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ENERGIC OD European NEtwork for Redistributing Geospatial Information to user Communities - Open Data

D6.2 IMPLEMENTATION GUIDELINE DOCUMENT

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Table of Contents

ENERGIC OD Consortium.....	1
Revision History.....	2
Document Information	3
Table of Contents	4
Abbreviations and acronyms	5
EXECUTIVE SUMMARY	6
1. INTRODUCTION	7
2. METHODOLOGY	8
3. IMPLEMENTATION GUIDELINES.....	9
3.1. GENERAL IMPLEMENTATION GUIDELINES	9
3.2. CODE CONVENTIONS.....	11
3.3. USE OF DATA AND EXTERNAL SYSTEMS.....	13
3.4. PRACTICES FOR REALISATION OF SOLUTIONS.....	15
4. CONCLUSION.....	17
5. REFERENCES	17

Abbreviations and acronyms

Abbreviation / Acronym	Description
(X)HTML	W3C standard for Extensible Hypertext Markup Language
.htaccess	Hypertext access file
ArcGIS	Geographic information system and similar solutions by the Environmental Systems Research Institute
CA	Consortium Agreement
CIP	Competitiveness and Innovation Framework Programme
CSS	Cascading Style Sheets
DoW	Description of Work
EB	Executive Board
EC	European Commission
ENERGIC OD	European Network for Redistributing Geospatial Information to user Communities-Open Data
GA	General Assembly
GIS	Geographic Information System
GrAg	Grant Agreement
GUI	Graphical user interface
HTML	Hypertext Markup Language
httpd	Hypertext Transfer Protocol Daemon
ICT	Information and Communications Technologies
IIS	Internet Information Services by Microsoft
NEF	Negotiation Form Facility
OGC	Open Geospatial Consortium
PC	Project Coordinator
PEAR	PHP Extension and Application Repository
PHP	Server-side programming language
PO	Project Officer
PSP	Policy Support Programme
QC	Quality Control
R&D	Research and Development
SDI	Spatial Data Infrastructure
SSL	Secure Sockets Layer
UMN	University of Minnesota
UTF-8	8 bit Universal Character Set Transformation Format
VH	Virtual Hubs
W3C	World Wide Web Consortium
WP	Work Package
WPL	Work Package Leader
XML	Extensible Markup Language

Table 1. Abbreviations and Acronyms

EXECUTIVE SUMMARY

This deliverable defines a set of implementation guidelines for all partners of work package 6 based on the collected information about the applications and services to be developed in time and minimising efforts, and with the objective of developing high quality applications, which are conform to the application requirements defined in deliverable 6.1.

The mandatory implementation guidelines include instructions for help and communication about development specific issues and error management inside the ENERGIN OD project. Further, the provision and logging of solution related information which are legible for all involved partners are addressed. The minimum requirements for the development of all solutions include providing information about the applications and service at least in English, UTF-8 encoding for specific parts of the applications and services as well as logging of errors and other events.

In addition, the demand for logging of application and service specific errors and events facilitate the improvement these solutions and enable the evaluation of the new Virtual Hubs.

Other guidelines are recommendations for the developers and are related to aspects of coding, security, use of data and integration of external systems.

1. INTRODUCTION

This document specifies rules and recommendations to develop all applications and services of the ENERGIC OD project, in the following named as solutions, as smooth as possible. These implementation guidelines are addressed to all developers of work package 6 of the ENERGIC OD project.

The implementation guidelines are the base to enable a common approach for all work package 6 partners with following objectives:

- Realization of the requirements of deliverable 6.1 "Application based requirements and standards catalogue".
- Development of high quality solutions in time.
- Reduction of efforts during the development of solutions.
- Preservation of the diversity and individuality of the solutions.
- Creation of an environment to evaluate and improve the new Virtual Hubs of the ENERGIC OD project.

Finally the simple realization of all solutions and their diversity with integration of the Virtual Hubs shows the quality of these Virtual Hubs.

The implementation guidelines have to be understood by all development teams of work package 6 and adapt to their specific solutions.

In general the implementation guidelines cover essential aspects of software development and affect the source code implementation as well as activities of the project management. Related to the different status of solution development and different conditions of the development teams the implementation guidelines do not specify each aspect of development in detail. The implementation guidelines are more a rough framework for all developers inside the ENERGIC OD project.

