



Horizon 2020 Societal challenge 5:
Climate action, environment, resource
efficiency and raw materials

WP3 - Subcontracting about *Visualization* - Annex 2

Design specifications

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List of acronyms

DMP	Data Management Plan
NIS	Nexus Information System
QST	Quantitative Story-Telling
UT	University of Twente (project partner based in Enschede, The Netherlands)
JRC	Joint Research Center (project partner based in Ispra, Italy)

and others from DMP (see the document titled *Core requirements* for reference).

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MAGIC WP3 – Visualization tools

Simple infographics and short videos

In order to effectively disseminate MAGIC outcomes and foster the engagement of different stakeholders (policy makers, scientists and practitioners, no-profit organizations and EU citizens) suitable means to deliver direct and sharp messages are required. The way to summarize concerns about various relevant *nexus* themes is producing policy briefs and short videos. The formers will embody/link to effective infographics and the latter are a 3 to 5 minutes clips to be posted on social media too.

Both the contents are prepared by project partners and limited support to the final form is expected from the subcontractor.

Advanced interactive graphs and maps

UniNA partner is identifying and prototyping custom visualization for many of the case studies (e.g. see <http://www.magic-nexus.eu/visualization-methods>) and other partners are producing this kind of visualization as well. The subcontracting has been proposed to finalize integration of these visualization into the project website (running on CMS Drupal) as well as in dashboards (see the next section).

Customizable dashboards

Since the unit of work in MAGIC is a *case study*, as identified and ruled by the DMP, the different themes worked out by the project partners in the 3 work packages that addressed quantitative results (viz. WP4, WP5 and WP6) can be grouped and a few (3 to 5) typologies of required dashboards identified. Currently the work has been completed and revised for WP4 (approach for the quantitative analyses), is under completion for WP5 (checking about narratives on *nexus*) and 6 (innovation cases), and undergoing for the supporting work packages: WP2 (engagement of stakeholders), WP3 (Nexus Information System and Space development) and WP7 (dissemination of results). All the public deliverables produced in the scope of WPs are freely accessible in the document repository section in the MAGIC Knowledge Hub (www.magic-nexus.eu/)

What kind of information customizable dashboards should present?

All types of graphs and maps we deem useful to show results of the metabolic analysis in the case studies (these are prototyped and tested by UniNA through Python/R scripts and apt sw libraries). They should be rendered from output data generated by case studies analyses, retrieved from the NIS repository (via an user agent, already set up by UniNA) or obtained from the NIS backend calculations (through the JSON output and/or the csv matrices it is currently able to supply on demand).



Figure 1: Key components of a functional dashboard for MAGIC (a visually catching example, the image is from the *Myst3* game).

A key feature is to handle scenarios for engaging users in interaction, thus allowing various stakeholders to check relevant narratives about the *nexus* against different standpoints; this ask for more than widget controls in the dashboards. Specifically, the dashboard should enable users to:

- 1) selecting relevant *indicators*, also allowing actors to declare (and the analytics behind the dashboard to calculate) new ones;
- 2) setting parameters for checking fresh scenarios (and coping with the eventual need to re-elaborate a case study by the backend, via the available Restful API) and
- 3) declaring their own benchmarks¹ and rules² to assess indicators and synthesize the final response about *Feasibility, Viability & Desirability* (F-V-D checking, that implies that a *Fuzzy Inference System* – developed at UniNA – is effectively integrated into the case study dashboard on order to receive user input and supply the results in a coherent interface).

This will enable analysts to perform sensitivity analysis (this aim should be also supported programmatically) and stakeholders to capture relevant relationships, interactions and trade off.

Educational games

An educational game about water and its role in the *nexus* is under active development by partner UT. The game is based on a *simulation engine*, already prepared by UT in the form of an Excel workbook, and should allow the interaction of different users, from students to general stakeholders. To this end it should be further developed in the form also of a Role Play Game and ported to be used online (on computer via an internet browser as well as by mobile devices – both tablet and phones). The refinement of the interface and the porting of the game fall in the scope of present subcontracting.

¹ This could be obtained by identifying fuzzy sets that represent the classes of values for the indicator (i.e. defining the term set of the indicator treated like a linguistic variable).

² The rule base will drive (eventually in a hierarchical manner, defined by a tree of rules in the form of IF-THEN-ELSE) the inference from the indicator calculated values to the overall assessment of F-V-D.

