

Flood resilience building in living labs

Lessons learnt in the living lab Hedwige-Prosperpolder

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DE PERSOONLIJKE HOGESCHOOL

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About me

- Background in **civil & hydraulic engineering**
- PhD in **flood risk management**
- Affinity with **coastal disasters surveys**
- Affinity with **cross-disciplinary approaches** to risk management



NATO school, Germany 2018



Tsunami survey, Japan 2011



Tsunami survey, Indonesia 2019



Hedwige-Prosperpolder 2021 (**Polder2C's**)



Van Oord 2016



Building with Nature Research group



My basis

South West Delta



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Southwest Delta

A strong identity defined by its recent history

the 1953 flood



the delta works



Life

Economic activity

Environment

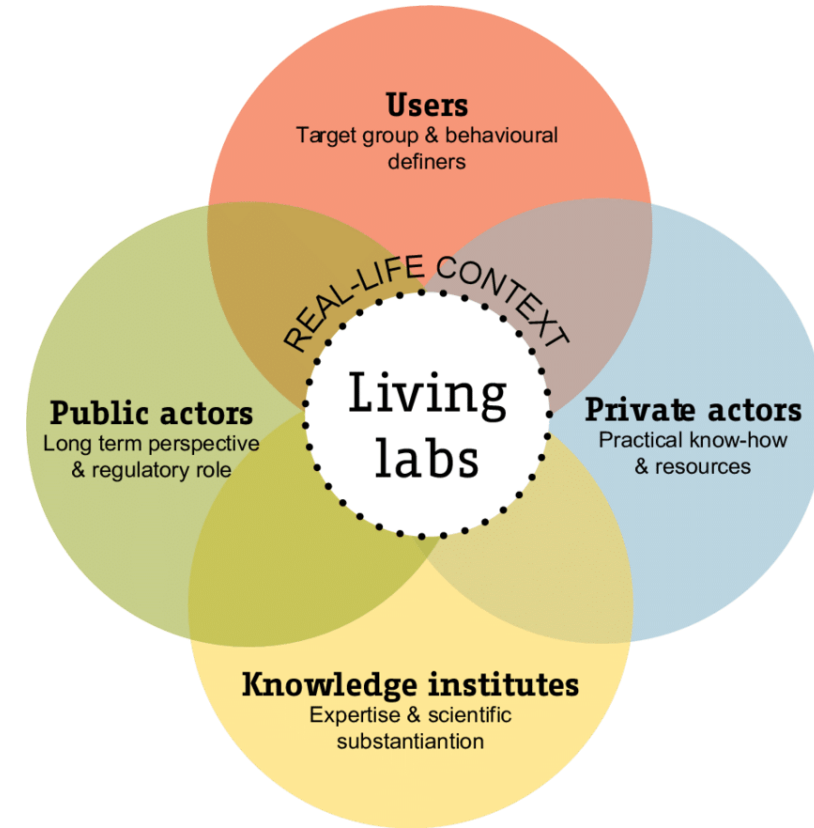
About living labs

Definition

A user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts. (Eriksson et al. 2006)

Key elements (Almirall et al. 2012)

1. Experimentation in **real-world settings** (pilots)
2. **Involve actors** that help capture domain-based knowledge and needs
3. Focus on both **tacit and theoretical** knowledge
4. **Partnerships** for generating initial demand and giving feedback in the process



Living labs in the South West Delta (examples)

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The underwater lab



Added value with mussels



Coastal landscape transitions



Hedwige-Prosperpolder

Flood resilience building



About resilience

psychology



Individuals

social sciences



Communities

engineering

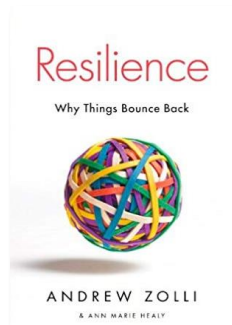


Technical systems

ecology



Ecosystems



*‘Resilience is the capacity of a system, community or a person to maintain its **core purpose** and **integrity** in the face of **dramatically changed circumstances**’.*

