

# Stepwise Decision Making on landfill valorisation

Decision Support Tools Cedalion & Orion

Cuinera Isenborghs (p), Eddy Wille  
OVAM

18th INTERNATIONAL SYMPOSIUM ON  
WASTE MANAGEMENT AND SUSTAINABLE LANDFILLING  
SESSION C02 - Landfill mining - 11 October 2021 / 17:00 - 18:30  
Chair / Presidente: Raffaello Cossu (IT)



# Overview



- Why decision support tools?
- Decision Support Tool 1: **Cedalion**
  - Ranking
  - Structure of the tool
  - The Cedalion field application
- Decision Support Tool 2: **Orion**
  - Concept behind Orion
  - Use of Orion: interactive web application

# Why decision support tools?



- Support policy makers, landfill owners, spatial developers, ... in identifying the most promising landfills in terms of
  - valorisation potential
  - project feasibility
- Decision Support Tools (DST) can improve decision-making by increasing the efficiency and lowering the uncertainty
- Data collection is also part of an economic process and has its **limits**
  - How can we proceed with minor data supply and take the right decisions?
  - A stepwise approach offers an efficient and cost-effective solution

# The myth of Orion, Cedalion



Servant Cedalion is leading the temporary blinded giant Orion to the light Eos.

The metaphor of dwarfs standing on the shoulders of giants (Latin: *nanos gigantum humeris insidentes*) expresses the meaning of "discovering truth by building on previous discoveries".

Isaac Newton in 1675: "If I have seen further it is by standing on the shoulders of Giants."

# The myth of Orion, Cedalion



## DST 1 : Cedalion

Easy to use application (no specific expertise required).

→ Quick scan & overview

## DST 2 : Orion

Roadmap and dashboard to facilitate detailed analysis by using specific tools\* (expert level required).

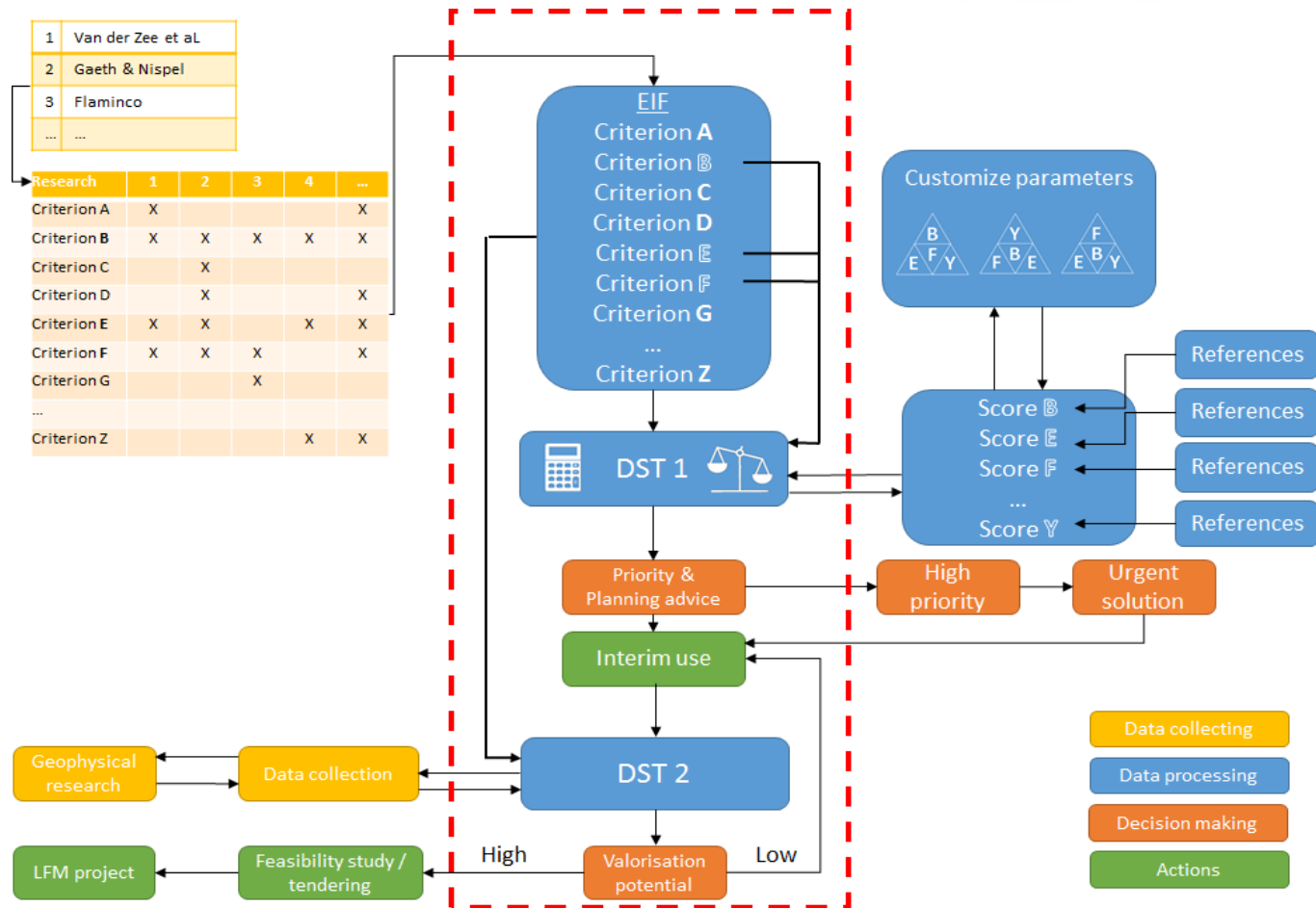
→ Complex, only for most promising landfills.

→ Ranking & preparation business cases

(\*) "Intelligent decision making entails knowing what tool to use for what problem."

Gerd Gigerenzer, Risk Savvy: How to Make Good Decisions

# The myth of Orion, Cedalion



# Decision Support Tool 1: Cedalion



# Cedalion: the ranking tool



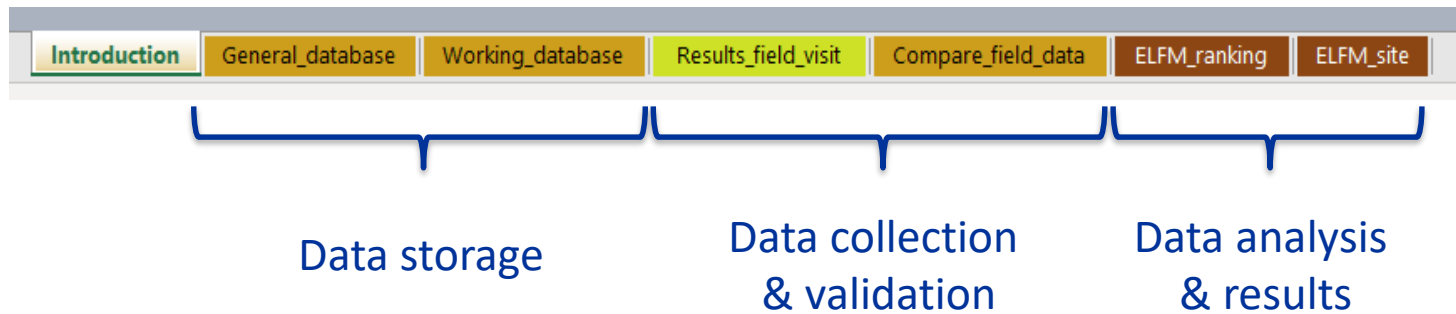
Principle: basic criteria will give a scoring on four main scenario's:

- Waste to Materials (WtM)
- Waste to Energy (WtE)
- Waste to Land (WtL)
- Interim Use (IU)

# Cedalion: Intro



- Excel based
- 7 different sheets



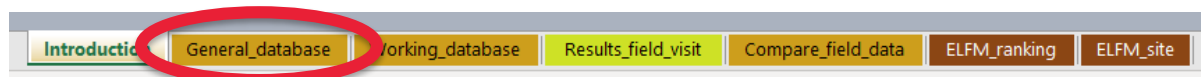
# Cedalion: general database



- Info provided by the (governmental) institution that deals with landfills
- Capacity ? Huge : over 3318 records in region of Flanders

**General database**  
You cannot change the content of the general database. Do not manually copy data from general to working database

| General information |               |                      |             |          |     |                 |              |              |
|---------------------|---------------|----------------------|-------------|----------|-----|-----------------|--------------|--------------|
| DLM ID              | Landfill name | Municipality         | Postal code | Street   | N°  | Cadastral codes | X coordinate | Y coordinate |
| 1                   | LF1           | Vlierzele            | 9520,00     | Street 1 | 2   |                 | 0            | 0            |
| 2                   | LF2           | Rumbeke              | 8800,00     | Street 2 | 32  |                 | 64516,75     | 176360,53    |
| 3                   | LF3           | HOUTHALEN-HELCHTEREN | 3530,00     | Street 3 | Z/N |                 | 0            | 0            |
| 4                   | LF4           | Antw ERPEN           | 2030,00     | Street 4 | 99  |                 | 0            | 0            |
| 5                   | LF5           | ANTWERPEN            | 2030,00     | Street 5 | 5   |                 | 0            | 0            |
| 6                   | LF6           | Doel                 | 9130,00     | Street 6 |     |                 | 0            | 0            |
| 7                   | LF7           | GENT                 | 9000,00     | Street 7 | 50  |                 | 0            | 0            |
| 8                   | LF8           | Zw evegem            | 8550,00     | Street 8 | 1   |                 | 0            | 0            |
| 9                   | LF9           | OVERIJSE             | 3090,00     | Street 9 |     |                 | 157389,19    | 163106,69    |