2. METHODOLOGY

To create these Implementation Guidelines and to frame their extent, following information was used:

- Deliverable 6.1 “Application based requirements and standards catalogue” of the ENERGIC OD project, including the detail information about the applications in the appendix of deliverable 6.1.
- The information gathered at the workshop in Potsdam on 9th and 10th of June 2015.
- Input from the work packages 2, 4 and 5.

The current status of development was another aspect that was taken under consideration. In combination with the assumption that all involved developers have detailed knowledge about their experience and environment of development, e.g. possible efforts in man-days, hardware and other restrictions, these Implementation Guidelines are more recommendations than strict rules. But to convey the assumed importance of each guideline and to set the focus on the new Virtual Hubs the following terms are used:

- **must** means that the developers have to respect this guideline.
- **should** means a strong recommendation.
- **can** means general recommendation.

The Implementation Guidelines are grouped by topics, derived from the requirements of deliverable 6.1, and by source code specific aspects.

Each Implementation Guideline is provided in the layout as follows:

- Objective and the respective context of the guideline
- Content of the guideline
- Additional information and example for the guideline (optional)

3. IMPLEMENTATION GUIDELINES

3.1. GENERAL IMPLEMENTATION GUIDELINES

The general implementation guidelines affect most of the guidelines in "Code Conventions", "Use of Data and External Systems" and "Practices for realisation of solutions". Therefore all following guidelines have to be regarded in consideration of these general guidelines.

3.1.1. ENCODING AND INTERNATIONALISATION

Objective:

To facilitate the communication between the partners of the ENERGIC OD project about the solutions to be developed it is necessary that every project partner understands the respective solution. This facilitates the testing phase and finally reduces efforts. Therefore a harmonised handling of characters is needed, which enables the realisation of interoperability between components of a solution as well as solutions and external systems.

Content:

The character encoding **should** be UTF-8 and **must** be declared at least for XML and (X)HTML files. For a smooth handling of data, these **should** be hold and provided in UTF-8 too. In the same way this aspect affects the log files.

The solutions **should** provide all interfaces, e.g. GUI, with English named control elements and parameters.

Additional Information:

Textual contents for the control elements of a GUI are provided in different languages and separated from the code for the GUI and link inside the code to the specific textual content.

If all components, scripts, and data of the solution have the same encoding it facilitates the reduction of encoding problems.

Detailed information is provided by the W3C under ["Internationalization - Character encodings"](#) ^[1]

3.1.2. SECURITY

Objective:

Related to the security requirement of the solutions there is on the one hand the need for protection of personal user data and on the other hand the protection of the client and server side system.

These two aspects are closely connected. A secure system facilitates the protection of user data. But to protect the server side system it is helpful to use user data to check the authorisation and control the client side system access. Finally, a balance between protection of user data and server side system has to be found.

Content:

Each solution **should** not request and save more personal user data than necessary. If private user data are needed, user transparency is a key request and user control **should** be provided.

User data, especially passwords, **should** be stored and transferred in an encrypted form. All user data **should** be held separately.

Different access rights to each level of the system **should** be allocated, e.g. use of one database for a web user, which restrict the access rights from the end user of your solution, and another one with administrator rights, which are not claimed by the end users.

If external systems, which provide data and need an authentication for access, are used the access of data for this systems **should** be held separately and not be written directly in the source code.

In case that your solution is build up on a multi-level architecture permit only a direct access between successive level, e.g. do not enable a direct access from the client to the data level. Here an entry point of the server level **should** be used.

All inputs which are received from the client **should** be validated against the expected content and form.

The use of cookies to handle user data **should** be well-considered to ensure the protection of these data.

Access to the system components **must** be logged to detect security gaps.

To enable request from another domain the domain of the web client, the [specifications for cross-origin resource sharing](#)^[2] by the W3C **must** be followed.

Each solution **must** be conform to the national law of the specific ENERGIC OD partner.

Additional Information:

For the basic user authentication and hold user accounts .htaccess files are suitable.

The use of SSL certificates can help to communicate the security of the solution to the end user.

