



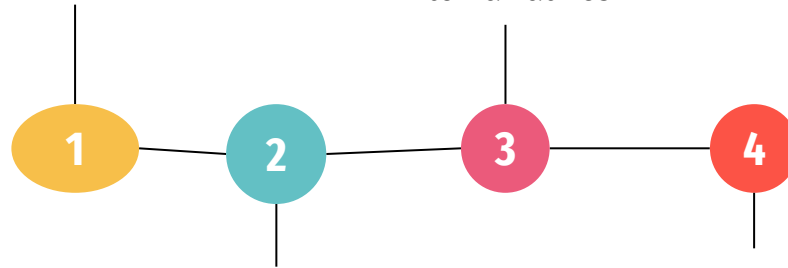
Creating and Visualising Semantic Story Maps

Valentina Bartalesi Lenzi

A narrative is...



The production of imaginative projects and experiences shown in movements and vocal expressions



A means to make sense of reality by structuring events into narratives

A conceptual basis of collective human understanding

A means used by different scientific communities to create shared meanings



Wertsch, J. V., & Roediger III, H. L. (2008). Collective memory: Conceptual foundations and theoretical approaches. *Memory*, 16(3), 318-326.

Taylor, C. (1992). *Sources of the self: The making of the modern identity*. Harvard University Press.

McInerney, G. J., Chen, M., Freeman, R., Gavaghan, D., Meyer, M., Rowland, F., ... & Hortal, J. (2014). Information visualisation for science and policy: engaging users and avoiding bias. *Trends in ecology & evolution*, 29(3), 148-157.

Maps

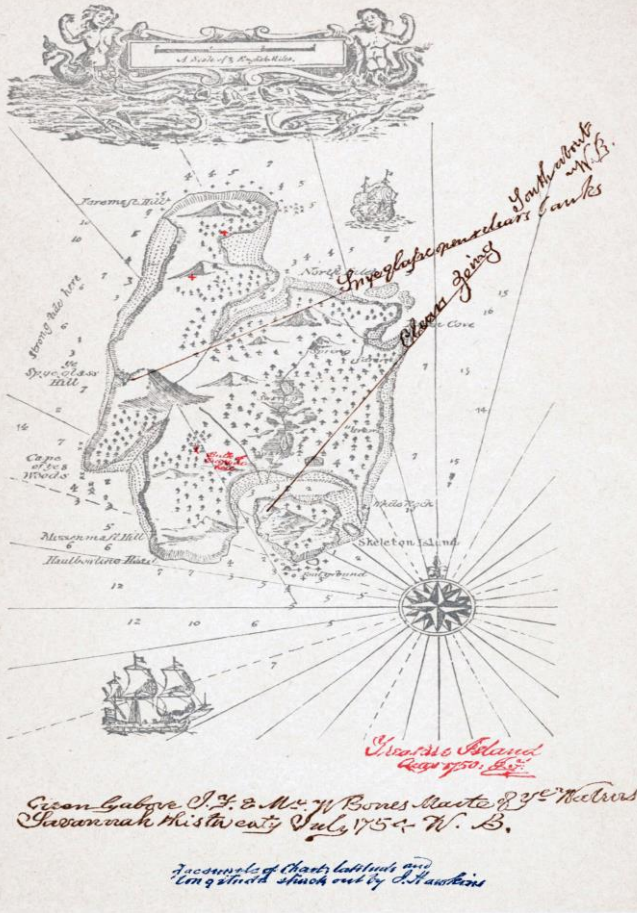
Maps have always geographically supported narratives, and stimulated people's imagination.

Conrad, Heart of Darkness (1899):

Marlow tells “...when I was a little chap I had a passion for maps. I would look for hours at South America, or Africa, or Australia, and lose myself in all the glories of exploration.”

Stevenson (1894), My First Book - Treasure Island:

“I made the map of an island. The shape of the map took my fancy beyond expression; it contained harbours that pleased me like sonnets; and with the unconsciousness of the predestined, I ticketed my performance Treasure Island.”



Map of *Treasure Island* by Robert Louis Balfour Stevenson from the 1883 edition by Cassell

The Map is not the Territory

1) Perceptive cartographic challenge

for a map is when it tries to represent also the life, emotions, reality, fiction, legends, and expectations associated with the described territory.



2) How can we meet the challenge?

the challenge could be met by enriching geographic locations with media that communicate emotional messages.



The Territory Beyond the Map

Maps, alone, represent the spatiotemporal structure of a story, i.e., they represent the geography of a territory and the relationships between places, but should be enriched with oral/written events or digital audio/video material to describe the overall territorial complexity.

Story Maps

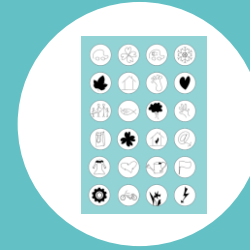
Story maps are computer science realizations of narratives based on maps. They are online interactive maps enriched with text, pictures, videos, data, and other multimedia information, whose aim is to tell a story over a territory.

Issues with Current Software for Story Map Building



The software is commercial and thus cost-ineffective

1



Stories are independent from one other

2



No inter-linking of stories sharing the same topics


3

The Story Map Building and Visualizing Tool (SMBVT)

Entirely **open-source**, free-to-use and Open Science compliant

Automatically builds up a **user-shared KB** that interconnects all stories

Build a Narrative
about...



or...

Search for a different subject:

Show 10 entries Search your Narratives:

id	Title	Delete
1265	Michelle Obama	
250	UK Scotland – Speyside Malt Whisky Value Chain	
247	Hungary: Transdanubia Mountains – Agroecological Knowledge Value Chain	
246	Switzerland: Swiss Alps Grain Value Chain	
245	Spain: Sierra Morena - Jamón Ibérico Value Chain	