# Cedalion: general database

- Criteria in line with ELIF-data
- 7 types of criteria included

| Criteria 1 - Type |               |     |            |                    |            |       |         |          |             |              |                |       |                           |                |
|-------------------|---------------|-----|------------|--------------------|------------|-------|---------|----------|-------------|--------------|----------------|-------|---------------------------|----------------|
| DLM ID            | Landfill name | MSW | Industrial | Dredging materials | WWT sludge | Inert | Fly ash | Asbestos | Metal slags | Mining waste | Military waste | Other | Nature of mixed landfill? | Mono landfill? |
| 1                 | LF1           | Y   | N          | N                  | N          | N     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 2                 | LF2           | Y   | N          | N                  | N          | N     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 3                 | LF3           | Y   | Y          | N                  | N          | Y     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 4                 | LF4           | Y   | Y          | Y                  | Y          | N     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 5                 | LF5           | Y   | Y          | Y                  | Y          | N     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 6                 | LF6           | Y   | Y          | N                  | N          | Y     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 7                 | LF7           | N   | N          | Y                  | Y          | Y     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 8                 | LF8           | Y   | N          | N                  | Y          | Y     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 9                 | LF9           | Y   | N          | N                  | N          | Y     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |

# Cedalion: general database

| DLM ID | Landfill name | Criteria 2 - Age          | Criteria 3 - Volume |                              |                               |             | Criteria 4 - Use |                    |             |         |
|--------|---------------|---------------------------|---------------------|------------------------------|-------------------------------|-------------|------------------|--------------------|-------------|---------|
|        |               | Period of main activities | Surface area (m²)   | Depth below ground level (m) | Height above ground level (m) | Volume (m³) | Type of cover    | Surface conditions | Slope angle | Erosion |
| 1      | LF1           | 1955-1980                 | 202891              | -14,0                        | 0,0                           | 2840474     | Geomembrane      | Grass              | Flat        | None    |
| 2      | LF2           | 1955-1980                 |                     |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 3      | LF3           | 1955-1980                 |                     | -8,0                         | 0,0                           | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 4      | LF4           | 1955-1980                 | 1600000             |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 5      | LF5           | 1955-1980                 | 1600000             |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 6      | LF6           | 1980-1999                 | 241551              |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 7      | LF7           | 1980-1999                 | 66000               |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 8      | LF8           | 1955-1980                 |                     |                              |                               | 0           | Geomembrane      | Shrubs             | Flat        | None    |
| 9      | LF9           | 1955-1980                 | 38755               | 0,0                          | 5,0                           | 193775      | Soil             | Grass              | Flat        | None    |

# Cedalion: general database

|        |               | Criteria 5 - Accessibility |                                  |                |                    |                                                                            |
|--------|---------------|----------------------------|----------------------------------|----------------|--------------------|----------------------------------------------------------------------------|
| DLM ID | Landfill name | Paved roads?               | Accessible with heavy equipment? | Stations       | Max. distance (km) | CEMT canals                                                                |
| 1      | LF1           | N                          | Y                                | Roeselare, Ing | 7,6                | Dender                                                                     |
| 2      | LF2           | N                          | N                                |                | 5538,9             | Kanaal Roeselare-Leie                                                      |
| 3      | LF3           | Y                          | Y                                |                | 5538,9             | Albertkanaal                                                               |
| 4      | LF4           | Y                          | Y                                |                | 5538,9             | Schelde / Albertkanaal / Schelde-Rijnverbinding                            |
| 5      | LF5           | Y                          | Y                                |                | 5538,9             | Schelde / Albertkanaal / Schelde-Rijnverbinding                            |
| 6      | LF6           | N                          | Y                                |                | 5538,9             | None                                                                       |
| 7      | LF7           | Y                          | Y                                |                | 5538,9             | Schelde / Zeekanaal Gent-Terneuzen / Ringvaart / Leie / Kanaal Gent-Brugge |
| 8      | LF8           | N                          | Y                                |                | 5538,9             | Kanaal Bosuit-Kortrijk / Leie / Schelde                                    |
| 9      | LF9           | N                          | Y                                | Groenendaal    | 4,8                | Kanaal Dijle-Leuven                                                        |

# Cedalion: general database

|        |               | Criteria 6 - Surroundings      |             |               |             |            |                          |            |              |            |             |            |             | General remarks |         |
|--------|---------------|--------------------------------|-------------|---------------|-------------|------------|--------------------------|------------|--------------|------------|-------------|------------|-------------|-----------------|---------|
|        |               |                                |             |               | Residential |            | Recreational / Touristic |            | Agricultural |            | Industrial  |            | Natural     |                 |         |
| DLM ID | Landfill name | Drinking water protection area | Nature area | Flooding risk | Present Res | Future Res | Present Rec              | Future Rec | Present Agr  | Future Agr | Present Ind | Future Ind | Present Nat | Future Nat      | Remarks |
| 1      | LF1           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | Y          | N           | N          | N           | N               |         |
| 2      | LF2           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | Y            | N          | N           | N          | N           | N               |         |
| 3      | LF3           | Acceptable                     | N           | Low           | N           | N          | N                        | Y          | N            | N          | N           | N          | N           | N               |         |
| 4      | LF4           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | N          | Y           | Y          | N           | N               |         |
| 5      | LF5           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | N          | Y           | Y          | N           | N               |         |
| 6      | LF6           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | N          | Y           | Y          | N           | N               |         |
| 7      | LF7           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | N          | Y           | Y          | N           | Y               |         |
| 8      | LF8           | Acceptable                     | N           | Low           | N           | N          | N                        | N          | N            | N          | N           | Y          | N           | N               |         |
| 9      | LF9           | Acceptable                     | N           | Low           | Y           | N          | N                        | N          | Y            | N          | N           | N          | N           | N               |         |

# Cedalion: working\_database

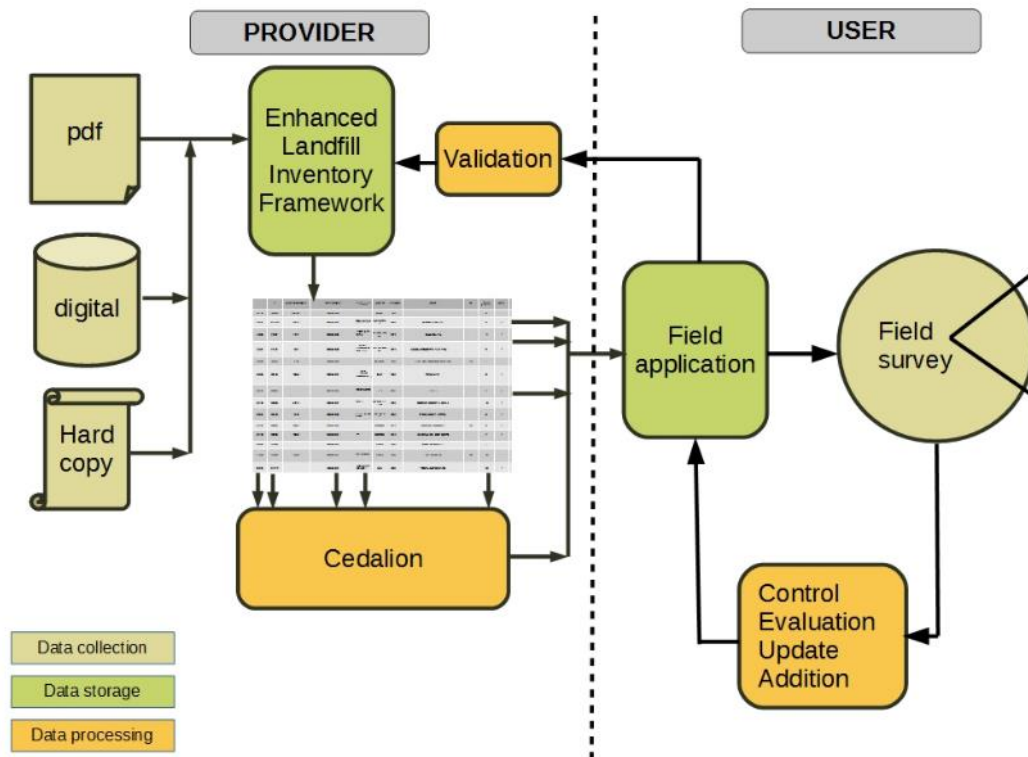
- Copy from the general database until data were changed by the user (only administrator can change general database)
- Action buttons for selection, exchange and ranking

**Working database**  
Please select the landfill sites for which you would like to run the ranking tool. Select by 'Site ID'  +   
Select by 'Municipality'  +   
Example: 1-10;12-14;36;115-129  
  
  
  
