish public agency that is responsible for road transportation. The Finnish road network has approximately 78,000 km of public roads, in sparsely populated regions. In addition, there are 350,000 km of smaller private roads, many of which are used for forestry purposes. Finland has about 780 km of motorways and 120 km of semi-motorways[20]. Transportation accounts for about one fifth of Finland's greenhouse gas emissions and road transport accounts for 90% of the domestic transportation emissions[21].

5.3 What Works / What Doesn't

Reindeer Herders

[18] E. Lepy, M. Kasanen, T. Komu, H. Heikkinen, CLICHE Project. WP8. Impacts of Climate Change on Arctic herding Communities.

19 Sarkki, S., T. Komu, H. I. Heikkinen, N. Acosta García, É. Lépy, and V.-P. Herva. 2016. Applying a synthetic approach to the resilience of Finnish reindeer herding as a changing livelihood. Ecology and Society 21(4):14. http://dx.doi.org/10.5751/ ES-08819-210414 https://www.ecologyandsociety.org/vol21/iss4/art14/ES-2016-8819.pdf

[20] VII_Climate_Change. Finland's Seventh National Communication under the United Nations Framework Convention on Climate Change.

https://www.stat.fi/static/media/uploads/tup/khkinv/

[21] Finnish Climate Policy- toward a low-carbon and energy-efficient future. Ministry of the Environment, Ministry of Agriculture and Forestry and Ministry of Employment and the Economy 2015. https://ilmasto-opas.fi/ilocms-portlet/article/8a54c390-fed4-42da-a2c2-4bab74993ebd/r/b844a8fb-f69d-4c20-a506-cf17ac9f5a9e/suomen_ilmastopolitiikka_rgb_en.pdf

The herders can move the animals quickly; are therefore the most adaptable of the PUC3 Stakeholders[22]. The reindeer herders have identified[23] both short-term and long-term adaptation priorities affected by climate change such as feeding issues, change of pastures, and reindeer and calves' health. The herders have a deep knowledge from experience how to mitigate and react to short-timescale climate changes, however *they don't have near-term and long-time-scale strategies.*

Challenges brought by reindeer herding management, economic pressures, and climate change developments include border fences between the nations (Finland, Russia, Sweden, and Norway); the introduction of snowmobiles in the 1970s; overgrazing, which was particularly apparent in the 1980s; the price of reindeer meat; and the development of other land uses[24].

There is considerable land-use competition. The National Board owned by the FI Government negotiates land use with the Saami. Entities of logging companies (forestry), road building, wind farms all want to use the land. Wind Farms have an effect on the reindeer- the movement of the blades scare them[25].

Figure 7 describes outcomes from the CLICHÉ project, which identifies some concerns of the Reindeer herders[26]:

Our EOPEN Surveys (Deliverable D2.2) identified the following climate-related concerns of the herders.

Short-term and long-term adaptation priorities affected by climate change:

[22] Interview with Sirpa Rasmus Researcher, geophysicist Arctic Centre, University of Lapland, May 6, 2019.

[23] CLICHE project. WP8: Traditional livelihoods of the CLICHÉ Project; Impacts of climate change on Arctic environment, ecosystem services and society) project, part of the research programme on Climate Change (FICCA) launched by the Academy of Finland in 2011.

https://www.aka.fi/globalassets/awanhat/documents/tiedostot/ficca/ficca-16.04.2013/korhola_cliche.pdf

[24] Forbes, B. C., M. Bölter, L. Müller-Wille, J. Hukkinen, F. Müller, N. Gunslay, and Y. Konstatinov, editors. 2006. Reindeer management in northernmost Europe. Ecological Studies 184. Springer, Berlin, Germany. http://dx.doi.org/10.1007/3-540-31392-3

[25] Interview with Sirpa Rasmus Researcher, geophysicist Arctic Centre, University of Lapland, May 6, 2019.