RESTful APIs

The dashboards and other interactive tools in the scope of the subcontracting could require interaction with a suitable backend. To this end stable and documented APIs are to be assured.

The NIS components already set up by UniNa and ITC (managed on a dedicated server hosted at UniNA premises) are a repository and a Python backend, both available via RESTful APIs (see the table in the following). Any further component to be added should be made accessible by the same technology. The code should be released as open source, made available in the MAGIC Git-hub and Zenodo repositories and suitably documented for maintainability and reusing; all the involved file format for input/output should be interoperable and any libraries it is based upon should be available for free and, hopefully, open source too.

- The NIS backend and the repository already set up in MAGIC (by partners UniNA and ITC)

By invoking a GET on an URL in form:

https://one.nis.magic-nexus.eu/nis_api/isession/rsession/state_query/datasets/<name>.<allowed_format_extension>

- The Nextcloud internal repository of the MAGIC project is also accessible (with credentials) via WebDAV APIs; documentation about the current version can be found here: https://docs.nextcloud.com/server/12/developer_manual/client_apis/WebDAV/index.html
- The elaboration via R script developed by UniNA could be made available through APIs too; a Swagger service managed on an RStudio instance with the plumber (plumber.io) package is currently in place on an experimental server (UniNA server replica)
- A similar approach will be followed for making available any calculation developed by Python scripts in the Jupyter Lab instance
- Part of the code developed in the scope of the present subcontracting could also be made accessible via suitable API; the need will be evaluated by UniNA with ITC (responsible for the code of the NIS backend) and discussed with the subcontractor.

Table 1: list of the currently implemented APIs toward the NIS backend and repository

High level connection operation	HTTP Method	HTTP Path (prepend https://one.nis.magic-nexus.eu/nis_api) + Request	Expected result	Description
Login	POST	/isession	204 → OK	Start interactive session
Login	PUT	/isession/identity?user=<user_name>	200 → OK Else → KO	Identify user (“user_name” should be “test_user”)
Login (if previous returns != 200)	DELETE	/isession	200 → OK	Close interactive session
Logout	DELETE	/isession/identity	200 → OK	Unidentify user
Logout	DELETE	/isession	200 → OK	Close interactive session
Open Session	POST	/isession/rsession?uuid=&read_version_state=False&create_new=True&allow_saving=False&cs_name=	204 → OK	Open reproducible session
Close Session	DELETE	/isession/rsession?save_before_close=False&cs_uuid=&cs_name=	200 → OK	Close reproducible session
Submit	POST	/isession/rsession/generator?execute=True®ister=False Data: <binary of .xlsx file> Header “Content-Type”: application/vnd.openxmlformats-officedocument.spreadsheetml.sheet	200 → OK A JSON containing the list of issues	Submit “.xlsx” file in NIS format. File is parsed, executed and solved at the backend A list of issues is returned after this process. After execution, state can be queried

High level connection operation	HTTP Method	HTTP Path (prepend https://one.nis.magic-nexus.eu/nis_api) + Request	Expected result	Description
Query Parameters	GET	/isession/rsession/state_query/parameters	200 → OK A JSON containing the parameters	Obtain the parameters of the submitted model. Useful to build the inputs part of a generic dashboard.
Query Scenarios	GET	/isession/rsession/state_query/scenarios	200 → OK A JSON containing a list of scenario names and the values for the parameters	Obtain the scenarios and the values of parameters for each of them. Useful to build the inputs part of a generic dashboard.
Submit parameters	PUT	/isession/rsession/state_query/parameters Data: JSON dictionary <parameter_name>: <parameter_value> Header "Content-Type": application/json	200 → OK A JSON containing the list of issues	The model is reevaluated (taking advantage of possible computation optimizations) A list of issues is returned after this process.
Query output results	GET	/isession/rsession/state_query/datasets	200 → OK A JSON containing the list of output results	The full list of outputs is obtained. Outputs can be of different types: dataset, graph, json, script, ... Each element of the JSON has the fields: name, type, description, list of formats (each element is made of format descriptor and the URL to obtain the output in that format)
Query output result	GET	<URL in the previous result>	200 → OK Read the	Obtain a file with one of the outputs, for later processing and/or visualization.