  
The ranking tool only works with data in the working database, copied from the general database with the predefined buttons.  
Reset working database  
Show ELFM ranking without data field visit  
Or collect data through field questionnaire. <https://tinyurl.com/cedalionrawfill> or use QR code 

| General information |               |                      |             |          |     |                 |              |              | Criteria 1 - Type |            |                    |            |       |         |          |             |              |                |       |                           |                |
|---------------------|---------------|----------------------|-------------|----------|-----|-----------------|--------------|--------------|-------------------|------------|--------------------|------------|-------|---------|----------|-------------|--------------|----------------|-------|---------------------------|----------------|
| DLM ID              | Landfill name | Municipality         | Postal code | Street   | N°  | Cadastral codes | X coordinate | Y coordinate | MSW               | Industrial | Dredging materials | WWT sludge | Inert | Fly ash | Asbestos | Metal slags | Mining waste | Military waste | Other | Nature of mixed landfill? | Mono landfill? |
| 1                   | LF1           | Vlierzele            | 9520        | Street 1 | 2   |                 | 0            | 0            | Y                 | N          | N                  | N          | N     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 2                   | LF2           | Rumbeke              | 8800        | Street 2 | 32  |                 | 64516,75     | 176360,53    | Y                 | N          | N                  | N          | N     | N       | N        | N           | N            | N              | N     | Heterogeneous             | N              |
| 3                   | LF3           | HOUTHALEN-HELCHTEREN | 3530        | Street 3 | Z/N |                 | 0            | 0            | Y                 | Y          | N                  | N          | Y     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 4                   | LF4           | Antw ERPEN           | 2030        | Street 4 | 99  |                 | 0            | 0            | Y                 | Y          | Y                  | Y          | N     | N       | N        | N           | N            | N              | N     | Layered                   | N              |
| 5                   | LF5           | ANTWERPEN            | 2030        | Street 5 | 5   |                 | 0            | 0            | Y                 | Y          | Y                  | Y          | N     | N       | N        | N           | N            | N              | N     | Layered                   | N              |

# Data management & Cedalion

Objective : Getting actors interested in landfills by providing information and viable options which they can evaluate and customize.



# Cedalion field application

- Application: smartphone, tablet, laptop,...
- Target: collect up to date info about the landfill, by doing a 360° prospection on site
- Output: mail with Excel-file
- Receivers: user of field app (and administrator)

A screenshot of a mobile web browser displaying a form titled "Interreg RAWFILL Cedalion-tool field visit". The browser's address bar shows "forms.office.com/Pages". The page has a blue header with the title and a subtitle "Questionnaire to be imported in the Cedalion spreadsheet". Below the header, there's a section for "General information" with two required fields. The first field is "1. DLM ID" with a note "As specified in the working database" and a validation error message "The value must be a number". The second field is "2. Landfill name" with a note "As specified in the working database" and a placeholder "Enter your answer". At the bottom of the form is a blue "Next" button. Below the button is a small text "Never give out your password. [Report abuse](#)". The browser's status bar at the bottom shows the time "09:00" and various icons.

# Cedalion field application



09:01

forms.office.com/Pages

Interreg RAWFILL Cedalion-tool field visit

Criteria 3 - Volume

3. Surface area (m2)

The value must be a number

4. Depth below ground level (- meters)

Please enter a value below zero for the landfill depth.

The value must be a number

5. Height above ground level (+ meters)

Please enter a value above zero for the landfill height.

The value must be a number

Back

Next

Never give out your password. [Report abuse](#)

09:01

forms.office.com/Pages

Interreg RAWFILL Cedalion-tool field visit

Criteria 4 - Use

6. Type of cover

☐ Geomembrane
 ☐ Mineral cover
 ☐ Soil

7. Surface conditions

☐ Grass
 ☐ Rough
 ☐ Shrubs
 ☐ Trees
 ☐ Other

09:01

forms.office.com/Pages

Interreg RAWFILL Cedalion-tool field visit

Criteria 5 - Accessibility

10. Are there paved roads surrounding the landfill?

☐ Y
 ☐ N

11. Is the landfill accessible for heavy equipment?

☐ Y
 ☐ N

Back

Next

Never give out your password. [Report abuse](#)

09:01

forms.office.com/Pages

Interreg RAWFILL Cedalion-tool field visit

Criteria 6 - Surroundings

Example: At present the landfill is located in an agricultural area. It is possible that in the future the area will be developed as residential area. The right answer: present agricultural, future agricultural, future residential.

12. Present Residential

☐ Y
 ☐ N

13. Future Residential

☐ Y
 ☐ N

14. Present Recreational

☐ Y
 ☐ N

09:01

forms.office.com/Pages

Interreg RAWFILL Cedalion-tool field visit

\* Required

General remarks

22. Remarks

Enter your answer

23. E-mail address to send results to \*

Enter your answer

24. In which country or region did you execute the survey?

\* The results will also be sent to the organisation managing the Cedalion tool in this country/region.

☐ Vlaanderen (OVAM)
 ☐ Wallonie (Spaque)
 ☐ Rheinisch-Bergisches Land

# Cedalion field application

**Cedalion Survey Response**

Microsoft Power Apps and Power Automate <microsoft@powerapps.com>  
 Aan CC elfm 26/08/2021

RAWFILL Interreg NWE - Cedalion - Field visit results.xlsx  
 24 KB

Bericht vertalen naar het: Nederlands Nooit vertalen vanuit het: Engels

Dear user,

Thank you for using the Cedalion tool developed by the RAWFILL project. To use the data acquired during your field visit, please follow the instructions:

1. Open the attached spreadsheet.
2. Paste the single row in the attached spreadsheet in on the Results\_field\_visit" sheet of the Cedalion tool.
3. In the "Compare\_field\_data" sheet of the Cedalion tool, press the button "Get data from field visit" to compare the data collected on site with the original data from your database.
4. If you want to update your database with the new data, change the content of the pale green cells and press the button "change fields in working database".
5. Start the ranking calculation.

A copy of your field observations have been also sent to the organisation managing the Cedalion in your region. These data will help them to update their database.

For more information regarding the RAWFILL project, please visit the [RAWFILL website](#).

Thank you again for using our tool,

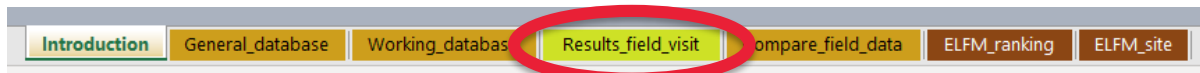
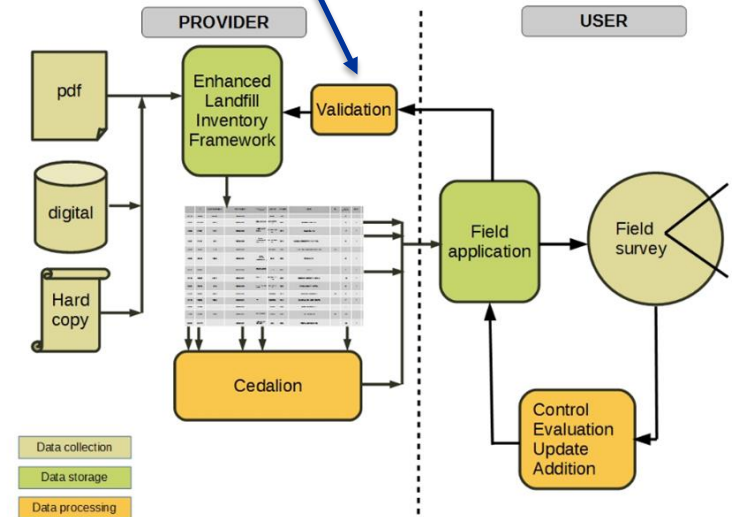
The RAWFILL project partners.

If you want to unsubscribe from these emails, please use this [form](#).

## Results of the site visit

Please copy the results of your site visit here. An Excel table has been sent to your e-mail address, after submitting the form. If you haven't received

| General information |               | Criteria 3 - Volume |                              |                               | Criteria 4 - Use |                    |               |         |
|---------------------|---------------|---------------------|------------------------------|-------------------------------|------------------|--------------------|---------------|---------|
| DLM ID              | Landfill name | Surface area (m²)   | Depth below ground level (m) | Height above ground level (m) | Type of cover    | Surface conditions | Slope angle   | Erosion |
| 2                   | LF2           | 86000               | 4                            |                               | 2 Soil           |                    | Less than 15° |         |



# Cedalion: comparing and controlling results

- The info from the excel sheet is copied and pasted in the tab 'Results\_field\_visit'
- The collected information will be checked and compared in the tab 'Compare\_field\_data'
  - In order to spot odd data and avoid corruption of your database

## Compare data site visit and general database

Compare the data collected during the site visit with the data from the 'general database'.

If you want to make changes in the working database, please change the content in the pale **green** cells and press the button "change fields in working database".