Uses **Linked Open Data** paradigm to publish stories

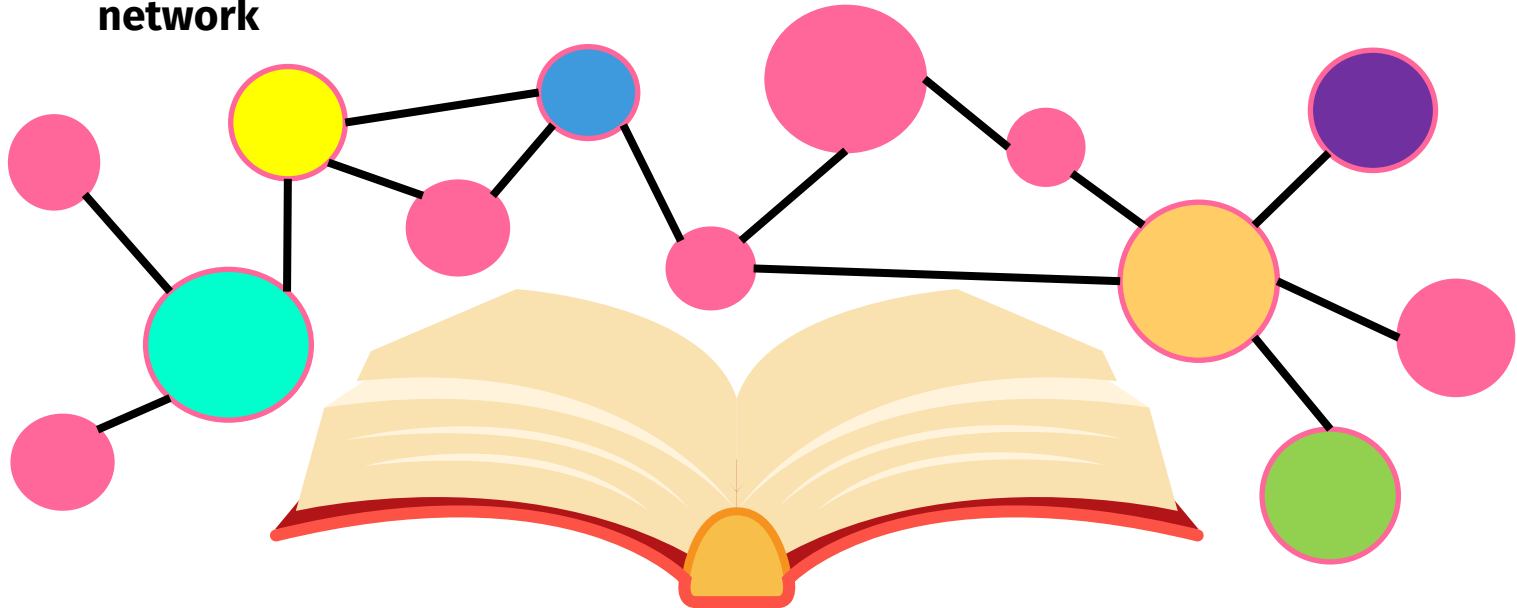
Uses **Wikidata** as external reference KB

The KB is modelled on the basis of the **Narrative Ontology**

Freely subscribe to <https://dlnarratives.eu/tool.html>

Narrative Ontology

A **narrative** is composed of **events**, with a possibly associated **text** or **multimedia-object**, that are linked to the digital objects of the **existing digital libraries** and are endowed with a set of **semantic relations** connecting these events into a meaningful **semantic network**



Narrative Conceptualisation

As derived from the narratology and AI literature, a narrative consists of three main elements:

Fabula

the fabula, i.e. the story itself as the events happened in chronological order



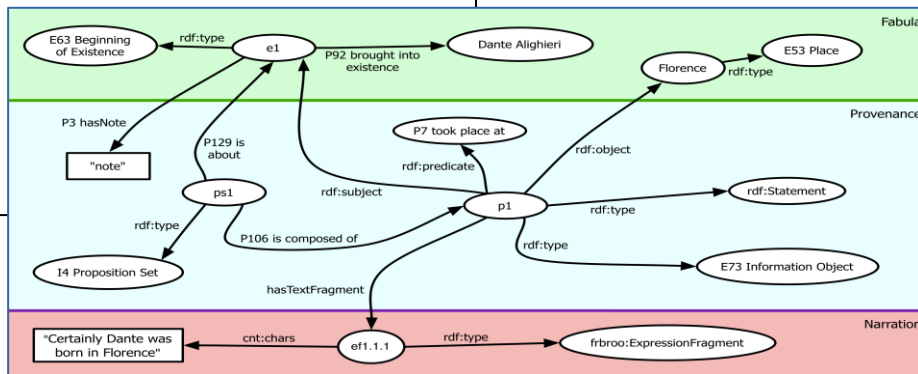
Narrations

one or more expressions, each in its own language and medium, which narrate the fabula



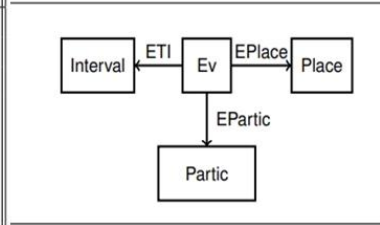
Reference Relation

the **reference relation** that connects the narrations to the fabula

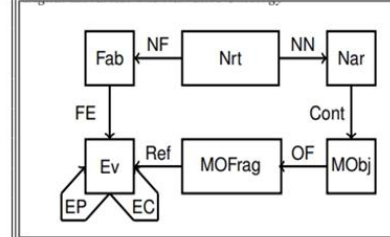


The Logic Specification of the Conceptualisation

Unary Predicate Symbols	
Ev(e)	e is an event
Interval(t)	t is a time interval
Place(p)	p is a place
Partic(c)	c is an entity that may participate in an event (i.e. a person, an object or a concept)
Fab(f)	f is a fabula
Nar(a)	a is a narration
MOBj(o)	o is a media object
MOFrag(r)	r is a media object fragment



Binary Predicate Symbols	
EP(e ₁ ,e ₂)	event e ₁ is part of event e ₂
EC(e ₁ ,e ₂)	event e ₁ is causally dependent on event e ₂
ETI(e,t)	event e occurs at time interval t
EPlace(e,p)	event e occurs in place p
EPartic(e,c)	event e has participant c
FE(f,e)	fabula f has event e
Cont(n,o)	narration n has content o
OF(o,r)	media object o has fragment r
Ref(r,e)	fragment r is about event e
TINC(t ₁ ,t ₂)	interval t ₁ includes interval t ₂
TIP(t ₁ ,t ₂)	interval t ₁ starts before interval t ₂



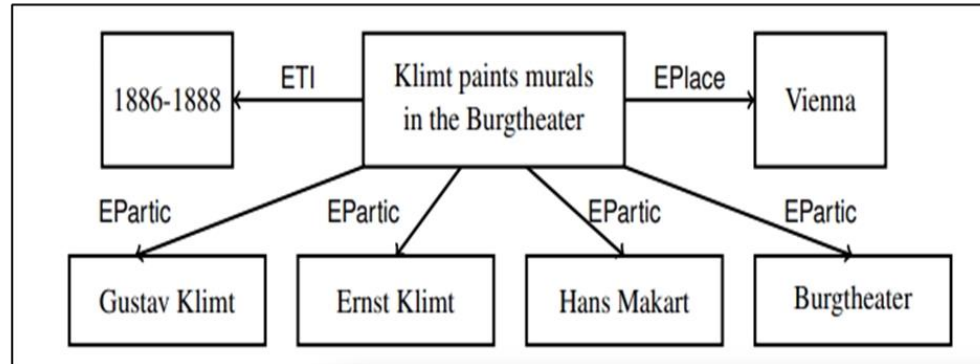
$$EP(x,y) \rightarrow Ev(x) \wedge Ev(y)$$