Further information by the W3C about aspects of security are stated in the:

- [Content Security Policy Level 2](#)^[3]
- [User Interface Security Directives for Content Security Policy](#)^[4]
- [Subresource Integrity](#)^[5]
- [Mixed Content](#)^[6]
- [Web Security Context: User Interface Guidelines](#)^[7]
- [Web Application Privacy Best Practices](#)^[8]

Recommendations for data protection by the European Commission are:

- [Data protection in the EU](#)^[24]
- [Protection of personal data](#)^[25]

3.1.3. USER HELP

Objective:

The final target of a solution is the use by end users. In best case a solution is self-explaining and an end user does not need help for solution handling. Related to the aspect that each user has different skills and knowledge and necessary communication about a solution within the ENERGIC OD project, which does not regard the actual end users, a user help for the internal communication about the solution is needed to decrease the barriers to use and test a solution.

Content:

At least one kind of user help **must** be provided and **should** be revised on feedback by tester and end users.

The user help **should** be at least in English.

Additional Information:

Established kinds of user help are:

- Online or offline user manual
- Tooltips

3.1.4. LOGGING

Objective:

Logging is a feature, which facilitate the realization of non-functional requirements of the solutions, especially maintenance and security. In detail, logging enables:

- Getting an overview about solution related activities.
- Tracking unexpected and invalid situations.
- Debugging and improving the virtual hub or hubs the solution is using, by log information about data searches and access to them.

All partners of the ENERIGIC OD project should be able to read and understand the log files to help each other to solve problems and evaluate the use of a solution or the Virtual Hubs.

Content:

To achieve an uniform and comparable log file format for all solutions of the ENERIGIC OD project the guidelines for [“Logging Control In W3C httpd”](#)^[9] and [“Extended Log File Format”](#)^[10] by the W3C **must** be observed.

Each component of a solution **should** be covered by logging, particularly with regard to the use of the Virtual Hubs and the facility for improvement of them.

Additional Information:

The capability for logging of most web servers, e.g. [Apache Server](#)^[11] or [IIS](#)^[12], is a way to realize the logging.

3.2. CODE CONVENTIONS

The following guidelines are related to the creation of source code and are oriented at the stated main programming languages and libraries by the developers in preparation of deliverable 6.1. Therefore these guidelines are recommendations and complement the knowledge of the solution developers. These recommendations should mainly apply to solutions that will be eventually released as open source.

3.2.1. GENERAL CODING RULES

Objective:

The coding is one phase of the solution development. Like each other phase the coding has

to be involved with the least efforts as possible. In addition the coding affects requirements like maintenance of a solution. The maintenance of code includes the finding and fixing of bugs as well the extension in future.

Content:

For the realization of the requirements of a solution more than one programming language and corresponding libraries are possible. The following aspects **should** be considered to choose suitable programming languages and libraries:

- Knowledge and experience of developers
- Provided functionality
- Licence model and fees
- Quality of documentations
- Quality of code

The code **should** be structured. Each entity of code **should** handle at most one functional aspect of a solution.

Code components **should** be reusable.

The layout of the code **should** represent the logical structure of the respective contents and functions, e.g. indentation of control structures.

The layout of code and the naming of variables and functions **should** be uniformly and clearly legible by current and future developers.

The code **should** be commented.

If available, libraries routines **should** be used.

During the creation of code the effective use of client and server side hardware resources **should** be considered.

Additional Information:

In most cases, a combination of different programming languages and libraries facilitate the coding and the realization of solution requirements. Assuming that the code of a solution is structured in modules of functional content and considering the related system architecture for each of these code entities a suitable programming language can be used.

3.2.2. PROGRAMMING LANGUAGE SPECIFIC CODING CONVENTIONS

Objective:

To facilitate the readability and the maintenance of a solution by developers and peer-reviewers a uniform way for coding is needed. An appropriate way to enable this is the use of common and language specific coding conventions. Beside, coding conventions can facilitate a compensation of missing experience of developers during the phase of source code implementation.

Content:

Related to the diversity of used programming languages in the ENERGIC OD project in the following recommended coding convention for the main programming and script languages are stated and **can** be used:

- [HTML](#)^[13]
- [JavaScript](#)^[14]
- [PHP](#)^[15]
- [Java](#)^[16]
- [CSS](#)^[17]

Additional Information:

Most of the stated coding conventions are extended by additional guidelines, which are based on specific libraries, frameworks and other extension, e.g. the [PEAR extension](#)^[18] for PHP.