[26] WP8: Traditional livelihoods of the CLICHÉ Project; Impacts of climate change on Arctic environment, ecosystem services and society) project, part of the research programme on Climate Change (FICCA) launched by the Academy of Finland in 2011.
https://www.aka.fi/globalassets/awanhat/documents/tiedostot/ficca/ficca-16.04.2013/korhola_cliche.pdf

- warmer winters → ice under or in the snow pack → digging problems for reindeer, additional feeding needed
- There's more rain in the summer, which can lead to moulding. More disease for the reindeer.
- more extreme weather events → insufficient resources → insurance compensation claims require proof that extreme event is 'extreme' on a time scale of 10 years.
- changes in snow pack → changes in pastures → extra work for herders
- Fall is warmer and longer. Winter snow starts to melt earlier; Spring comes earlier, warm May with a following cold period and ice. If a lot of snow is early, then it stays far into June.
- No strategies for long-term changes
- Lack of information for planning which pastures to use in near future (1mo – next year), daily weather observations cover for the next couple of days

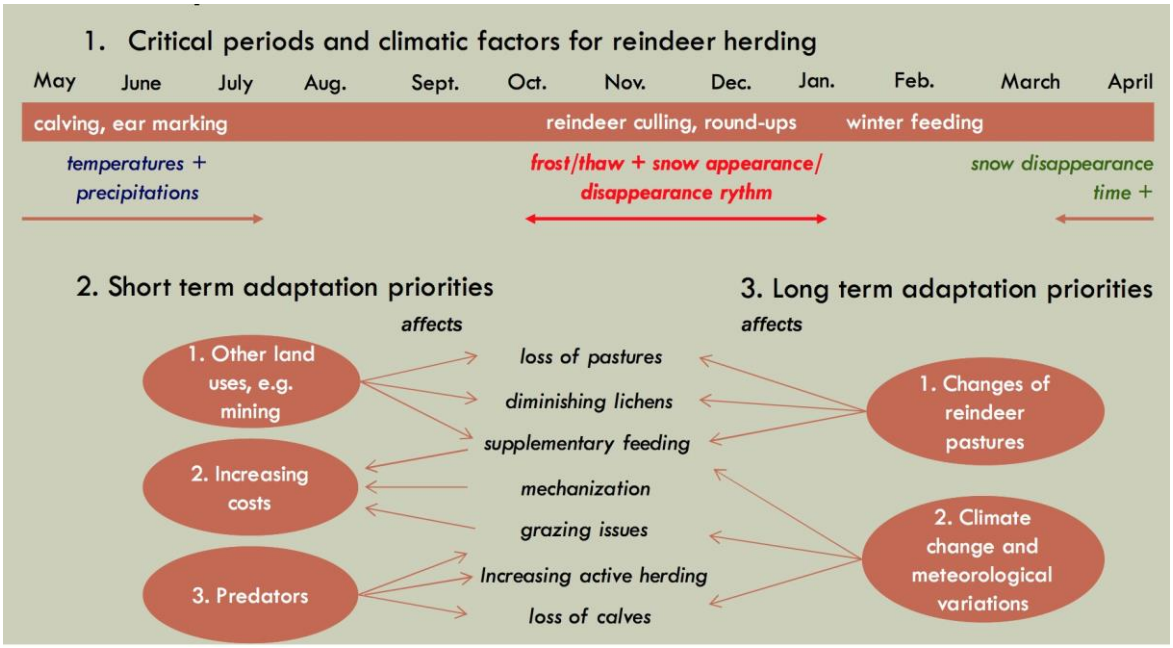

Figure 7. Some concerns of the Reindeer herders (CLICHÉ Project).

Currently, the best snow information the herders obtain is by them moving around by cars and snowmobiles, which is very limited in spatiotemporal coverage.

Reindeer Herding Research

Not enough ***fine-resolution of reindeer herders' snow-conditions-consequences***, to match their climate research and modelling with the herders' information

Finnish Transportation Infrastructure Agency

Climate change is expected to impact all facets of the transport system: the infrastructure, modes of transport and operations[27], and, especially, the maintenance.