$$EC(x,y) \rightarrow Ev(x) \wedge Ev(y)$$

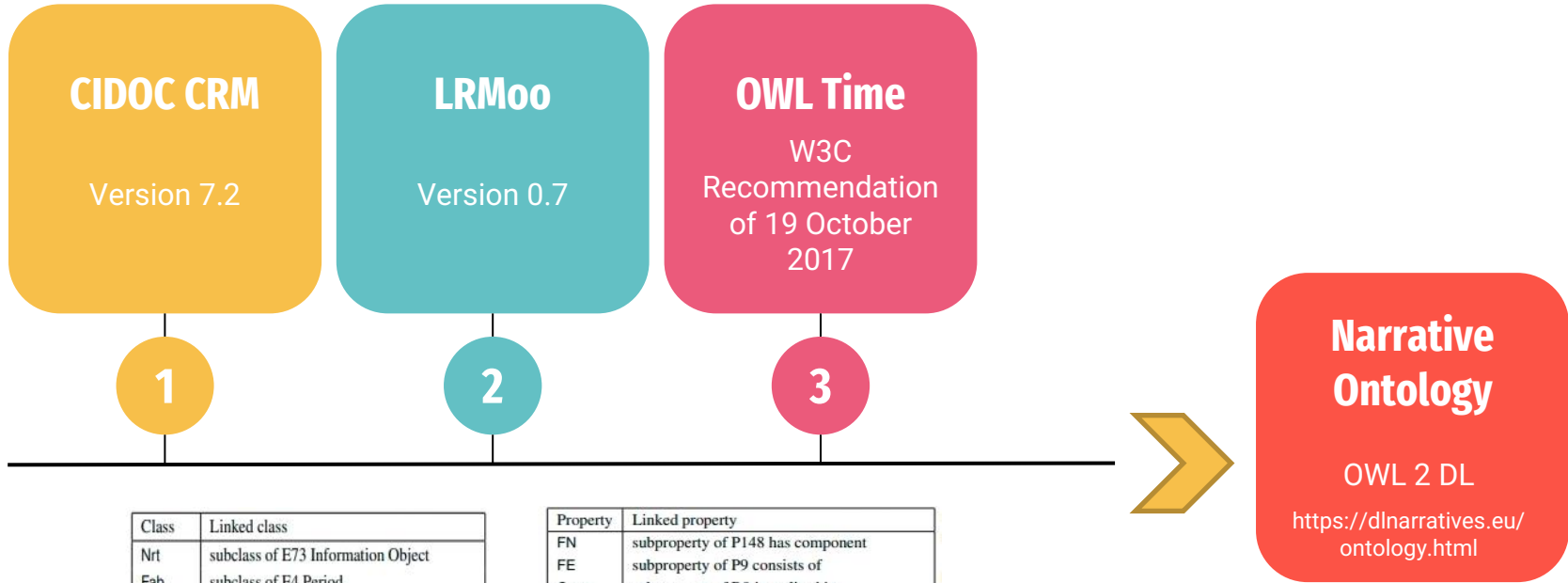
$$ETI(x,y) \rightarrow Ev(x) \wedge Interval(y)$$

$$Cont(x,y) \rightarrow Nar(x) \wedge MOBj(y)$$

$$OF(x,y) \rightarrow MOBj(x) \wedge MOFrag(y)$$



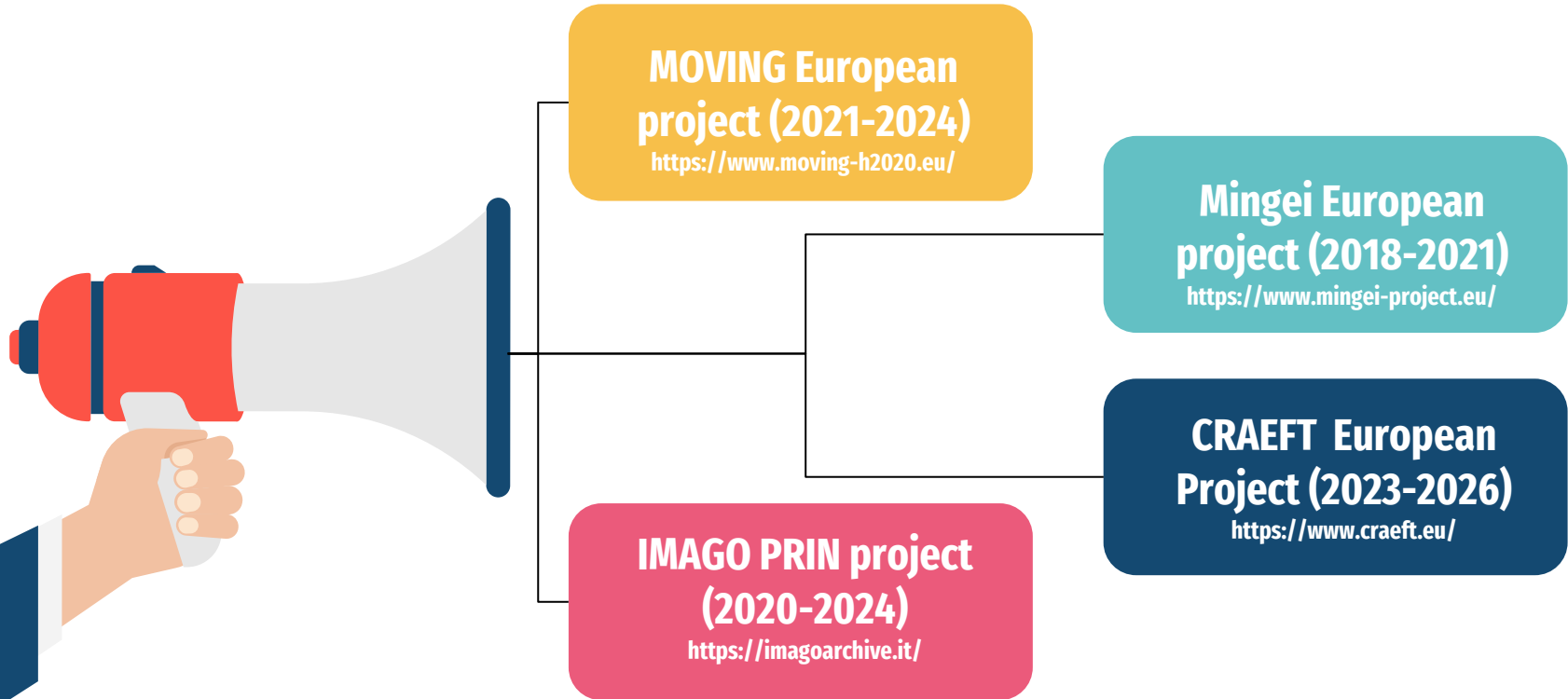
Narrative Ontology Development



Class	Linked class
Nrt	subclass of E73 Information Object
Fab	subclass of E4 Period
Nar	subclass of F14 Individual Work
Ev	equivalent to E5 Event
MObj	subclass of F22 Self-Contained Expression
MOFrag	subclass of F23 Expression Fragment
Interval	equivalent to Proper Interval of OWL Time and to E52 Time-Span