3.3. USE OF DATA AND EXTERNAL SYSTEMS

Considering the use of external systems, guidelines for data provision and processing by the solutions are presented. The final application of these guidelines depends on the architecture and software components, e.g. GeoServer, ArcGIS for Server or UMN Mapserver, and can be affected by other presented guidelines.

3.3.1. INTEGRATION OF DATA AND EXTERNAL SYSTEMS

Objective:

The integration of data which are hold directly in the system of a solution or provided by an external system affect significantly the realisation of most functional and non-functional requirements.

The integration of external systems concerns as well the Virtual Hubs, which are interfaces to external systems and will be realized in the ENERIGC OD project. The use of the Virtual Hubs by the solutions will help to evaluate and improve the Virtual Hubs.

Content:

The integration of data **must** preferably be implemented by the use of the Virtual Hubs. If there are other external systems which provide the needed data and implicate less efforts for the implementation of a solution, these alternatives **can** be used. In detail the decision for the use of the Virtual Hubs or an external system depends on the current and future capability to realize the requirements of a solution.

Before an external system or external data is used the legal status and restrictions **must** be checked and the end user **must** be informed about them.

Data and links to external systems **should** be kept at a separate level. That means that the URL to request an external system and data, which are stored at the solution side, **should** not be specified directly inside the code. The direct links and the necessary login information to the databases, data files and external systems **should** be stated in a kind of proxy script. The actual code of a solution **should** only contain constant links to this proxy script and the stated interfaces. This structure simplifies the maintenance of the solution and the management of integrated data sources.

The compatibility of an external system with the guidelines of this deliverable **must** be checked.

If a database is used to hold data the following guidelines **should** be considered:

[Database Design and Modeling Fundamentals](#)^[19]

Additional Information:

- not available -

3.3.2. DATA PROVISION**Objective:**

The provision of data for end users and other systems by the solution is an essential functional requirement which is specified in deliverable 6.1. Other non-functional requirements like performance, interoperability or security depend on the provision of data.

The use of the Virtual Hubs to provide data is another essential objective of the ENERGIC OD project and enables the evaluation and improvement of the Virtual Hubs.

Content:

Metadata about the data and the services which provide the data **should** be free and transparent for all users to facilitate the use of data. Information about the legal status and last changes of the data support the user decision to use data.

The interface for the data provision **should** be up to the [OGC](#)^[20], [ISO](#)^[27] and [W3C](#)^[21] specifications. This enables the provision by a Virtual Hub as a broker and **should** ensure that almost all of users **can** request data.

No direct access to data **should** be enabled. Use an instance like a proxy to protect the system of your solution and control the request of data.

Additional Information:

A cache or any other kind of server side storage is suitable to hold data, which are independent from user configurations, will be provided in a constant form, and increase the performance of data provision by avoiding the reprocessing of data with each user request. Another way to increase the performance of data provision is the use of compressed data to reduce the amount of data which has to be provided by a solution. Data which have to be sent from a server to a client include additionally the code of a solution. This code, e.g. JavaScript, HTML and CSS, can be minified to speed up the load of client side functional code.

3.3.3. DATA PROCESSING**Objective:**

The processing of data transforms or derives any kind of data are requested by users of a solution. This affects requirements like visualization and performance.

Content:

Related to performance and security of the solution a data processing approach which maximizes both requirements **should** be chosen. The first step is to clarify the level where the data processing, client or server side, **can** be executed. This decision depends among other things on the legal status and the amount of data. If data are requested from another external system, e.g. a Virtual Hub, this system **should** be checked and **can** be used to process the requested data.

Additional Information:

The following guidelines are suitable to find an optimal approach for data processing:

[Design Guidelines for Application Performance](#)^[22]

3.4. PRACTICES FOR REALISATION OF SOLUTIONS

This section describes guidelines for the actions of the developers among each other inside the ENERGIC OD project to stimulate the communication about aspects and issues of development and reduce efforts.