(Zolli & Heally, 2012 p.6)

Flood resilience

The capacity of a **system** or **community** to maintain its core purpose and integrity when afflicted by a **major flood**

Flood resilience in hydraulic engineering

Design of flood defence structures

Resilient flood defences may fail, but they do not fail catastrophically

Catastrophic failure is usually associated with breaches



(Intl. Levee Handbook, 2013)



(Eastern Scheldt barrier)



(Taro, Japan, 2011)



(New Orleans, USA, 2005)

Flood resilience in flood risk management

Design of flood protection systems

Multi-layered safety framework



Layer 3

Emergency management

Layer 2

Spatial planning

Layer 1

Prevention

Catastrophic failure is usually associated with an overwhelmed state of all layers



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The living lab Hedwige-Prosperpolder

A depoldering site

Interreg 
2 Seas Mers Zeeën
POLDER2C'S

European Regional Development Fund



This project has received funding from the Interreg 2 Seas programme 2014-2020 co-funded by the European Regional Development Fund under subsidy contract No [2S07-023]



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The living lab participants

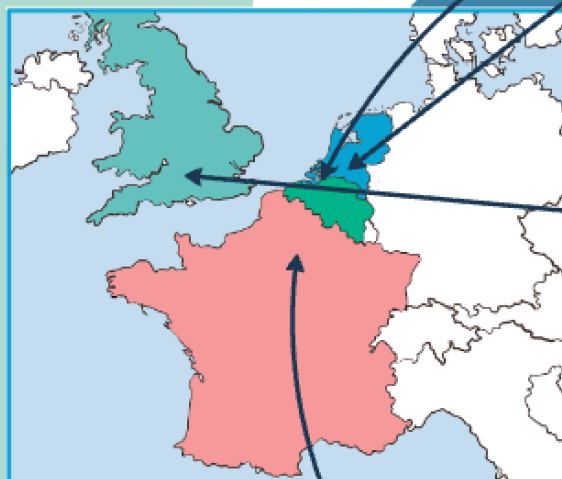
15 Partners



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The living lab participants

OBSERVERS



NL

- > Wageningen Universiteit
- > Open Universiteit
- > Waterschap Brabantse Delta
- > Hogeheemraadschap Schieland en de Krimpenerwaard
- > Hogeheemraadschap Hollands Noorderkwartier (HHNK)
- > Waterschap Buitenveld

- > Waterschap Scheldestromen

UK

- > UK Research and Innovation - British Geological Survey (UKRI - BGS)
- > HR Wallingford
- > Construction Industry Research and Information Association (CIRIA)
- > Sayers and Partners (SLP)
- > University of Sheffield (Department of civil and Structural Engineering)
- > Somerset County Council (SCC)

USA

- > U.S. Army Corps of Engineers (USACE)

BE

- > Dienst Noodplanning van de Gouverneur van de provincie Antwerpen
- > Defensie België, Genie/Koninklijke Militaire School
- > INBO
- > Vrije Universiteit Brussel (VUB)
- > Universiteit van Gent (UG)
- > Universiteit Antwerpen
- > Service Public de Wallonie Mobilité et Infrastructures