Property	Linked property
FN	subproperty of P148 has component
FE	subproperty of P9 consists of
Cont	subproperty of R9 is realised in
OF	subproperty of R15 has fragment
Ref	subproperty of P129 is about
EP	subproperty of P9 consists of
EC	superproperty of P15 was influenced by
ETI	equivalent to P4 has time-span
EPartic	equivalent to P12 occurred in the presence of
EPlace	equivalent to P7 took place at

Narrative Ontology Assessment



SMBVT: Story Building Interface

<https://dlnarratives.eu/tool.html>

The tool **retrieves** and **assigns IRIs** to the instances of the classes using **Wikidata** as **source**

The instances are **automatically organized** in the **classes** of the **Narrative ontology**

The user can introduce **new entities** not present in Wikidata

The screenshot displays the SMBVT interface for creating a story. At the top, the title is "Greece: Crete Central Rethymno Carob Value Chain". The interface is divided into several sections:

- Navigation:** "HOME" button and "MY NARRATIVES" / "VALENTINA BARTALE" tabs.
- Class Selection:** A vertical sidebar on the left lists categories: ALL, SEARCH, PEOPLE, ORGS, OBJECTS, CONCEPTS, PLACES, WORKS, OTHER, and NEW (highlighted with a pink box).
- Instance Grid:** A central grid of colored buttons representing instances from Wikidata. The grid includes: Rethymno Regional..., Altimetry, Carbon dioxide, Carob, Ceratonia siliqua, Climate change, Crete, Employment, Italy, Population, Population densit..., Portugal, Primary sector of..., Secondary sector..., Selli, Soil, Spain, and Tertiary sector o...
- Form:** A form on the right for creating a new event. It includes:
 - EVENT TITLE:** "Central Rethymno Carob Value Chain"
 - START DATE (dd-mm-yy or yyyy):** [Empty field]
 - END DATE (dd-mm-yy or yyyy):** [Empty field]
 - LATITUDE (e.g. 43.9930):** "35.29996200559993"
 - LONGITUDE (e.g. 10.31055):** "24.514270130418794"
 - Find coordinates from map:** [Input field]
 - EVENT TYPE:** [Empty field]
 - ENTITIES:** A row of buttons for "Rethymno", "Carob", "Crete", and "Selli".
- Actions:** Buttons for "SAVE FORM", "CLEAR FORM", "VISUALIZE MAP", "VISUALIZE TIMELINE", "EXPORT IN JSON", "PUBLISH STORY", and "HELP".
- Filter:** A "filter events" input field.
- Story Preview:** A bottom row of panels showing the story structure with tabs: "Central Rethymno Carob V...", "Description of the Referenc...", "Geography and Population", "Income and Gross Value A...", "Tourism", and "Employment". Each panel contains relevant instance buttons.

SMBVT: Story Building Interface

The tool has a panel to create an event

A series of buttons to perform different actions

Shows the list of the created events at the bottom of the interface

The screenshot displays the SMBVT Story Building Interface. At the top, the page title is "Greece: Crete Central Rethymno Carob Value Chain". The interface is divided into several sections:

- Left Panel:** A vertical list of filter categories: ALL, SEARCH, PEOPLE, ORGS (highlighted in yellow), OBJECTS, CONCEPTS, PLACES, WORKS, OTHER, and NEW.
- Central Grid:** A grid of buttons representing various concepts and entities. The buttons include: Rethymno Regional..., Altimetry, Carbon dioxide, Carob, Ceratonia siliqua, Climate change, Crete, Employment, Italy, Population, Population densit..., Portugal, Primary sector of..., Secondary sector..., Selli, Soil, Spain, and Tertiary sector o...
- Form (Right):** A form for creating an event, titled "Central Rethymno Carob Value Chain". It includes fields for START DATE, END DATE, LATITUDE (35.29996200559993), and LONGITUDE (24.514270130418794). There is a "Find coordinates from map" button. Below the form, the "EVENT TYPE" field is empty, and the "ENTITIES" section shows buttons for Rethymno, Carob, Crete, and Selli.
- Right Panel:** A vertical list of actions: SAVE FORM, CLEAR FORM, VISUALIZE MAP, VISUALIZE TIMELINE, EXPORT IN JSON, PUBLISH STORY (highlighted in green), and HELP.
- Bottom Panel:** A horizontal list of created events, each with a title and a grid of buttons. The events are: "Central Rethymno Carob V...", "Description of the Referenc...", "Geography and Population", "Income and Gross Value A...", "Tourism", and "Employment".

SMBVT: Visualising Interface

The screenshot displays the SMBVT interface, which includes a map of Rethymno, Crete, and a value chain diagram. The map shows various locations and events marked with colored icons: red for current events, yellow for historical events, green for natural events, and orange for valorisation events. A legend in the bottom-left corner identifies these markers. The value chain diagram on the right shows the flow from 'Crete' to 'carob' to 'Selli' to 'Rethymno Regional Unit'. A photograph of a carob tree is also visible. The interface includes navigation controls like a zoom in (+) and zoom out (-) button, a 'Map Overview' button, and a 'Back To Beginning' button. A right arrow button is also present on the right side of the map area.

Map Overview Back To Beginning ↶

Current event
Historical event
Natural event
Valorisation event

Crete • carob • Selli • Rethymno Regional Unit

Digital Objects
1

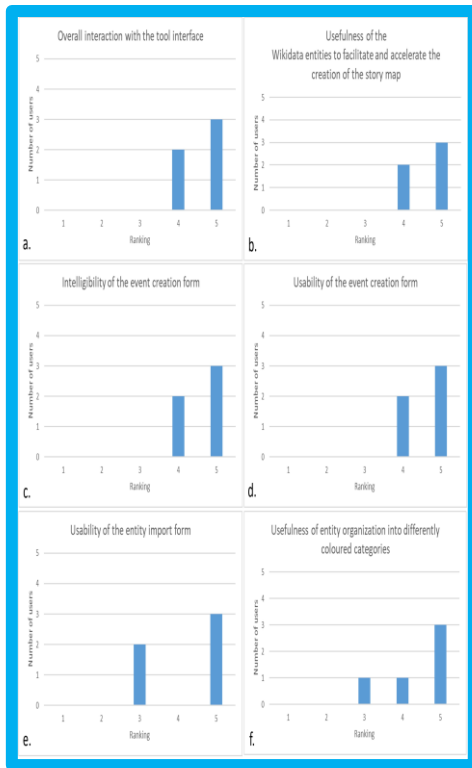
Central Rethymno Carob Value Chain

The Selli area carob cultivation has become the origin of an extensive Value Chain (VC) developed in Rethymno prefecture, which involves local farmers and family firms producing a multitude of local products (bread, baked goods, pasta, cocoa, syrup used as natural sweetener, cosmetics, alternative sweeteners and animal feed), ornamental use and timber, and firms for standardization, packaging, promotion and marketing. The carob products, part of the local gastronomy, are present in hosting activities and in tourism in general.