Get data from Field Visit

Change fields in Working database

Show validation circles

| General information |               | Criteria 3 - Volume            |                              |                               | Criteria 4 - Use |                    |               |         | Criteria 5 - Accessibility |                                  | Criteria 6 - Surroundings |            |             |            |             |            |             |            |             |            | General remarks |
|---------------------|---------------|--------------------------------|------------------------------|-------------------------------|------------------|--------------------|---------------|---------|----------------------------|----------------------------------|---------------------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-----------------|
| DLM ID              | Landfill name | Surface area (m <sup>2</sup> ) | Depth below ground level (m) | Height above ground level (m) | Type of cover    | Surface conditions | Slope angle   | Erosion | Paved roads?               | Accessible with heavy equipment? | Present Res               | Future Res | Present Rec | Future Rec | Present Agr | Future Agr | Present Ind | Future Ind | Present Nat | Future Nat | Remarks         |
| 2                   | LF2           | 86000                          |                              |                               | Geomembrane      | Shrubs             | Flat          | None    | N                          | N                                | N                         | N          | N           | N          | Y           | N          | N           | N          | N           | N          |                 |
| 2                   | LF2           | 86000                          | 4,0                          | 2,0                           | Soil             |                    | Less than 15° |         | Y                          | Y                                | N                         | Y          |             |            |             |            |             |            |             |            | masterplan      |

Introduction

General\_database

Working\_database

Results\_field\_visit

Compare\_field\_data

ELFM\_ranking

ELFM\_site

# Cedalion: ranking sheet

## Ranking per ELFM scenario

Recalculate ranking

Ranking based on data in working database

### Ranking Waste-to-Material

|         |      |
|---------|------|
| Minimum | 46,0 |
| Maximum | 72,5 |
| Average | 63,9 |
| Median  | 66,0 |

### Ranking Waste-to-Energy

|         |      |
|---------|------|
| Minimum | 44,0 |
| Maximum | 63,0 |
| Average | 52,6 |
| Median  | 52,0 |

### Ranking Waste-to-Land

|         |       |
|---------|-------|
| Minimum | 64,0  |
| Maximum | 106,3 |
| Average | 91,1  |
| Median  | 95,5  |

### Ranking Intermediate Use

|         |      |
|---------|------|
| Minimum | 38,5 |
| Maximum | 63,0 |
| Average | 48,6 |
| Median  | 45,0 |

| Landfil | WtM  |
|---------|------|
| 4       | 72,5 |
| 5       | 72,5 |
| 3       | 68,0 |
| 6       | 66,0 |
| 9       | 66,0 |
| 1       | 65,0 |
| 7       | 62,0 |
| 8       | 57,0 |
| 2       | 46,0 |

| Landfil | WtE  |
|---------|------|
| 1       | 63,0 |
| 4       | 60,5 |
| 5       | 60,5 |
| 3       | 54,3 |
| 7       | 52,0 |
| 6       | 47,0 |
| 8       | 46,3 |
| 9       | 45,5 |
| 2       | 44,0 |

| Landfil | WtL   |
|---------|-------|
| 6       | 106,3 |
| 4       | 106,3 |
| 5       | 106,3 |
| 7       | 98,7  |
| 9       | 95,5  |
| 8       | 91,0  |
| 3       | 85,3  |
| 1       | 67,0  |
| 2       | 64,0  |

| Landfil | IU   |
|---------|------|
| 1       | 63,0 |
| 2       | 58,0 |
| 9       | 56,5 |
| 7       | 52,3 |
| 3       | 45,0 |
| 8       | 44,7 |
| 6       | 40,7 |
| 4       | 38,5 |
| 5       | 38,5 |

| Landfill | Quick response | Reason              |
|----------|----------------|---------------------|
| 9        | Orion          | Land value/pressure |

Introduction

General\_database

Working\_database

Results\_field\_visit

Compare\_field\_data

ELFM\_ranking

ELFM\_site

# Cedalion: report per landfill

## ELFM potential

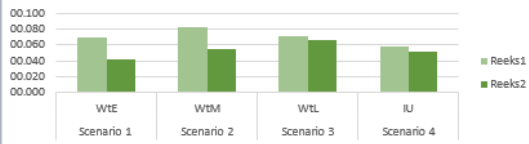
**DLM ID Landfill:** 2

**Quick response:**  Because of

**Summary score per scenario**

|                | Site ID | Average |
|----------------|---------|---------|
| Scenario 1 WtE | 70,0000 | 41,7361 |
| Scenario 2 WtM | 82,0000 | 54,8125 |
| Scenario 3 WtL | 71,0000 | 66,1667 |
| Scenario 4 IU  | 58,0000 | 51,4792 |

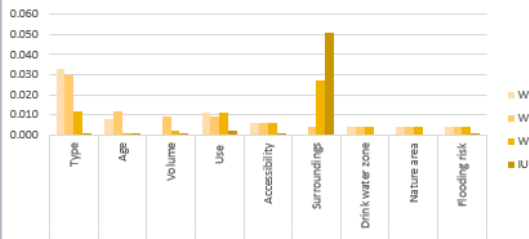
**Summary score per scenario**



**Sum per criteria**

|                             | WtE    | WtM    | WtL    | IU     |
|-----------------------------|--------|--------|--------|--------|
| Criteria 1 Type             | 33,000 | 30,000 | 12,000 | 1,000  |
| Criteria 2 Age              | 8,000  | 12,000 | 1,000  | 1,000  |
| Criteria 3 Volume           | 0,000  | 9,000  | 2,000  | 1,000  |
| Criteria 4 Use              | 11,000 | 9,000  | 11,000 | 2,000  |
| Criteria 5 Accessibility    | 6,000  | 6,000  | 6,000  | 1,000  |
| Criteria 6 Surroundings     | 0,000  | 4,000  | 27,000 | 51,000 |
| Criteria 7 Drink water zone | 4,000  | 4,000  | 4,000  | 0,000  |
| Criteria 8 Nature area      | 4,000  | 4,000  | 4,000  | 0,000  |
| Criteria 9 Flooding risk    | 4,000  | 4,000  | 4,000  | 1,000  |

**Sum per criteria**



**Characteristics landfill:**

The landfill consists of ... WWT sludge  
 The landfill dates back to: >1999 documented  
 Volume (m³): "Average" (default 35000-350000)  
 Use of landfill: Grass

[Introduction](#)

[General\\_database](#)

[Working\\_database](#)

[Results\\_field\\_visit](#)

[Compare\\_field\\_data](#)

[ELFM\\_ranking](#)

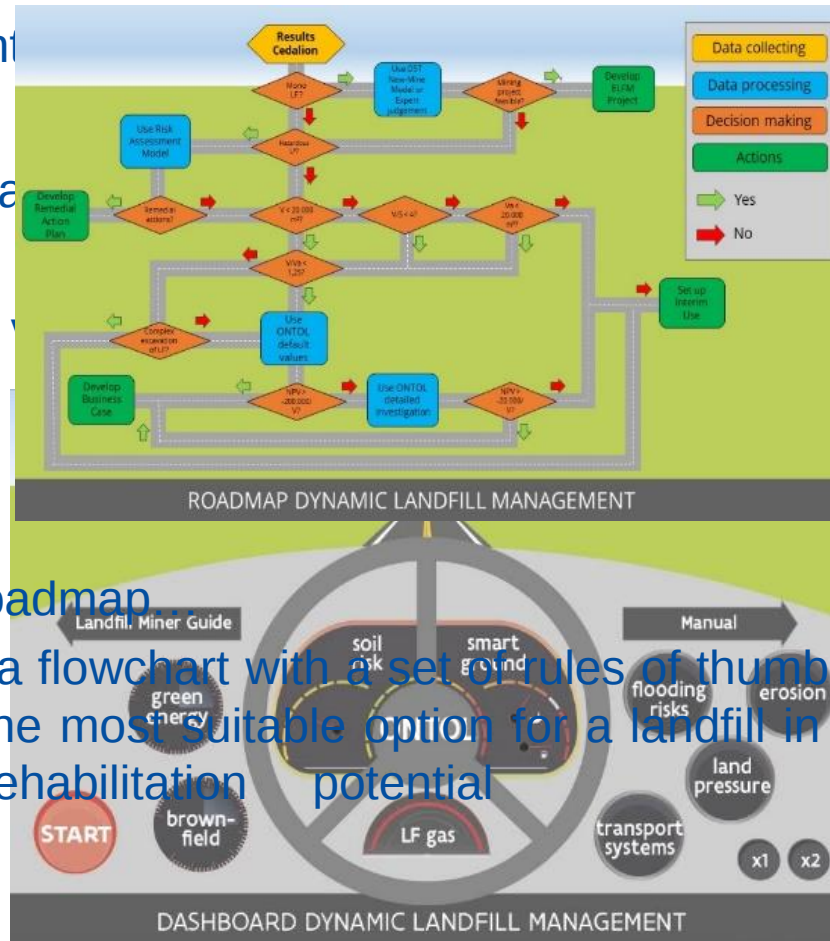
[ELFM\\_site](#)

## Decision Support Tool 2: Orion



## What? Concept behind Orion.

- ... provides  
evaluate the v



- ... provides a flowchart with a set of rules of thumb that will guide the user to select the most suitable option for a landfill in terms of resource valorisation or rehabilitation potential

# Introduction

Why? *Rationale behind Orion.*



Starting a landfill valorisation or rehabilitation project requires answers to a large set of questions on:

- Content of the landfill
- Context of the landfill
- Economic conditions and financing
- Stakeholder involvement
- ...

Orion is the second step in the Decision Support Tool delivered by RAWFILL and enables you to pose and answer the right questions before entering the final stage of setting up a business model.