- Near-zero temperatures are becoming more common due to climate change
- Continuous cycle of freezing and thawing increase stress on the road surfaces → increased need for deicing and road maintenance → increased costs
- Increase in peak river flow rates increase wear on bridge structures
- Insufficient monitoring of snow conditions on lower-class roads
- Need to adapt and refine strategies, including new guidelines and prepare sufficient maintenance funding. The FTIA must make decisions based on yearly trends in weather and climate. In their work they plan courses of action for road maintenance and prepare their budget for sufficient road maintenance funding.

Some specific examples of Climate Change related maintenance:

- Icy conditions resulting from temperatures close to zero degrees and freezing road surfaces are likely to become more common in Central and Northern Finland in Climate Change. The cycle of ice and thaw hovering around zero degrees increases stress on the road surfaces, breaking them. The road repair from thermal cycling and the need for anti-icing is likely to increase in these parts of Finland[28]. The increasing use of salt and rising average temperatures accelerate corrosion in bridges, and higher flow rates increase wear on underwater structures. These factors also contribute to the rising costs of maintaining roads and bridges.

Many of the above impacts are seen in the concerns, Fig. 8, of the traffic authorities surveyed in in the ROADEX project[29]

[27] VII_Climate_Change. Ibid.

[28] **https://julkaisut.liikennevirasto.fi/pdf2/3201122-v-ilmastonmuutoksen_vaikutus_kunnossapitoon.pdf**

[29] The European Union ROADEX Project 1998 – 2012 was a trans-national roads co-operation aimed at developing ways for interactive and innovative management of low traffic volume roads throughout the cold climate regions of the Northern Periphery Area of Europe. Its goals were to facilitate co-operation and research into the common problems of the Northern Periphery. This report is an output of the ROADEX "Implementing Accessibility" project (2009-2012). It gives a summary of the results of research into adaptation measures to combat climate change effects on low volume roads in the Northern Periphery. The research was carried out between January 2000 and March 2012. http://www.roadex.org/wp-content/uploads/2014/01/8.-Climate-change-adaptation-A-Hudecz.pdf