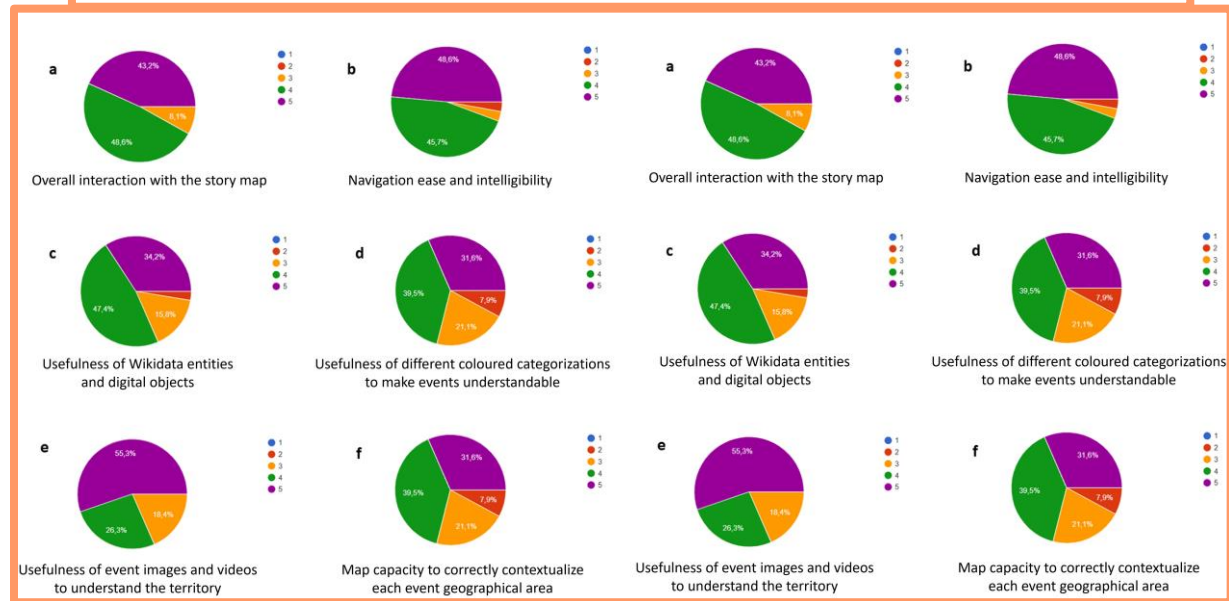
SMBVT based on StoryMapJS | Leaflet | © OpenStreetMap and contributors. Under an open license

First Assessment of the usability of SMBVT

Building interface: 5 users (2022) → 28 users (2023)

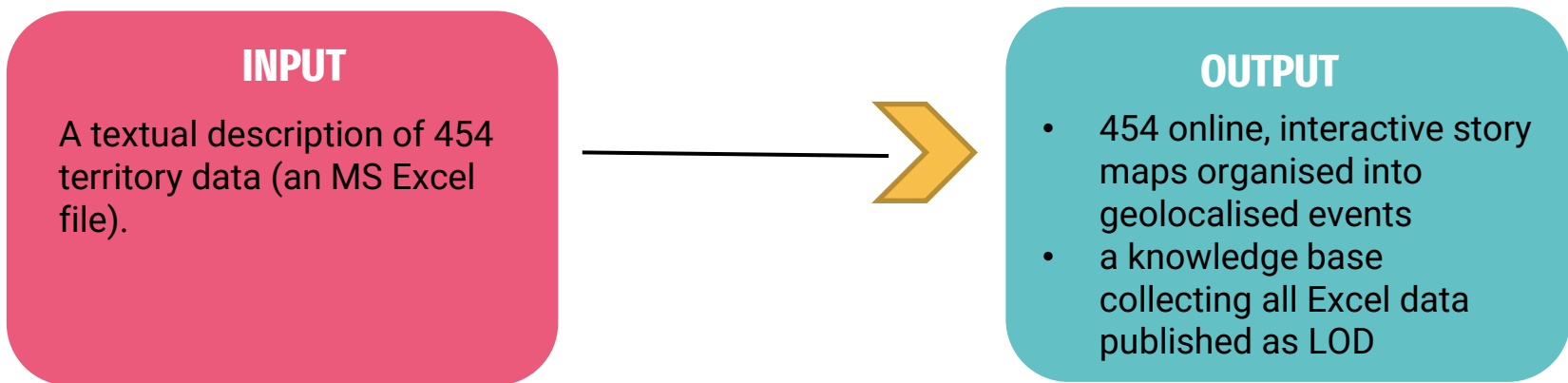


Visualising interface: 38 users (2022) → 60 (2023)



From textual documents to Semantic Story Maps

A semi-automatic **workflow** to produce story maps from textual documents containing description of territory data.



Using **SMBVT** the community experts can **review the story maps**.

Workflow Modules

Data
Preparation

1



Story-structure
building module

2



Story map
creation module

3



Story map
review and
querying

4



Evaluation
Methodology

5



1

Data Preparation

Pre-processing

The data associated with each European territory can be distinguished into three categories:

1. **textual descriptions** of the territory's natural characteristics,
2. **quantitative descriptions** of the territory in terms of geography, population, income, tourism, and employment,
3. **key attributes** of the regional products and value chains.



We obtained one new textual document (in CSV format) for each territory. We organised this CSV by describing **one story event in each row**. Therefore, each row reports:

1. a **title**,
2. a **description** (produced by assembling multiple fields of territory Excel record)
3. **Barycenter** of LAU
4. one representative **image**.

The newly prepared documents were sequentially passed to our workflow as **input data**.

2 Story-structure building module

This module creates a structured story by processing the plain text of the input CSV rows (events).

NLPHub

automatically extracts **named entities** from the story titles and event descriptions.



Wikidata

the process uses the Wikidata semantic service SPARQL endpoint to retrieve, for each extracted named entity, the **corresponding Wikidata Internationalized Resource Identifier (IRI)** and for location the **geographic coordinates**.

Decision Algorithm

To assign the coordinates to the extracted location of each event. Our module realises this operation by selecting, for each event, the event's **entity-coordinates** that are either **unique** in the entire narrative or has the **lowest occurrence frequency**.

When a location is not found in an event, the barycenter of the LAU is reported.