# Introduction

Why? *Philosophy behind Orion.*



- Many interesting models/tools available for LF analysis (often EU funded)
  - *Orion = assembling good ideas*
- Orion guides you through these models/tools, in function of the most suitable valorization or rehabilitation strategy for your LF
  - *Orion = guidance towards relevant good ideas*

- \* Not reinventing but reusing
- \* Each tool has its strengths/weaknesses
- \* The dashboard contains all the references of these models/tools
- \* Possibilities to integrate regional tools

# Introduction

When ? *Reasons to use Orion.*

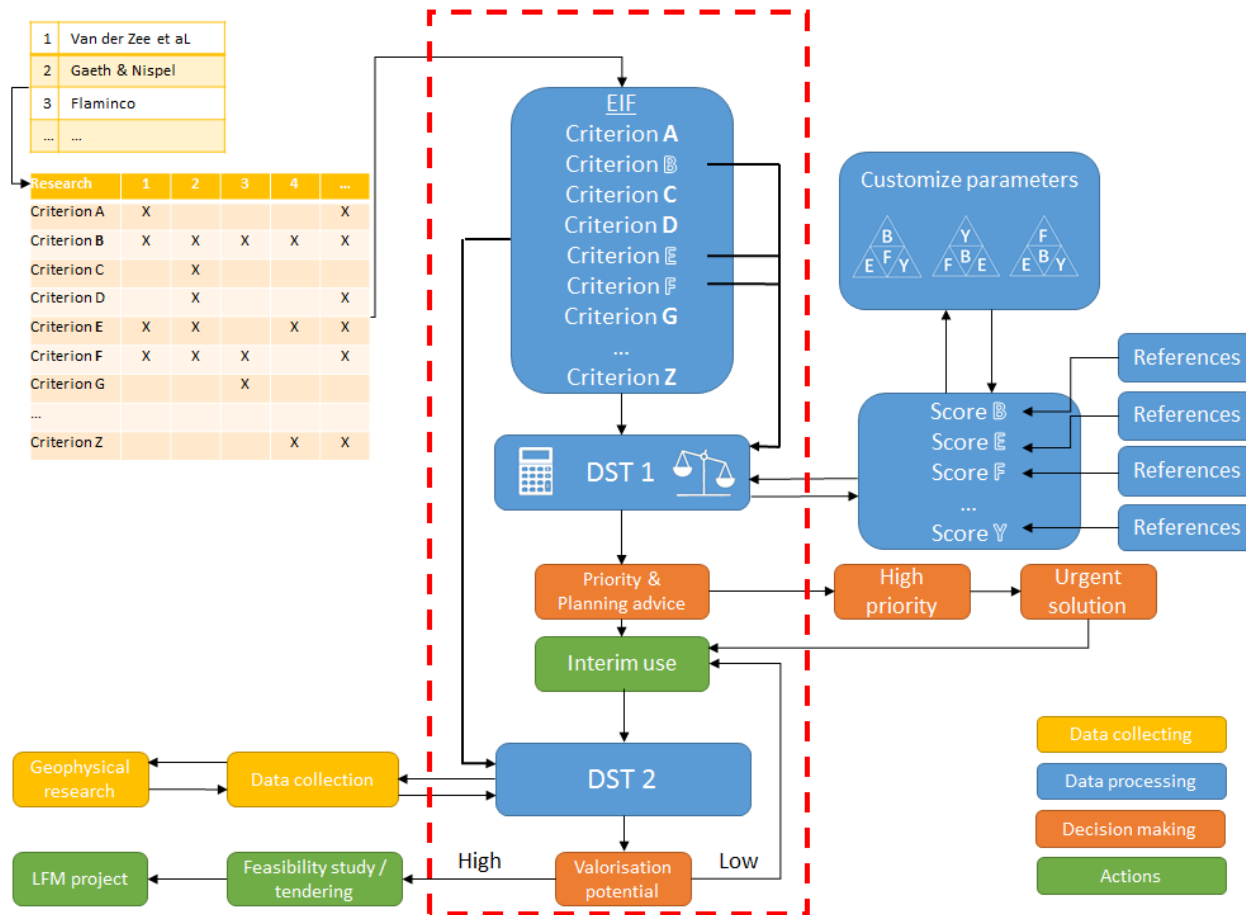


Orion can be used...

- To assess if your LF project is feasible
- To assess the valorisation potential of landfills
- To acquire a go/no go answer for setting up a business model for the valorisation of a landfill
- To determine the most promising future for your landfill
- To guide you to relevant models/tools to analyse your landfill

# Introduction

## Orion within the RAWFILL methodology



## Concept behind Orion



# Concept behind Orion

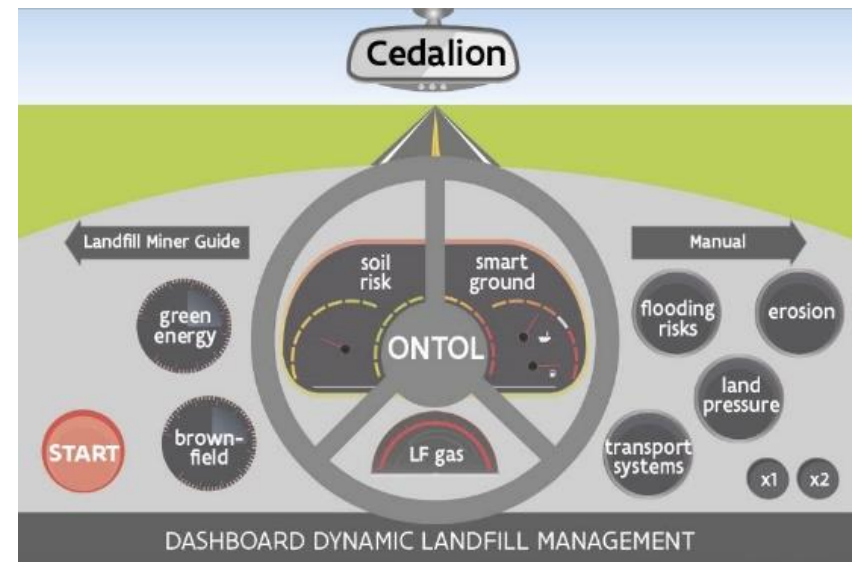
## Dashboard

Orion is an interactive web application that consists of two main components:

### 1. The Orion Dashboard...

... provides the necessary tools to evaluate the mining opportunity of a LF:

- Rearview mirror: **Cedalion**
- Steering wheel: tools to assess **content** of the LF (ONTOL, Smart-ground, ...)
- Dashboard buttons: tools to assess the **context** of the LF (land pressure, erosion, ...)
- Manual & LF Miner Guide provide **general** information