3.4.1. MONITORING AND ENSURE PROGRESS OF DEVELOPMENT

Objective:

To enable communication within the ENERGIC OD an effective process of solution development which is characterized by the completion of high quality solutions in time with little effort as possible a coordinated communication between the involved developers of all solutions is needed. This benefits the development of the solutions as well as the development of the Virtual Hubs by exposing bugs and inadequateness in handling.

Content:

The project management tool "[Redmine](#)"^[23] **must** be used to provide the current status of solution development and occurring bugs. This approach enables an early detection of problems and to find a solution by the partners of the ENERGIC OD project.

Each release of a solution **must** be identifiable by a unique version number and one of the following semantic identification:

- MAJOR
- MINOR
- PATCH

In Redmine published bugs **must** be labelled in the way which is described in "Testing and Error handling".

Complex tasks of solution developing **should** be broken down to manageable tasks.

Additional Information:

A presentation of the Redmine project management tool was presented at the ENERGIC OD workshop W3.2 in Potsdam on 7th and 8th of September 2015.

3.4.2. TESTING AND ERROR HANDLING

Objective:

In order to ensure solutions of high quality and the development in time with little efforts as possible, the solutions have to be tested. In case of bugs and under the assumption that there will still occur some few errors in each release of a solution an uniform handling and explicit publishing of errors insight the ENERGIC OD project is needed. The developers of the ENERGIC OD project should have the chance to communicate about errors and the confirmation of errors by users has to be unambiguous for the developers.

Content:

Each component and module of a solution **must** be tested for the specific functions and for the compliance of all non-functional requirements of deliverable 6.1. Besides, the interaction of components and modules of a solution **must** be tested. The testing **must** be executed during and after each phase of development.

During the development and the testing of a solution most of all possible errors **should** be detected. Errors **should** be caught by a structured exception handling and be identifiable by error codes. An end user **must** be informed if an error occurs and a function of a solution cannot be executed. All errors that will be reported to the end users **must** be understandable for these. End users **should** be able to fix the reason for the error with the help of reported error information, e.g. through changes in the configuration of the user side system, the use of a different browser to execute the solution or contacting the developers of the solution with a support request. In addition to the reported errors for end users, each error **must** be logged with a specific error code. Error codes reduce the size of log files and **should** primary be used by developers. In case those developers communicate about errors a catalogue with a description of the errors **must** be provided for all involved developers.

Provided descriptions of errors and bugs which occur during the debugging or running of a solution by end users **must** be in English, describe the used data, the environment of the solution or module (e.g. scripting language and libraries) and the functional context of the error.

Information about errors which are generated by external systems, e.g. the Virtual Hubs, **must** be logged and add to the own error description.

End users **should** be confronted with less implementation details as possible by the handling of errors.

Additional Information:

- not available -

3.4.3. PROJECT SPECIFIC CONVENTIONS

Objective:

The solutions which will be realized in the ENERGIC OD project represent the diversity as well as individuality of end user needs and strategies of software development. For each solution the best way of realization has to be found. The development of the solutions should result in information about the suitability of the new Virtual Hubs.

Content:

These implementation guidelines **must** be understood as a rough framework for the realization of each single solution. The decision about the application of these implementation guidelines falls to the developers of the solution.

Each integration of the Virtual Hubs **should** be done mindfully and documented to enable the evaluation of the Virtual Hubs.

Additional Information:

Related to the aspect that most of the solutions to be developed are prototypes and all of them use the new Virtual Hubs, which will be revised and updated, methods of agile software design^[26] are suitable for the realisation of the solutions. Thereby an approach to react on changes in the environment of development is given.

4. CONCLUSION

The stated implementation guidelines of this deliverable for the ENERGIC OD project are in most cases recommendation for the developers of the solutions, which should use the new Virtual Hubs. Each guideline has its own priority and is based on other guidelines or affects other guidelines. Therefore, the final decision about suitable applications and combinations of guidelines has to be made individually for each solution.

The application of the implementation guidelines has following objectives:

Reduction of efforts to realize the solutions

Realisation of high quality solutions

Enable the evaluation of the Virtual Hubs abilities

Facilitate the communication between the developers in the ENERGIC OD project

Early detection and solution of problems during the realisation of solutions

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