3 Story Map creation module

Each story structured file is **post-processed**

Text

All **acronyms** are expanded through a reference domain-specific dictionary. **Images** are linked to the events if referred in the original input text

1

2

JSON

The **event sequence** with all associated **entities** and **images** is described in JSON format, according to the schema used by SMBVT

3

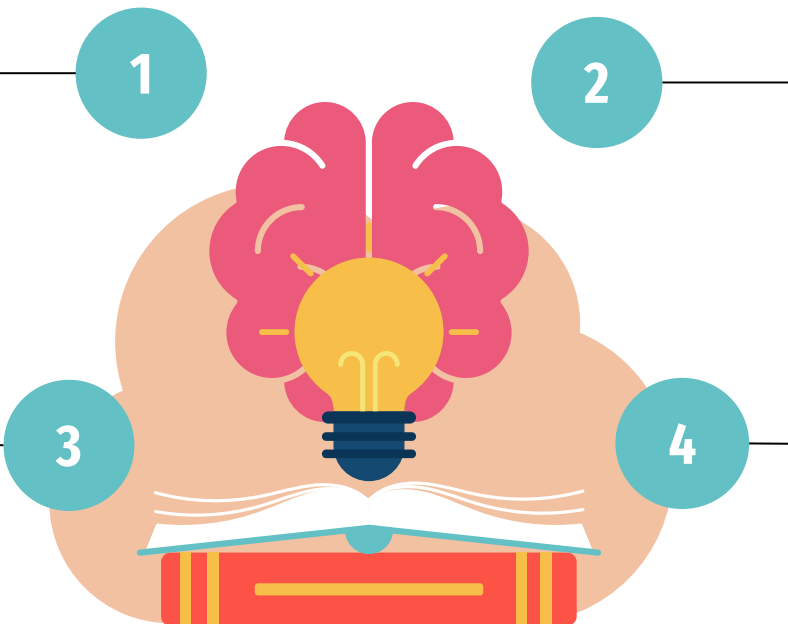
PostgreSQL database

An algorithm stores the JSON file on a PostgreSQL-JSON database

4

Knowledge Base

a JAVA-triplifier software translates the JSON document into a Web Ontology Language (OWL) graph.



4

SMBVT to review the story maps and query the KB

Using SMBVT, the experts can revise the story maps automatically created.

1

Experts can change and correct (if necessary) any element of the story, e.g. texts, images, coordinates etc.

2

Once the experts have reviewed the story maps, they can re-publish them.

3

The publication process returns a public link. Each publication operation overwrites the previous one so that the public link always points to the latest story-map version.

4

The publication operation is necessary to support continuous updating and to guarantee a long-term story's maintenance, usability, and accessibility.



4

Querying the Story Map Knowledge Base

We implemented 5 different predefined queries on the entities related to the story map events

Narratives
by entity

Narratives
by country

Events
by entity

Number of
occurrences
by entity

Select an entity
to find the
related entities



4

SMBVT to discover links among stories

Through SPARQL queries, it is possible to discover links between stories.

Retrieve the stories about the Protected Designation of Origin (PDO) products

Retrieve the stories that describe the territories in which a river flows

Retrieve the stories that describe territories included or near by a National Park



[Back to Map](#)

Narratives by entity

[Other Searches](#)

Selecting an entity you can find all the stories in which the entity appears

Show entries

Storymap

[Eastern Alps Trento Doc Wine Value Chain](#)

[France: Corsican Chestnut Flour Value Chain](#)

[Portugal: Cordilheira Central \(Serra da Estrela PDO Cheese\)](#)

[Serbia: Dinaric Mountains Sienica Lamb](#)

[Spain: Sierra Morena - Jamón Ibérico Value Chain](#)

[Swiss Jura Tête de Moine Cheese Value Chain](#)

Showing 1 to 6 of 6 entries

[Previous](#)

[1](#)

[Next](#)

Many Stories – One story



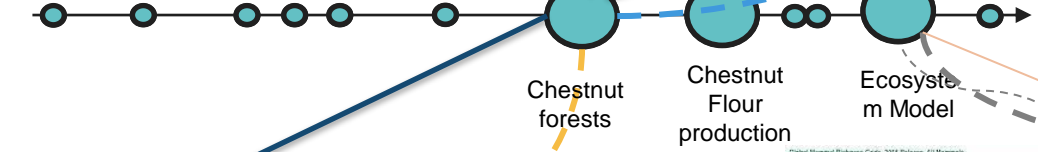
Foto: Massimo Sestini - ID



Corsican Chestnut Flour Value Chain

Apuan Alps Wildlife

Apuan Alps Chestnut Flour Value Chain



Castanea sativa Historic Development

300 BC

Theophrastus's Historia plantarum

643 AD
Edictum Rothari



1900

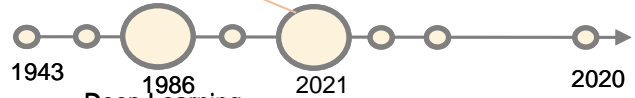


Digital Natural Resource Grids, 2015 Release, All Wares
Global Forests Database

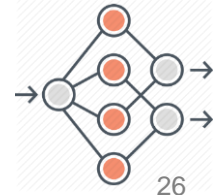
Artificial Neural Networks



Story of Artificial Neural Networks



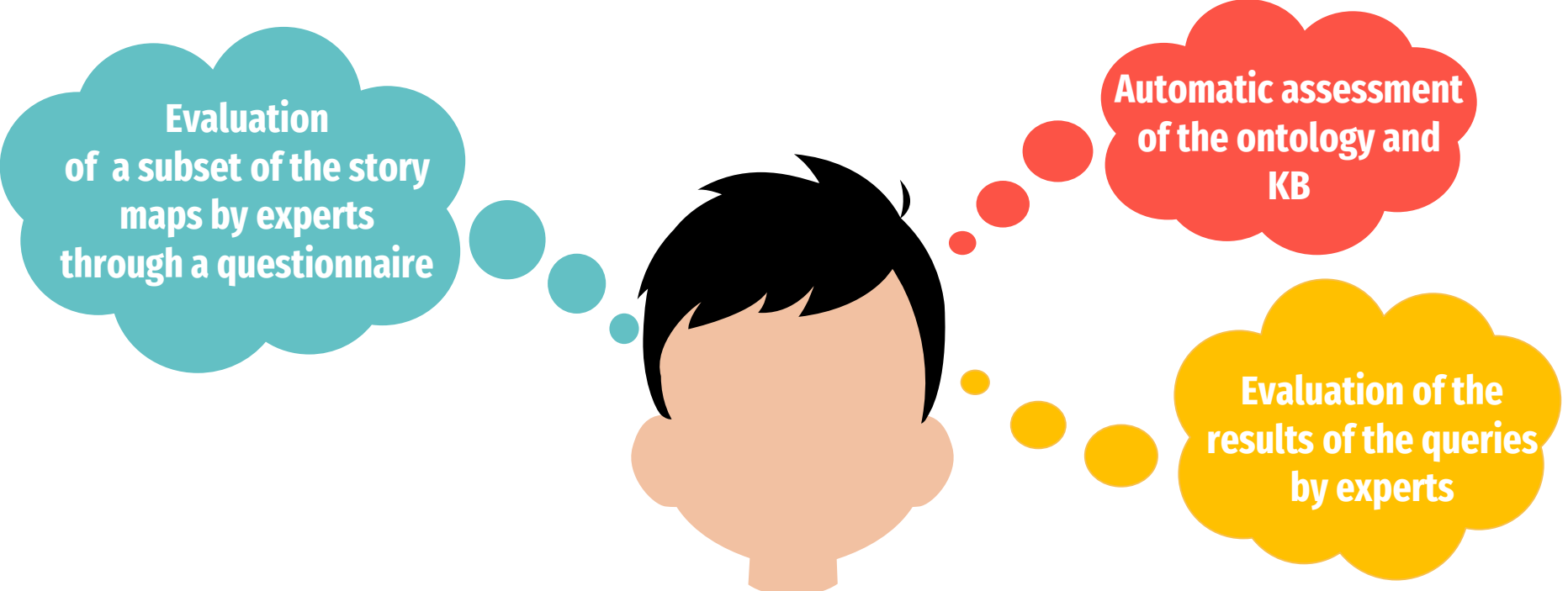
Used in ecosystem models for mountain areas