Land  
s, and Mine Sites

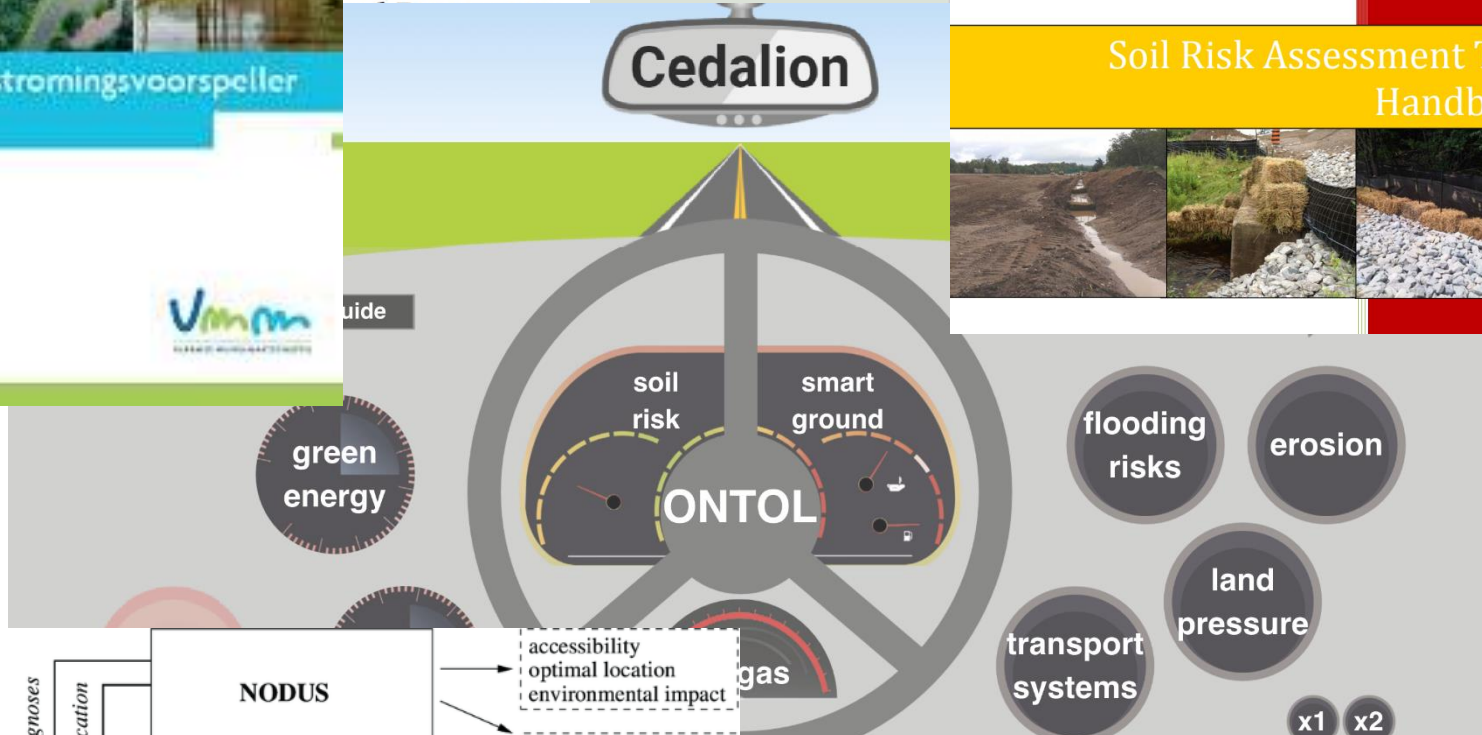


**Interreg**   
North-West Europe  
**RAWFILL**  
European Regional Development Fund

Soil Risk Assessment Tool  
Handbook



uide



POLICY MEASURES

traffic prognoses

optimal location

NODUS

LAMBIT

SIMBA

accessibility  
optimal location  
environmental impact

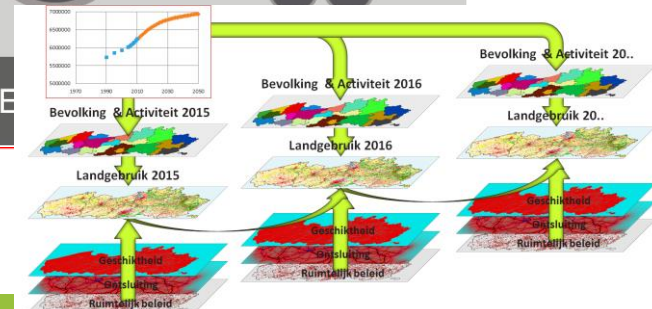
total costs  
modal shift

market area  
potential volume

reliability  
speed  
capacity utilization

LANDFILL MANAGE

bottom  
box to go to



**Interreg**   
North-West Europe  
**RAWFILL**  
European Regional Development Fund

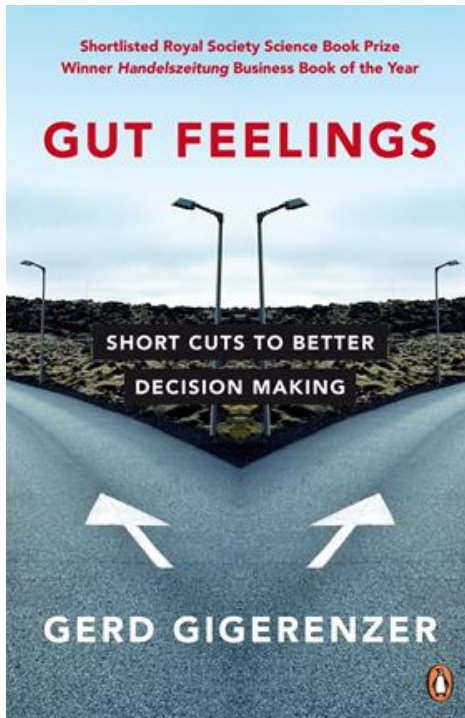
... provides a flowchart which enables the user to select the most relevant tools to evaluate the mining opportunities of a LF.

- Develop ELFM project
- Develop remedial action plan
- Set up interim use
- Develop business case

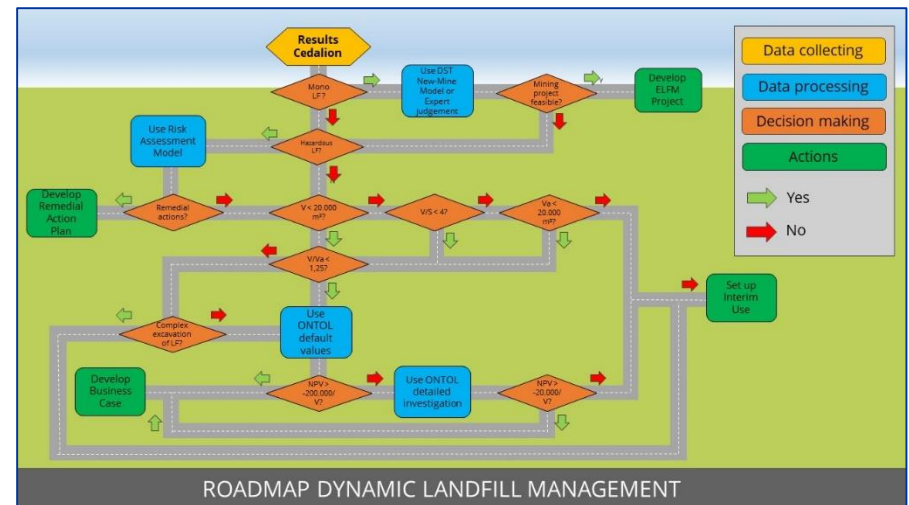


# Concept behind Orion

## Roadmap



"More information and more time and more sophisticated models do not necessarily lead to better decisions. In general, if you are in an uncertain world, make it simple."  
- Gerd Gigerenzer



# Concept behind Orion

## Conceptual site model

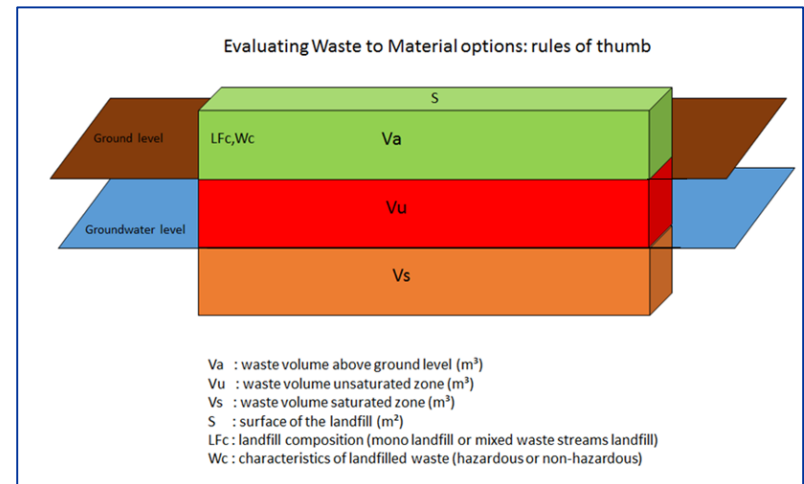


The Orion roadmap is mainly based on the conceptual site model of a landfill, which includes information on:

- the relative distribution of the landfill over the different soil layers,
- the surface and volume of the landfill,
- the type, characteristics and heterogeneity of the waste within the landfill.

→ all important parameters that should be taken into account within the budget and time management, concerning:

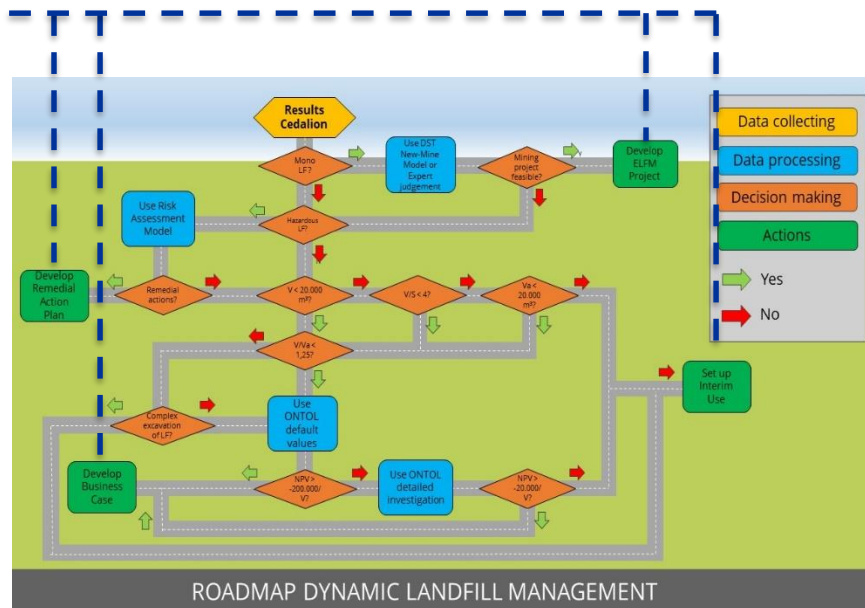
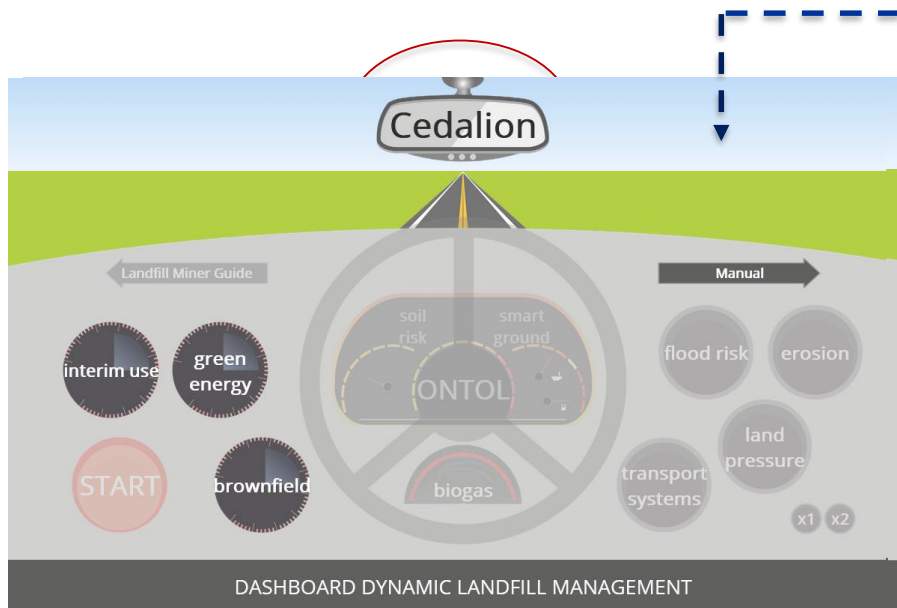
- Complexity of excavation
- Stability issues
- Extra measures to be taken
- ...