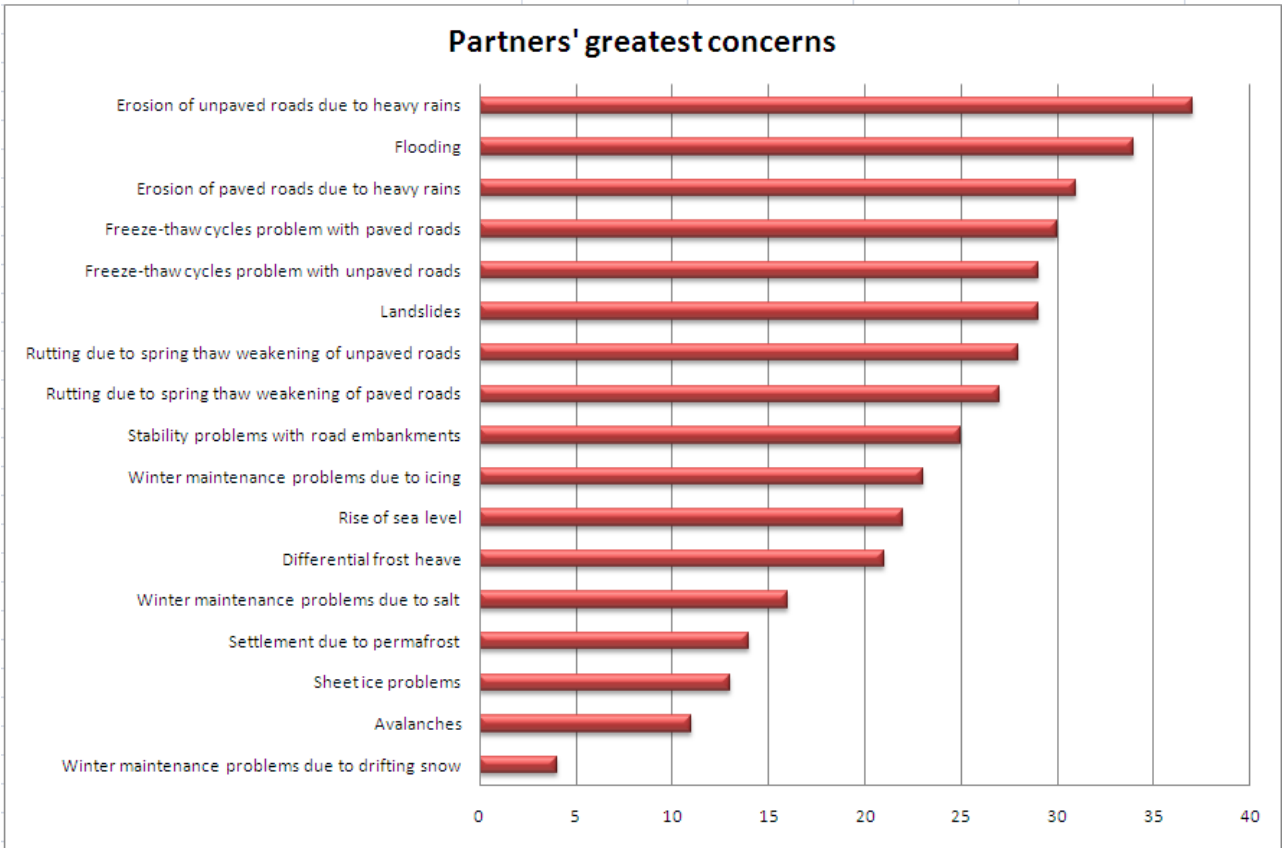

Figure 8: Bar chart of the ROADEX Partners' greatest concerns for road maintenance in the context of climate change.

Our EOPEN Surveys (Deliverable D2.2) identified the following concerns with several suggested solutions.

- Exceptionally warm weather in last 5 years
- Increased ice slipperiness in the Winter
- More difficult climate conditions in the Spring
- Higher road maintenance issues -> increased customer complaints
- New rules and guidelines[30] for current climate. The winter maintenance has a 24/7 Follow-up now[31].
    - Increased need of salt, a preventative for ice, at warmer climate temperatures.
    - More emphasis especially on drainage because there is more rain.
    - FTIA has more maintenance contracts.
    - FTIA's follow up involves road-level stations, where they have 400+ cameras.

FTIA envisaged solutions and strategies to enhance the adaptive capacity of the transport sector during the coming decades, including: developing warning systems with tailored guidance on transport impacts, developing maintenance operations, improving protection against weather, and maintaining the infrastructures.

[30] https://julkaisut.vayla.fi/pdf8/lto_2018-01_talvihoidon_toimintalinjat_web.pdf

[31] Interview with Otto Karki at FTIA 6 May 2019

The FTIA has developed adaptation actions, like improved forecasting models and an early warning system, together with the FMI. A remote monitoring system of the climatic conditions has been developed. More adaptation actions include[32] improving the safety equipment, proactive planning, developing the design and procurement practices, technical development, developing information services and traffic management, product and market monitoring, as well as cooperation in international regulation development.

The FTIA has a new (2018) Road Maintenance Manual [33]for snow removal and anti-skid road conditions. Both require analysis of past and present temperature and snow conditions to estimate the budget to meet maintenance needs.

The FTIA must make decisions based on yearly trends in weather and climate. In their work, they plan courses of action for winter road maintenance, and prepare their budget for sufficient road maintenance funding. Currently the FTIA uses data and images from satellites and ground-based weather observations.

5.4 EOPEN's Contribution

Reindeer Herders + Researchers

The Reindeer Herders have no access to snow maps or similar, or they don't know where to look or don't know how to use those services. Everything that EOPEN provides will improve the situation.

In particular, EOPEN temperature and snow maps cover time-series can fill that gap in knowledge and help them to see the phenomena which negatively affect their northern livelihoods: such as accumulation of snow over non-frozen soil, freezing of pastures, soil moisture (if possible), snow melt and rainfall accumulation.