High level connection operation	HTTP Method	HTTP Path (prepend https://one.nis.magic-nexus.eu/nis_api) + Request	Expected result	Description
			Content-Type header. Result can be text or binary, and can be GZIP compressed	

Branches of the work

The visualization toolkit envisioned in MAGIC is a suite of visual communication tools as well as software components for *visual analytics*, to be designed and prototyped by UniNA on interaction with all the partners of the consortium. As output of the project, a specific set of tools has been identified in the course of the project and in the following is specified what and how falls in the scope of present subcontracting. UniNA remains the responsible of the subcontracting, and as such the sole partner the subcontractor is required to interact with.

a) Progressive web app for delivering an **educational game**:

As output of the project an educational game to help students as well as other users to play with some scenario analyses related to water-energy-food and understanding nexus relationships is expected.

The game is under design by partner UT and is conceived to work at multiple levels (a basic one to make the dummy users confident with the problem and the interface, and some more complex levels to add more realism and degrees of interaction with the underlying simulations). UT is responsible for the delivery of a working prototype, with full documentation of the logic and the implementation. Specifically, a level will imply *roles* and engage multiple players in a competitive and/or collaborative setting. A set of (virtual) *cards* could be randomly drawn by players upon entering the game arena, assigning each of them a role and/or target(s), so to spark the role play game.

The concept could be extended to a few more nexus case studies, sharing the same general framework, engine and interface, being the project partners in charge of the fork with basic assistance by the subcontractor. This implies that the game project is well structured and suitably documented. The scripts for the game are to be proposed by the partner of the consortium, checked and refined by the subcontractor and, once implemented, tested by UniNA. A small number of iterations is expected to fine tune the game(s). The final package of the game is a progressive web app (desktop/mobile).

b) Implementation of **visualization tools** into MAGIC website:

UniNA is in charge of designing and experimenting a wide set of visualizations that are to be discussed and tested with the partners involved in the work on specific case studies. Once agreement is reached on a piece of visualization, UniNA produces a working prototype in an high level language (R and/or Python script) ready to be consumed through the web by a browser thanks to suitable javascript libraries; the prototype is refined with subcontractor by the designer and passed for implementation and integration in the chosen framework along with any useful documentation; a maximum of 3 iterations (usually one of two will suffice) is expected to the final delivery of each visualization tool.

c) Deployment of tailored **dashboards** for *Quantitative Story-Telling*:

UniNA is designing and prototyping a few (3 to 5) templates for the deployment of dashboards that will incorporate the a.m. visualization tools in a customizable interface that makes the users able to tailor their views on the case studies *Quantitative Story-Telling* to suit their different perspectives.

The dashboards are to be tested by the consortium internally as well as in controlled interaction with typical users; the designer role in the subcontracting is called to sustain this process and the initial iterations. Once the concept has been identified and the design suitable refined, a working prototype is passed by UniNA to the subcontractor for integration in the framework and final deployment; a maximum of 3 iterations (usually one of two will suffice) is expected to the final delivery.

d) Design and development of a **GUI** to the interactive system for F-V-D check:

The concept and a working prototype of the graphical interface (coded in Java) for the F-V-D check based on the key indicators in the dashboards will be supplied by UniNA to the subcontractor. The duty is to migrate it in the chosen framework, refine and test the GUI; a maximum of 2 iterations is expected to the final delivery.

e) Support for the production of **short videos**:

The scripts for the videos are to be prepared by the partners of the consortium, as well as any footage, animation and text for titles as well as the final voiceover; the scripts will be checked and refined by the designer and, once approved, lent by UniNA to the subcontractor for final montage. No iteration is expected once the material for the video(s) has been delivered to the subcontractor. The duration of each video is around 5 minutes and a maximum number of 15 videos is in the scope of the subcontracting.

Table 2: **Timeline (suggested; to be detailed into the contract):**

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Edu. game	brief	prerelease	testing	release		
Vis. Tools	prot. => prod.	prot. => prod.	prot. => prod.	prot. => prod.	code release	
Dashboards	concept	implem.	implem.	implem.	deployment	test & build
F-V-D GUI		specifications	migration	testing	integration	
Short Video	support	support	support	support	support	support
	Sept '19 (M40)	Oct '19 (M41)	Nov '19 (M42)	Dec '19 (M43)	Jan '20 (M44)	Feb '20 (M45)

N.B.: **M45** is the deadline for D3.2: **Report on NIS WP3 Visualization Methods** (resp. UniNA): the set of visualization tools, dashboard should be ready and properly reported into the deliverable by **February 2020** (no delay is admitted, since has been already asked to move the original due date, M42, to suit with the release of other project deliverables).

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