# Use of Orion: interactive web application

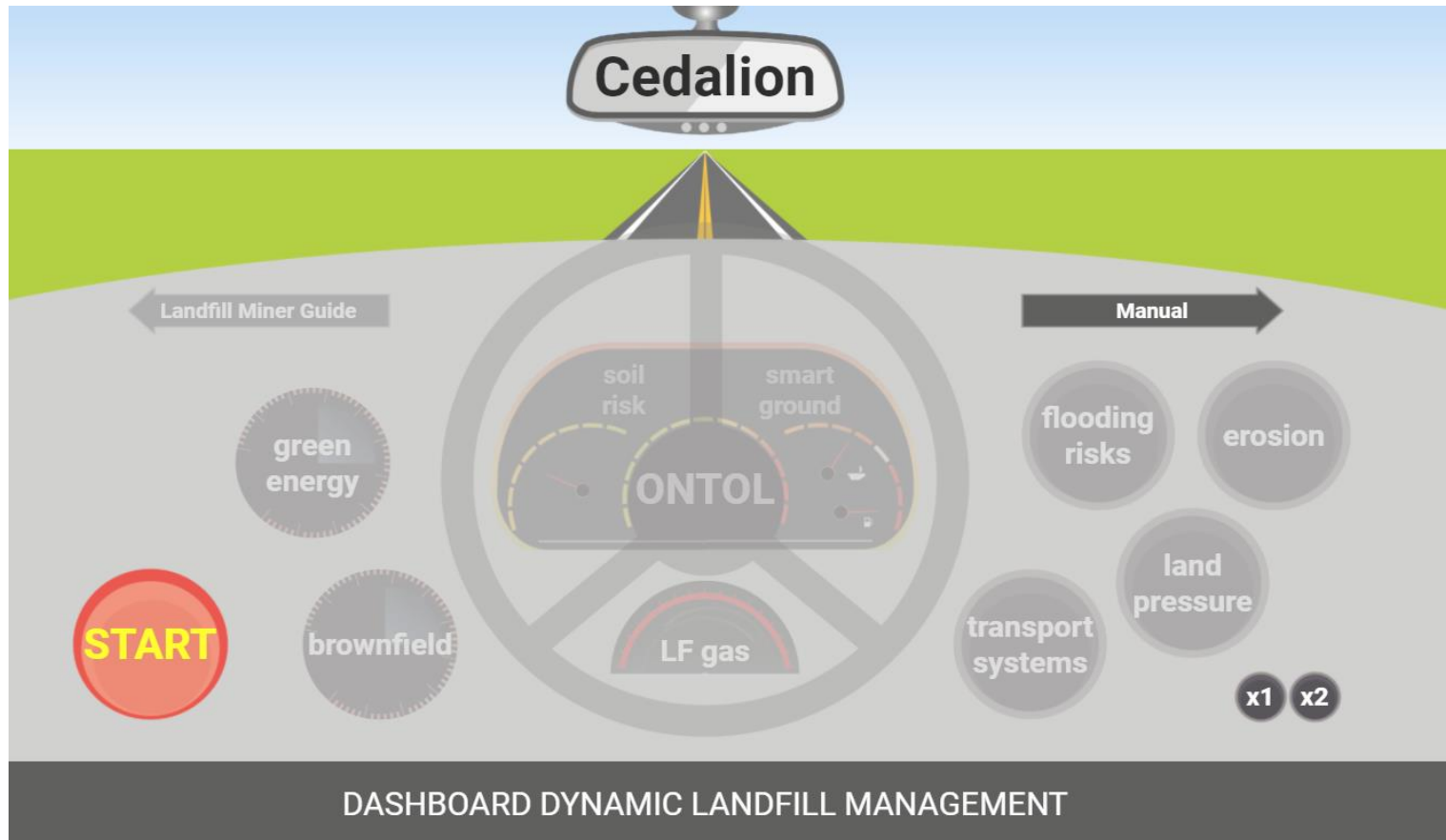


# Dashboard + Roadmap = Interactive web application



# Interactive web application

Homepage



# Interactive web application

## Example 1

Information on landfill x

| Parameter                       | Value                  |
|---------------------------------|------------------------|
| Type of waste                   | Fly ashes              |
| Hazardous waste                 | No                     |
| Volume (V)                      | 300 000 m <sup>3</sup> |
| Surface area (S)                | 30 000 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 60 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 0 m <sup>3</sup>       |
| Volume above ground level (Va)  | 240 000m <sup>3</sup>  |



**Orion Roadmap**

**Results Cedalion**  
 Select a landfill with high scores in Cedalion.

Fill in the name or reference of your chosen landfill:

[NEXT](#)

[CONCEPTUAL SITE MODEL](#)

# Interactive web application

## Example 1

Information on landfill x

| Parameter                       | Value                  |
|---------------------------------|------------------------|
| Type of waste                   | Fly ashes              |
| Hazardous waste                 | No                     |
| Volume (V)                      | 300 000 m <sup>3</sup> |
| Surface area (S)                | 30 000 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 60 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 0 m <sup>3</sup>       |
| Volume above ground level (Va)  | 240 000m <sup>3</sup>  |





### Orion Roadmap

[<< Back to Orion Dashboard](#)

**Is your landfill a mono landfill?** More Information +

Yes

No

I don't know

---

**This is Mono landfill** Less Information -

New-Mine aims specifically at Waste to Materials. The type of waste defines the viability.

The New Mine projects has deliverables in WP4 with regard to the evaluation of ELFM-projects. The provided link will bring you in contact with the developed models.

An alternative is the introduction of expert judgement. No specific accreditations are imposed and specific expertise should be proven by the interested contractor. A simplified checklist highlights the requested skills.

Checklist of expertise:

- Exploration
- Waste management
- Civil engineering
- Commodity markets
- Industrial processing
- Contaminated soil management
- Redevelopment of sites

Use DST New-Mine Model or Expert judgement



If you would like to receive the results to your email, please enter it here:

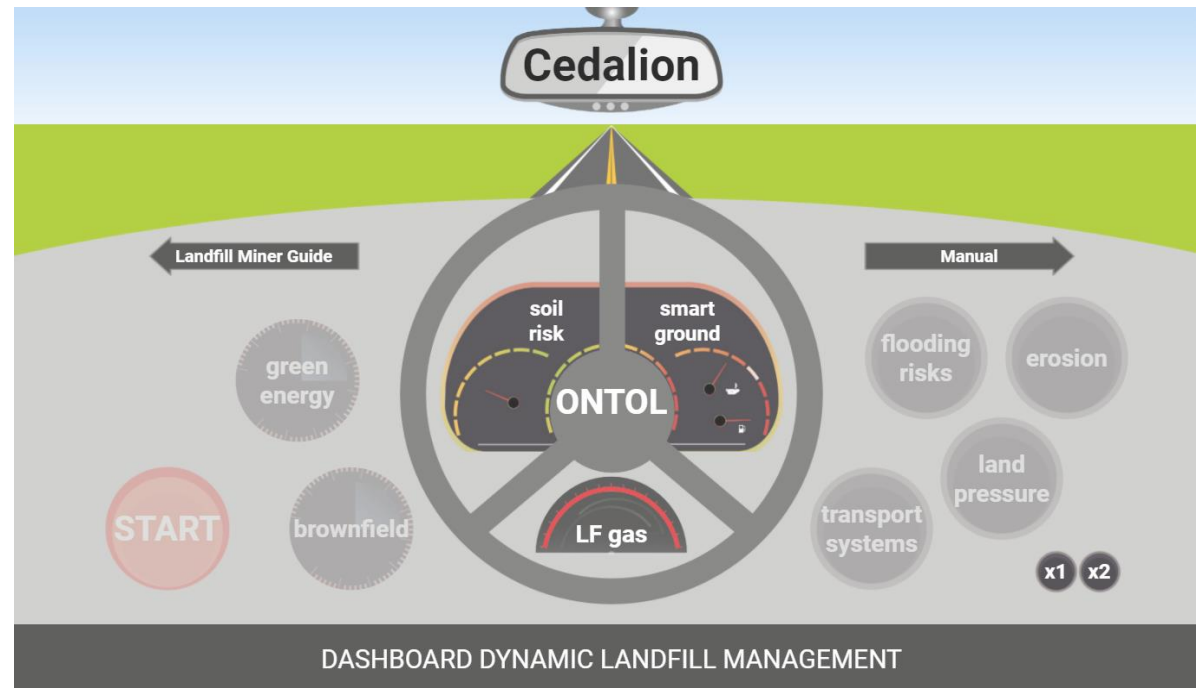
BACK TO ORION DASHBOARD

# Interactive web application

Example: Develop ELFM project

*Information on landfill x*

| Parameter                       | Value                  |
|---------------------------------|------------------------|
| Type of waste                   | Fly ashes              |
| Hazardous waste                 | No                     |
| Volume (V)                      | 300 000 m <sup>3</sup> |
| Surface area (S)                | 30 000 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 60 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 0 m <sup>3</sup>       |
| Volume above ground level (Va)  | 240 000m <sup>3</sup>  |



# Interactive web application

## Example 2

*Information on landfill y*

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |



**Orion Roadmap**

**Results Cedalion**  
 Select a landfill with high scores in Cedalion.

Fill in the name or reference of your chosen landfill:

[NEXT](#)

[CONCEPTUAL SITE MODEL](#)

# Interactive web application

## Example 2

Information on landfill y

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |





### Orion Roadmap

[<< Back to Orion Dashboard](#)