- > De Vlaamse Waterweg

FR

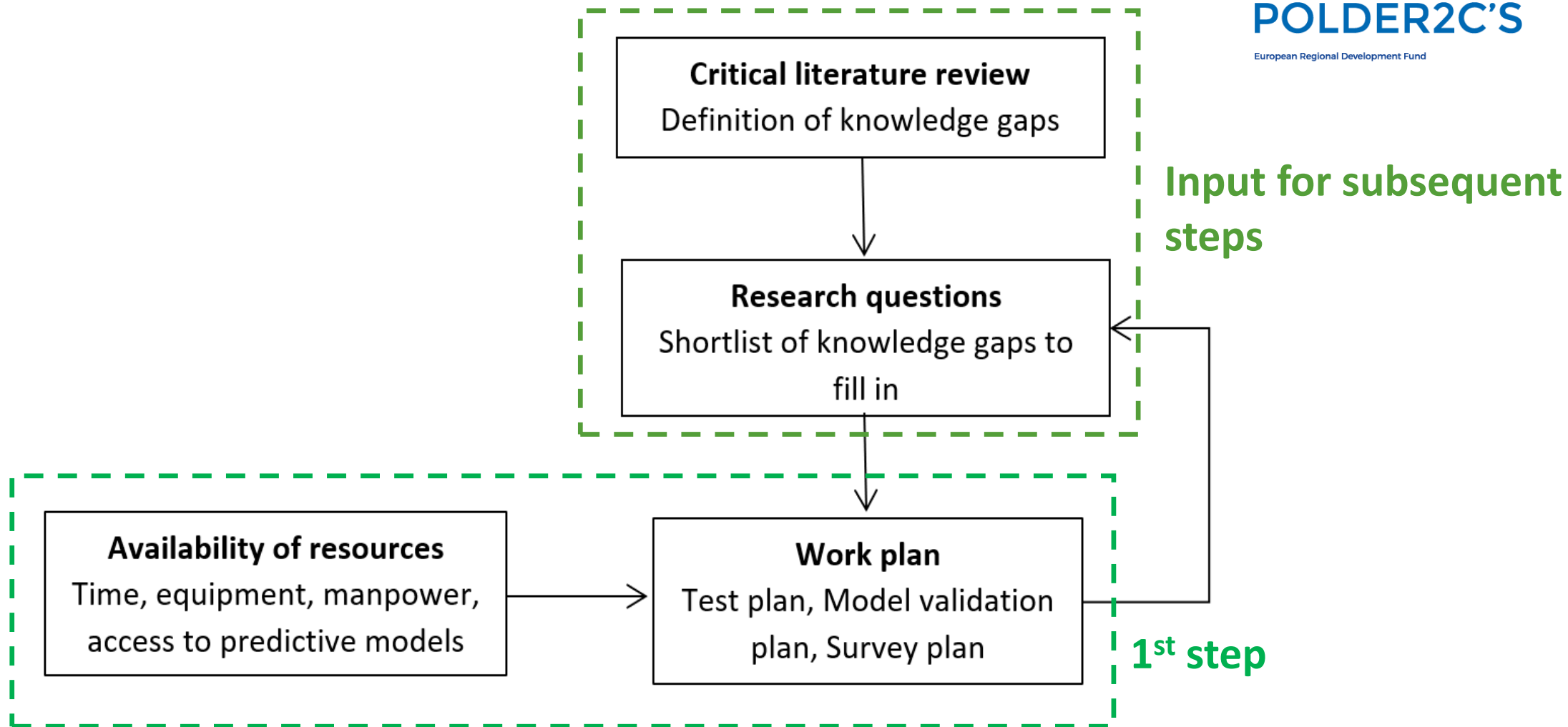
- > Irstea Aix Marseille Université
- > Syndicat Mixte du Marais Poitevin Bassin du Lay
- > Direction Régionale Aménagement et Logement Pays de la Loire - DREAL Pays de la Loire
- > France Dignes
- > Compagnie des salins de midi et des salines de L'Est (CSME)
- > Grenoble - Alpes Métropole (GAM)
- > Syndicat Mixte Baie de Somme - Grand Littoral Picard (SMB&GLP)
- > Direction Régionale Aménagement et Logement Hauts de France - DREAL Hauts de France
- > ICOLD - International Commission on Large Dams

Main objectives

Build capacity to cope with the adverse effects of climate change

- Advance and share knowledge on the **design and maintenance of levees**
- Advance and share knowledge and experiences in **flood emergency response**
- Develop a sound **knowledge infrastructure** that facilitates knowledge transfer across countries and generations
- Disseminate results to **various audiences**

Work method in the living lab



Selected activities / 'success stories'

Levee stress tests

- Simulation of various failure mechanisms
- Validation of erosion and hydraulic models
- Testing of innovative emergency repair methods