5

Evaluation Methodology

We are working to assess the created story maps and the related knowledge base

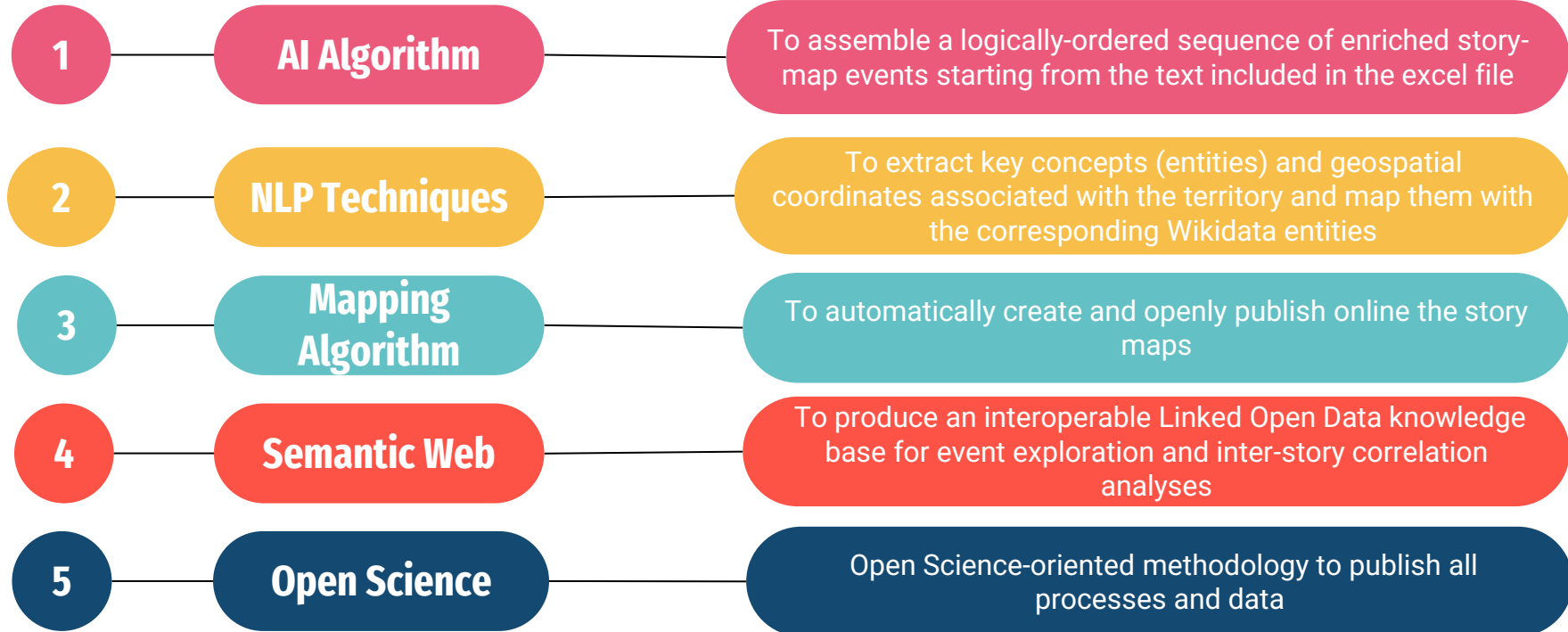


Evaluation of a subset of the story maps by experts through a questionnaire

Automatic assessment of the ontology and KB

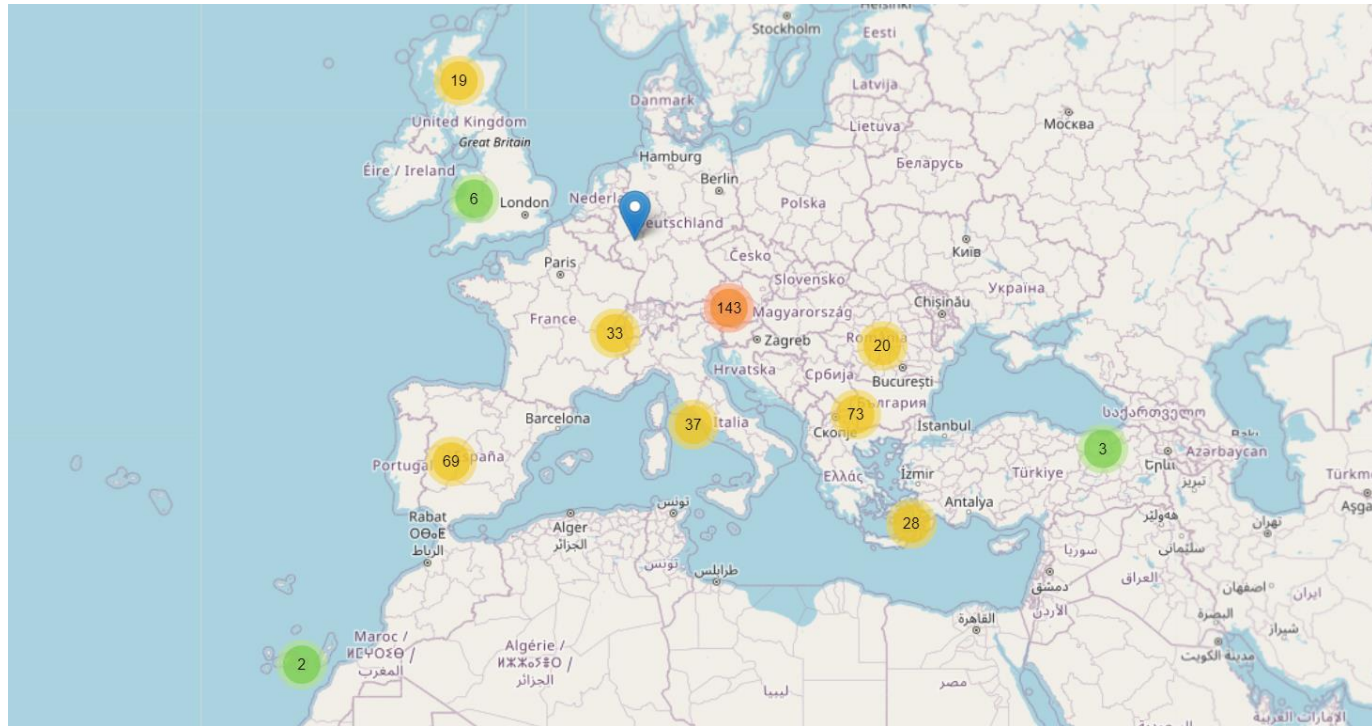
Evaluation of the results of the queries by experts