The Researchers combine data products with the herders' own experience to learn the data trends for problems that can be prevented or mitigated by suitable actions. Extrapolations might be useful for long-term planning in addition to the actual climate simulations performed by the Reindeer Researchers. EOPEN long-term trends can help the researchers to have more and longer-term snow-temperature data; so that they can perform long-term climate analysis on reindeer pastures and estimate its impact on the occurrence of different snow types in the future. The Researchers' studies would be further improved by EOPEN with its ease-of-access, improved weather radar observations, and more comprehensive satellite observation data. [EOPEN D2.2]

EOPEN will provide them tools and information to help them devise near-and far-term strategies. If they could browse daily snow (and moisture) maps for their region of interest, then they could use this information together with their own observations (things that do not show in the products now available), experience, and normal weather forecasts.

Finnish Transportation Infrastructure Agency

[32] Finland's Seventh National Communication under the United Nations Framework Convention on Climate Change. 2017. Ministry of the Environment and Statistics Finland, Helsinki. 314 p., Pg. 201

https://www.stat.fi/static/media/uploads/tup/khkinv/VII_Climate_Change_16102017.pdf

[33] https://julkaisut.vayla.fi/pdf8/lto_2018-01_talvihoidon_toimintalinjat_web.pdf

EOPEN will provide temperature snow, and freezing data trends that will inform the maintenance schedule of FTIA for when, where, and how much anti-icing material such as salt and sand will be needed. EOPEN would help their decisions by providing trends 'on the ground' in temperature and snow height all over Finland including their request [EOPEN D2.2] for better coverage of lowest class roads.

6 Evaluation plan

The evaluation of the EOPEN instantiations is occurring in 2019 as the JDIG is implemented after M6 with the User Requirements workshop. The evaluation ensures that the EOPEN Instantiations align with the expectations of the Use Case countries and the specified requirements for the EOPEN technology within that Test Bed.

The purpose of the evaluations are to subject the EOPEN Instantiations to tests in a controlled environment to ensure proper functioning of the several components across various dimensions (organisational/governance, workflows, technologies, ethical and legal, social and cultural, etc.). Using the EOPEN Use Cases, each instantiation is being tested using controlled data in a controlled set of circumstances in order to identify missing components or requirements that will be required during the test bed. This task requires active collaboration with end-users in order to ensure that their needs are being met by the instantiations. This testing may be carried out in person or remotely depending on the availability of participants.

Stages of the Evaluation

1. Identify a common set of high level goals, across all scenarios within the project, the objectives to complete them, and a set of measures to highlight successful performance.
2. Identify the processes and functionalities that are to be incorporated in to this instantiation, the current operating model (COM) and the target-operating model (TOM).
3. Map the processes and functionalities to the specific incidents contained within each instantiation.
4. Detail the expected inputs and the outcomes/results of each process within the scenario
5. Develop a set of controlled data (that will be added to in each scenario and pilot incrementally) in order to test of these functionalities; this data will both feed into the app/portal and may take the form of walking through the scenario with various end-users to validate their expectations
6. Identify any gap between their expectations and results from the preliminary evaluation and work with D2.2 and D2.3 and end users to close this gap before the pilot begins.

7 Conclusion

Deliverable D2.1 (The EOPEN Use Case Design Report) provides a guidance document for the instantiation of the EOPEN community-driven needs. This report document is used as guidance for the preparation (in D2.2), realisation (in 2.3) and evaluation (in Deliverables 7.1 M20 and 7.2 M28) of the EOPEN instantiations for the developing test beds.

As introduced in Section 1, because of the incremental approach being followed in EOPEN with multiple activities running in parallel for the definition of the requirements, concepts, models and

technology, this report will be kept as a living document, being enriched and refined as the project advances.

Updates for this Report will be included in the upcoming deliverables in WP2, in particular as sections in D2.2 (EOPEN User Requirements report; M6) and (EOPEN D2.3 “Joint Decision & Information Governance” of WP2; M6) in order to assure continuous update and refinement. The necessity of satellite imagery in the preparedness and recovery from a disaster event will be reported. Early warning is mainly ensured by meteorological information and weather forecasts. The key-role of social media in emergency response will also be highlighted in the upcoming deliverables of WP2.