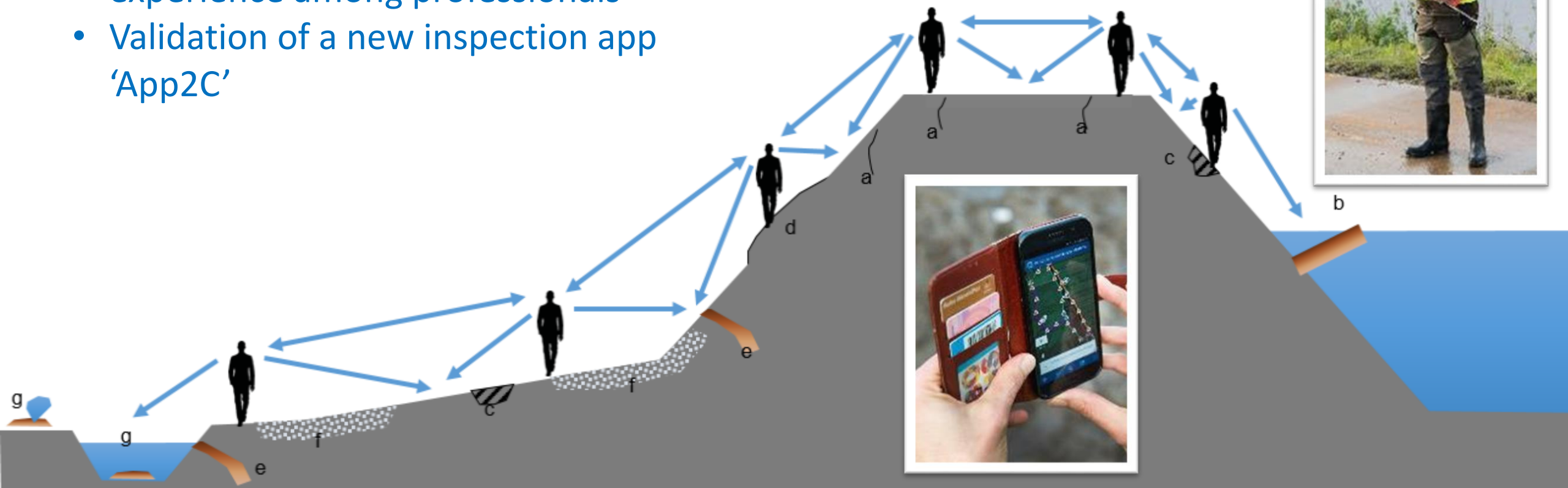


Levee guard trainings

- Exchange of knowledge and experience among professionals
- Validation of a new inspection app 'App2C'

Interreg 
2 Seas Mers Zeeën
POLDER2C'S

European Regional Development Fund



Testing of innovative levee survey and monitoring techniques

Example

- Development of a low-cost technique with smoke-bombs to detect animal dens in the subsurface of a levee.
- Technique improved based on repetitive trials in the living lab.



Collecting evidence on unresolved technical issues

Example: Harmful animal activity on levees

- Successful development of **evidence-based knowledge agenda** on the management of harmful animal activities on levees.
- First steps to **document tacit knowledge** and coordinate actions with **ecology** experts.



Proof-of-concept of a unique idea!

The Breach-defender

- Successful closure of an artificial breach with a military pontoon in the living lab.
- This required a large-scale military operation: construction of the Hedwige pool



Drivers of success

- **Clustering of expertise** and resources
 - ✓ *'mix and match'* of gear and personnel
- **Flexibility** in the work plan
 - ✓ *No prescribed work plan*
- **Motivation and trust** among participants
 - ✓ *exploratory activities* in the field that helped people to *bond* with each other
- **Accountability** of activity leaders

Challenges

- **Limited availability** of the living lab
 - ✓ *conditioned by the planning of the depoldering contractor and a neighbouring Natura 2000 area.*
- **Covid-19** restrictions
- **Documentation of activities** is a laborious and time-consuming process
- Sustained **availability of data** for future studies
- Can success be measured?

Thank you for your attention!

Questions?

Send an email to v.tsimopoulou@hz.nl

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