**Is your landfill a mono landfill?** More Information +

Yes
No
I don't know

**Does your landfill contain hazardous waste?**

Yes
No

More Information +

Use Risk Assessment Model

**Are remedial actions necessary?** More Information +

Yes
No

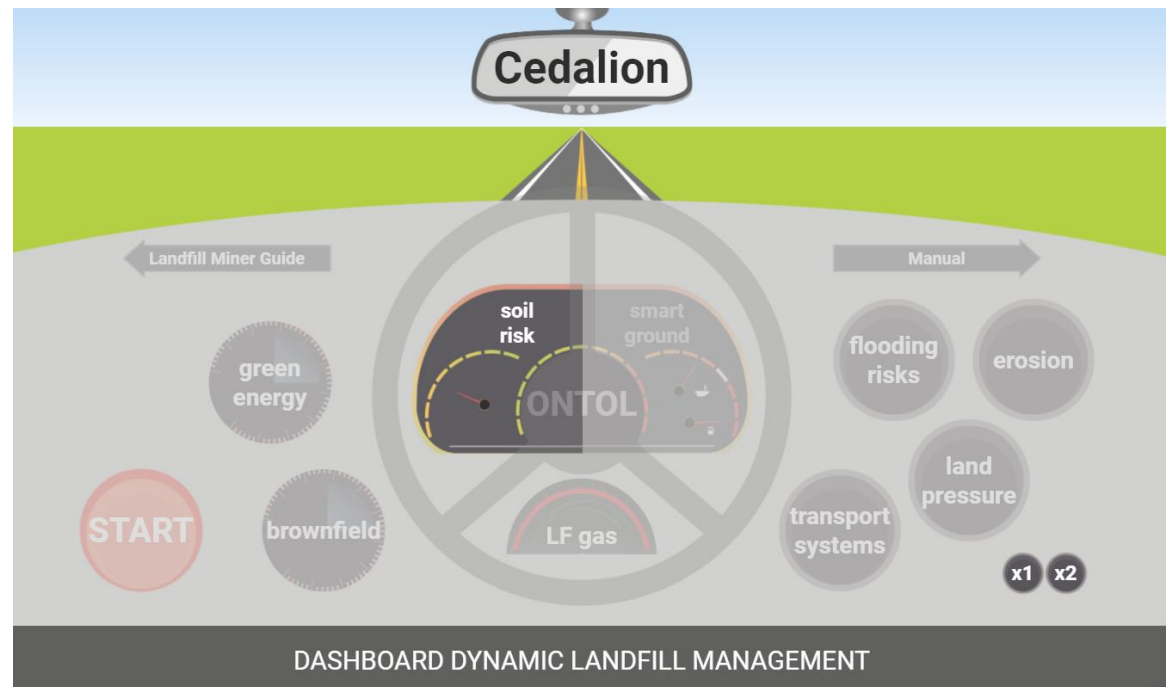
CONCEPTUAL SITE MODEL

# Interactive web application

## Example 2

*Information on landfill y*

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |



# Interactive web application

## Example 2

Information on landfill y

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |



**Orion Roadmap**

Use Risk Assessment Model

Are remedial actions necessary?

More Information +

Yes

No

$V < 20\,000\text{ m}^3$ ? ?

Yes

No

$V/V_a < 1,25$ ? ?

More Information +

Yes

No

Complex excavation?

More Information +

Yes

No

I don't know

CONCEPTUAL SITE MODEL

Vs

# Interactive web application

## Example 2

Information on landfill y

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |





### Orion Roadmap

**Complex excavation?** More Information +

**Vu/Vs > 5?** More Information +

**Distance to infrastructure > 10m?** More Information +

Excavation feasible

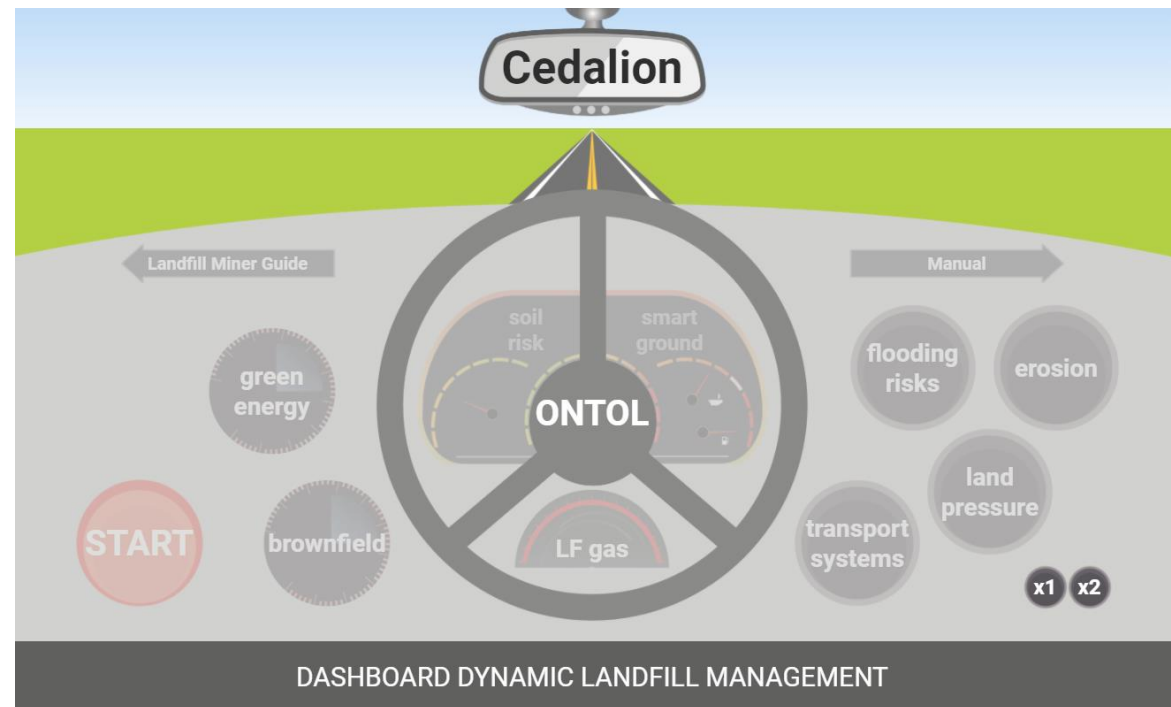
**NPV > -200 000/V?** More Information +

# Interactive web application

## Example 2

*Information on landfill y*

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |



# Interactive web application

## Example 2

Information on landfill y

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |





NPV > -200 000/V? 

Yes

No

Less Information 

Your stop:

Develop business case and use Orion Dashboard



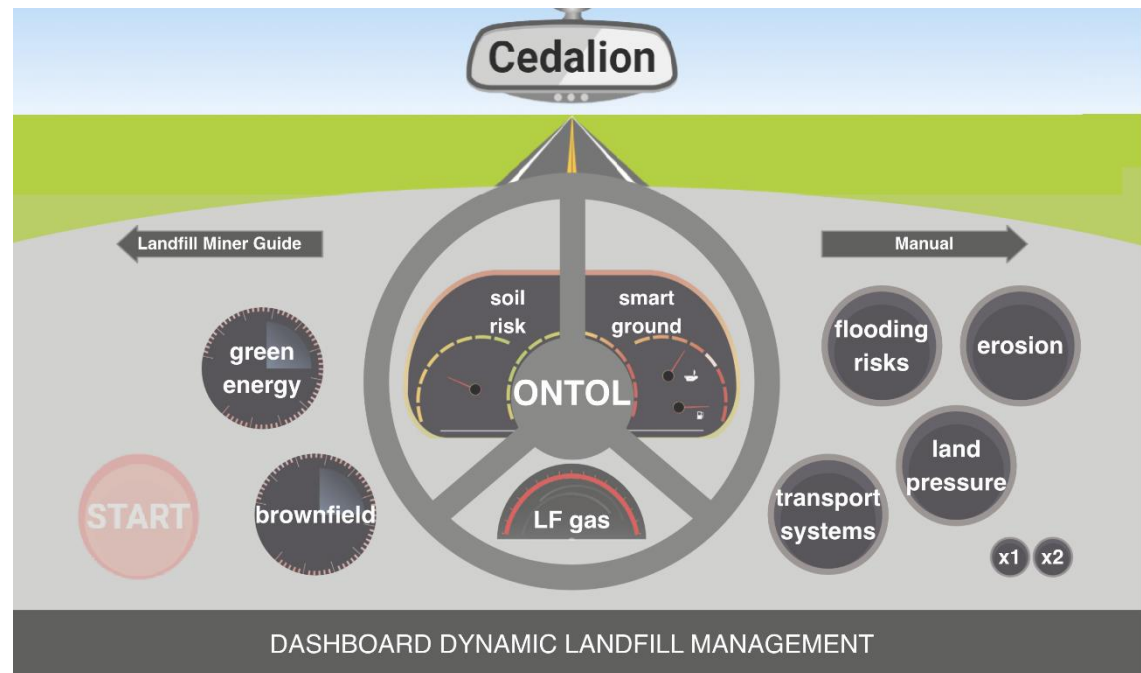
If you would like to receive the results to your email, please enter it here:

# Interactive web application

## Example: set up business case

*Information on landfill y*

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Type of waste                   | MSW and industrial    |
| Hazardous waste                 | Yes                   |
| Volume (V)                      | 12 000 m <sup>3</sup> |
| Surface area (S)                | 1 200 m <sup>2</sup>  |
| Volume of unsaturated zone (Vu) | 6 000 m <sup>3</sup>  |
| Volume of saturated zone (Vs)   | 1 200 m <sup>3</sup>  |
| Volume above ground level (Va)  | 4 800 m <sup>3</sup>  |



# Interreg



EUROPEAN UNION

## North-West Europe

## RAWFILL

European Regional Development Fund

# Thank you!