From textual documents to Semantic Story Map



454 Story Maps

<https://tool.dlnarratives.eu/storymaps/MOVING/mappa.html>



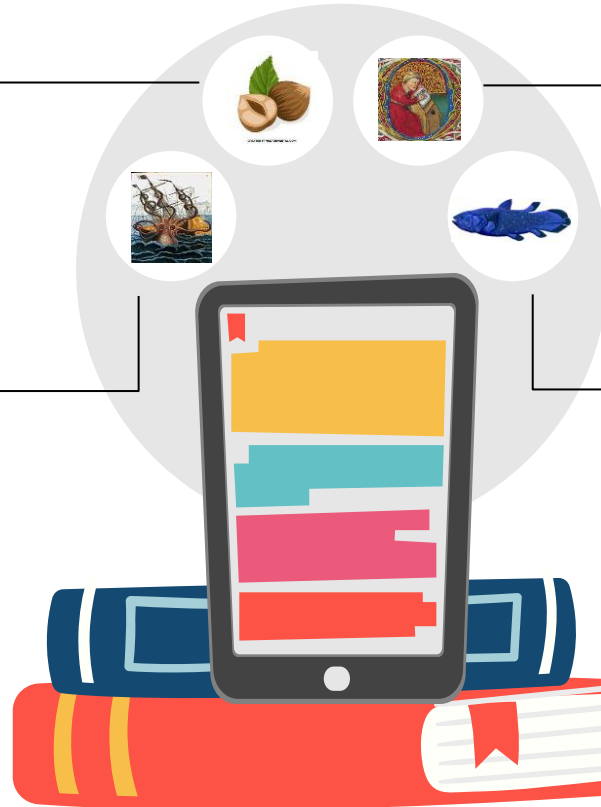
Same workflow, different stories

Agricultural Economics

[Italy: Northern Apennines Chestnut flour Value Chain](#)

Ecological Modelling

[The Giant Squid: When Myth encounters science](#)



Latin Philology

[De peregrinatione ad urbem Constantiam](#) by Leonardo Bruni (1414)

Biology

[A fish for our time: The coelacanth story](#)

Why using our workflow to create Semantic Story Maps?

1



To visualise unstructured textual data in a more suitable and user-friendly way as story maps are

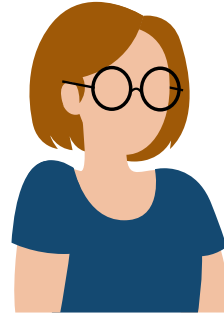
To overcome the gap between the map and the territory in narratives

2



To automatically create a KB of the data collected across the stories

3



To discover inter-correlations among different stories

4



Future Work

Main Limitation

The workflow takes as input an unstructured file i.e., CSV or Excel file

CSV or Excel files

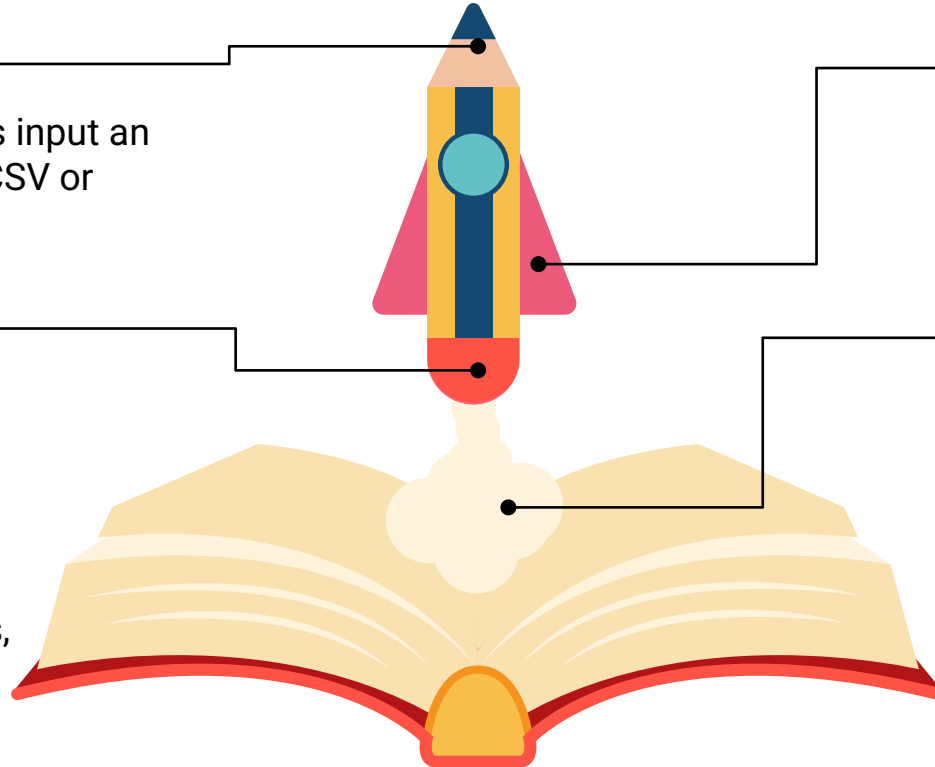
These types of files are frequently used by different scientific communities to store knowledge (e.g., agricultural economists, humanist scholars, biologists)

Plain Text

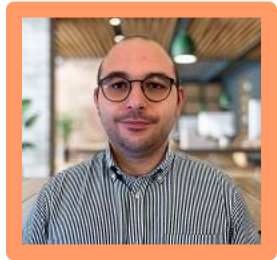
Enhancing the workflow, taking also plain text as input

Future Experiments

We plan to study existing systems that perform similar tasks that can be integrate into our workflow, e.g., Narrarquivo, a tool that automatically creates storylines from text. Can we also create story maps from text?



I'm not alone...

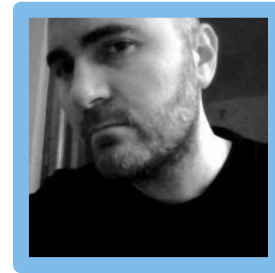


Emanuele
Lenzi

Nicolò
Pratelli



Gianpaolo
Coro



Me...



<https://dlnarratives.eu/>

Thank you

valentina.bartalesi@isti.cnr.it

